DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 1
Chapter 31 Climate Change

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Glossary

Term	Definition
Additional Mitigation	Measures identified through the EIA process that are required as further action to avoid, prevent, reduce or, if possible, offset likely significant adverse effects to acceptable levels (also known as secondary (foreseeable) mitigation). All additional mitigation measures adopted by the Project are provided in the Commitments Register.
Avoided Emissions	Greenhouse gas emissions that have been avoided (i.e. saved) that would have otherwise occurred if a certain action was not taken (e.g. renewable energy that would have otherwise been generated using natural gas).
Carbon Budget	A legally-binding restriction on the total amount of greenhouse gas emissions the UK can produce over a five-year period, which is set by the UK Government in accordance with the long-term net zero target.
Carbon Dioxide Equivalents (CO_2e)	A term for describing different greenhouse gases in a common unit. The unit takes the different global warming potentials of greenhouses gases into account. CO2e signifies the amount of carbon dioxide which would have the equivalent global warming impact.
Climate	The general weather conditions prevailing over a long period of time at a location.
Climate Change Impact	The resulting impact from a climate hazard which affects the ability of the receptor to achieve or maintain its functions or purpose.
Climate Change	A long-term change in global or regional climate patterns, such as seasonal averages and extremes.
Climate Hazard	A weather or climate-related event or trend in climate conditions, which has potential to do harm to receptors.
Climate Variable	A measurable, monitorable aspect of the weather or climate conditions.
Commitment	Refers to any embedded mitigation and additional mitigation, enhancement or monitoring measures identified through the EIA process and those identified outside the EIA process such as through stakeholder engagement and design evolution. All commitments adopted by the Project are provided in the Commitments Register.
Array Area	The area within which the wind turbines, inter-array cables and offshore platform(s) will be located.
Design	All of the decisions that shape a development throughout its design and pre-construction, construction / commissioning, operation and, where relevant, decommissioning phases.

Term	Definition
Development Consent Order (DCO)	A consent required under Section 37 of the Planning Act 2008 to authorise the development of a Nationally Significant Infrastructure Project, which is granted by the relevant Secretary of State following an application to the Planning Inspectorate.
Effect	An effect is the consequence of an impact when considered in combination with the receptor's sensitivity / value / importance, defined in terms of significance.
Embedded Mitigation	Embedded mitigation includes: • Measures that form an inherent part of the project design evolution such as modifications to the location or design of the development made during the pre-application phase (also known as primary (inherent) mitigation); and • Measures that will occur regardless of the EIA process as they are imposed by other existing legislative requirements or are considered as standard or best practice to manage commonly occurring environmental impacts (also known as tertiary (inexorable) mitigation). All embedded mitigation measures adopted by the Project are provided in the Commitments Register.
Embodied Carbon	Greenhouse gas emissions from upstream activities associated with materials, including extraction and processing of raw materials, transport to manufacturing site and manufacturing of products.
Energy Storage and Balancing Infrastructure (ESBI)	A range of technologies such as battery banks to be co-located with the Onshore Converter Station, which provide valuable services to the electrical grid such as storing energy to meet periods of peak demand and improving overall reliability.
Enhancement	Measures committed to by the Project to create or enhance positive benefits to the environment or communities, as a result of the Project. All enhancement measures adopted by the Project are provided in the Commitments Register.
Environmental Impact Assessment (EIA)	A process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information and includes the publication of an Environmental Statement.
Environmental Statement (ES)	A document reporting the findings of the EIA which describes the measures proposed to mitigate any likely significant effects.
Greenhouse Gas	A gas that traps heat in the atmosphere and causes the greenhouse effect. Greenhouse gas can also be referred to by its shorthand as "carbon".
Impact	A change resulting from an activity associated with the Project, defined in terms of magnitude.
Inter-Array Cables	Cables which link the wind turbines to the offshore platform(s).

Term	Definition
Jointing Bays	Underground structures constructed at regular intervals along the onshore export cable corridor to facilitate the joining of discrete lengths of the installation of cables.
Landfall	The area on the coastline, south-east of Skipsea, at which the offshore export cables are brought ashore, connecting to the onshore export cables at the transition joint bay above Mean High Water Springs.
Lifecycle Module	A broad category used to identify and report greenhouse gas emission sources across a project's whole lifecycle.
Link Boxes	Structures housing electrical equipment located alongside the jointing bays in the onshore export cable corridor and the transition joint bay at the landfall, which could be located above or below ground.
Mitigation	Any action or process designed to avoid, prevent, reduce or, if possible, offset potentially significant adverse effects of a development. All mitigation measures adopted by the Project are provided in the Commitments Register.
Monitoring	Measures to ensure the systematic and ongoing collection, analysis and evaluation of data related to the implementation and performance of a development. Monitoring can be undertaken to monitor conditions in the future to verify any environmental effects identified by the EIA, the effectiveness of mitigation or enhancement measures or ensure remedial action are taken should adverse effects above a set threshold occur. All monitoring measures adopted by the Project are provided in the Commitments Register.
Net Zero	When total greenhouse gas emissions are equal to or less than the emissions removed from the atmosphere, which can be achieved by a combination of emission reduction and removal.
Offshore Construction Base Port(s)	The offshore construction base port(s) will be the home for the Project's service vessels, crew transfers and the control centre for managing marine logistics and traffic for offshore construction activities. At this stage, no decision has been made regarding which port(s) would be used for the Project's offshore construction. A decision upon the offshore construction base port(s) would not be made until post DCO determination.
Offshore Development Area	The area in which all offshore infrastructure associated with the Project will be located, including any temporary works area during construction, which extends seaward of Mean High Water Springs. There is an overlap with the Onshore Development Area in the intertidal zone.
Offshore Export Cable Corridor (ECC)	The area within which the offshore export cables will be located, extending from the DBD Array Area to Mean High Water Springs at the landfall.
Offshore Export Cables	Cables which bring electricity from the offshore platform(s) to the transition joint bay at landfall.
Offshore Platform(s)	Fixed structures located within the DBD Array Area that contain electrical equipment to aggregate and, where required, convert the power from the wind turbines, into a more suitable voltage for transmission through the export cables to the Onshore Converter Station. Such structures could include (but are not limited to): Offshore Converter Station(s) and an Offshore Switching Station.
Onshore Converter Station (OCS) Zone	The area within which the Onshore Converter Station and Energy Storage and Balancing Infrastructure will be located in vicinity of Birkhill Wood Substation.
Onshore Converter Station (OCS)	A compound containing electrical equipment required to stabilise and convert electricity generated by the wind turbines and transmitted by the export cables into a more suitable voltage for grid connection into Birkhill Wood Substation.
Onshore Development Area	The area in which all onshore infrastructure associated with the Project will be located, including any temporary works area required during construction and permanent land required for mitigation and enhancement areas, which extends landward of Mean Low Water Springs. There is an overlap with the Offshore Development Area in the intertidal zone.
Onshore Export Cable Corridor (ECC)	The area within which the onshore export cables will be located, extending from the landfall to the Onshore Converter Station zone and onwards to Birkhill Wood Substation.
Onshore Export Cables	Cables which bring electricity from the transition joint bay at landfall to the Onshore Converter Station zone (HVDC cables) and from the Onshore Converter Station zone onwards to Birkhill Wood Substation (HVAC cables).
Operation and Maintenance (O&M) Base Port	The operation and maintenance (O&M) base port will be the home for the Project's service vessels, crew transfers and the control centre for managing marine logistics and traffic for offshore O&M activities. At this stage, no decision has been made regarding which port(s) would be used for the Project's offshore O&M activities. A decision upon an O&M base port would not be made until post DCO determination.
Project Design Envelope	A range of design parameters defined where appropriate to enable the identification and assessment of likely significant effects arising from a project's worst-case scenario. The Project Design Envelope incorporates flexibility and addresses uncertainty in the DCO application and will be further refined during the EIA process.
Representative Concentration Pathway (RCP)	Different possible trajectories of atmospheric concentrations based on socio-economic and policy assumptions used in climate change projection modelling.

Term	Definition
Scoping Opinion	A written opinion issued by the Planning Inspectorate on behalf of the Secretary of State regarding the scope and level of detail of the information to be provided in the Applicant's Environmental Statement. The Scoping Opinion for the Project was adopted by the Secretary of State on 02 August 2024.
Scoping Report	A request by the Applicant made to the Planning Inspectorate for a Scoping Opinion on behalf of the Secretary of State. The Scoping Report for the Project was submitted to the Secretary of State on 24 June 2024.
Scour Protection	Protective materials used to avoid sediment erosion from the base of the wind turbine foundations and offshore platform foundations due to water flow.
Study Areas	A geographical area and / or temporal limit defined for each EIA topic to identify sensitive receptors and assess the relevant likely significant effects.
Temporary Construction Compounds	Areas set aside to facilitate the construction works for the onshore infrastructure, which include the landfall construction compound, main and intermediate construction compounds for onshore export cable works and OCS and ESBI construction compounds.
The Applicant	SSE Renewables and Equinor acting through 'Doggerbank Offshore Wind Farm Project 4 Projco Limited'.
The Project	Dogger Bank D (DBD) Offshore Wind Farm Project, also referred to as DBD in this PEIR.
Transition Joint Bay (TJB)	An underground structure at the landfall that houses the joints between the offshore and onshore export cables.
Weather	Meteorological conditions prevailing at a specific time and location such as temperature and precipitation.
Whole Lifecycle Emissions	Net greenhouse gas emissions released and avoided by a project during the construction, operation and decommissioning phases.
Wind Turbines	Power generating devices located within the DBD Array Area that convert kinetic energy from wind into electricity.

31 Climate Change

31.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the Environmental Impact Assessment (EIA) of the Dogger Bank D Offshore Wind Farm Project (hereafter 'the Project' or 'DBD') on climate change.

2. **Chapter 4 Project Description** provides a description of the key infrastructure components which form part of the Project and the associated construction, operation and maintenance (O&M) and decommissioning activities.

3. The primary purpose of the PEIR is to support the statutory consultation activities required for a Development Consent Order (DCO) application under the Planning Act 2008. The information presented in this PEIR chapter is based on the baseline characterisation and assessment work undertaken to date. The feedback from the statutory consultation will be used to inform the final design where appropriate and presented in an Environmental Statement (ES), which will be submitted with the DCO application.

4. In accordance with the requirements of the Infrastructure Planning (EIA) Regulations 2017, the climate change chapter comprises two assessments as follows, which are provided separately:

- A greenhouse gas (GHG) assessment which considers the net effect of the Project on climate change as a result of the avoided emissions enabled by its operations, accounting for the GHG emissions released over its whole lifecycle (see **Section 31.2**); and
- A climate change resilience (CCR) assessment which evaluates future trends in climate change impacts and the effect on the Project's vulnerability and resilience to such changes (See **Section 31.2.11**).

5. The GHG and CCR assessments:

- Describe the baseline environment relating to GHG emissions and the climate respectively;
- Present an assessment of the likely significant effects with respect to GHG emissions and climate change impacts during the construction, O&M and decommissioning phases of the Project respectively;
- Identify any assumptions and limitations encountered in compiling the environmental information; and
- Set out proposed mitigation measures to avoid, prevent, reduce or, if possible, offset potential significant adverse environmental effects identified during the EIA process and, where relevant, monitoring measures or enhancement measures to create or enhance positive effects.

6. No inter-relationships with other EIA topics are identified for the GHG assessment, as no other environmental effects arising from the Project have the potential to influence the Earth's climate.

7. The CCR assessment should be read in conjunction with the following related chapters:

- **Chapter 8 Marine Physical Processes**;
- **Chapter 19 Geology and Ground Conditions**;
- **Chapter 21 Water Resources and Flood Risk**;
- **Chapter 23 Onshore Ecology and Ornithology**; and
- **Chapter 28 Major Accidents and Disasters**.

8. Additional information to support the climate change chapter includes:

- **Volume 2, Appendix 31.1 Consultation Responses for Climate Change**;
- **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**;
- **Volume 2, Appendix 31.3 Climate Vulnerability Assessment**; and
- **Volume 2, Appendix 31.4 Coastal Erosion Report**.

31.1.1 Consultation

9. Topic-specific consultation in relation to climate change has been undertaken in line with the process set out in **Chapter 7 Consultation**. A Scoping Opinion from the Planning Inspectorate was received on 2nd August 2024, which has informed the scope of the GHG and CCR assessments presented within this chapter (as outlined in **Section 31.2.2.2** and **Section 31.3.2.2** respectively). No other technical consultation on climate change has been undertaken.

10. **Volume 2, Appendix 31.1 Consultation Responses for Climate Change** summarises how consultation responses for the GHG and CCR assessments received to date are addressed in this chapter.

11. This chapter will be updated based on refinements made to the Project Design Envelope and to consider, where appropriate, stakeholder feedback on the PEIR. The updated chapter will form part of the ES to be submitted with the DCO application.

31.2 Greenhouse Gas Assessment

31.2.1 Policy and Legislation

31.2.1.1 National Policy Statements

12. Planning policy on energy Nationally Significant Infrastructure Projects (NSIP) is set out in the National Policy Statements (NPS). The following NPS are relevant to the GHG assessment:

- Overarching NPS for Energy (EN-1) (Department for Energy Security and Net Zero (DESNZ), 2023a); and
- NPS for Electricity Networks Infrastructure (EN-5) (DESNZ, 2023b).

13. The GHG assessment has been prepared with reference to specific requirements in the above NPS. The relevant parts of the NPS are summarised in **Table 31-1,** along with how and where they have been considered in this PEIR chapter.

Table 31-1 Summary of Relevant National Policy Statement Requirements for the Greenhouse Gas Assessment

NPS Reference and Requirement	How and Where Considered in the PEIR
Overarching NPS for Energy (EN-1)	
Paragraph 3.3.3: "To ensure that there is sufficient electricity to meet demand, new electricity infrastructure will have to be built to replace output from retiring plants and to ensure we can meet increased demand. Our analysis suggests that even with major improvements in overall energy efficiency, and increased flexibility in the energy system, demand for electricity is likely to increase significantly over the coming years and could more than double by 2050 as large parts of transport, heating and industry decarbonise by switching from fossil fuels to low carbon electricity." Paragraph 3.3.20: "Wind and solar are the lowest cost ways of generating electricity, helping reduce costs and providing a clean and secure source of electricity supply (as they are not reliant on fuel for generation). Our analysis shows that a secure, reliable, affordable, net zero consistent system in 2050 is likely to be composed predominantly of wind and solar." Paragraph 3.3.21: "As part of delivering this, UK government announced in the British Energy Security Strategy an ambition to deliver up to 50 gigawatts (GW) of offshore wind by 2030, including up to 5GW of floating wind, and the requirement in the Energy White Paper for sustained growth in the capacity of onshore wind and solar in the next decade."	The purpose of the Project is to contribute to climate change mitigation by replacing existing carbon-intensive energy generation, with a renewable form of energy, which will improve energy security and help the UK meet its net zero commitments.
Paragraph 5.3.4: "All proposals for energy infrastructure projects should include a GHG assessment as part of their ES (See Section 4.3). This should include: • A whole life GHG assessment showing construction, operational and decommissioning GHG impacts, including impacts from change of land use. • An explanation of the steps that have been taken to drive down the climate change impacts at each of those stages. • Measurement of embodied GHG impact from the construction stage. • How reduction in energy demand and consumption during operation has been prioritised in comparison with other measures. • How operational emissions have been reduced as much as possible through the application of best available techniques for that type of technology. • Calculation of operational energy consumption and associated carbon emissions. • Whether and how any residual GHG emissions will be (voluntarily) offset or removed using a recognised framework. • 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."	The GHG assessment presented in this chapter quantifies GHG emissions arising from the construction (including embodied carbon), O&M and decommissioning phases of the Project and includes a whole life assessment of GHG emissions from these phases. The assessment methodology is outlined in **Section 31.2.2.5** and **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**, and the assessment is presented in **Section 31.2.4.2.5**. A summary of proposed mitigation measures to ensure the management of GHG emissions over the Project's whole lifecycle and reduce emission where practicable is provided in **Section 31.2.2.3**. The overall carbon benefits of the Project, accounting for its whole lifecycle emissions, are discussed in **Section 31.2.5.4**.
Paragraph 5.3.5: "A GHG 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."	It is anticipated that the requirement for a GHG Reduction Strategy under EN-1 is primarily aimed at other energy generation forms. The GHG assessment clearly demonstrates the Project's net carbon benefit through the supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits enabled by inclusion of the Energy Storage and Balancing Infrastructure (ESBI).

NPS Reference and Requirement	How and Where Considered in the PEIR
Paragraph 5.3.6: "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." Paragraph 5.3.7: "Steps taken to minimise and offset emissions should be set out in a GHG Reduction Strategy, secured under the Development Consent Order. The GHG Reduction Strategy should consider the creation and preservation of carbon stores and sinks including through woodland creation, hedgerow creation and restoration, peatland restoration and through other natural habitats."	Mitigation measures to ensure whole life carbon management and reduce GHG emissions where practicable have been considered as part of the assessment and embedded into the project design as outlined in Section 31.2.2.3. Construction emissions form the largest proportion of the Project's total emissions across its whole lifecycle, and therefore the approach to mitigation focuses on the reduction of these emissions. This includes the provision of an Outline Carbon Management Plan (CMP) (see Table 31-4, Commitment ID CO98), which will be produced as part of the ES and secured as a DCO requirement. Indicative measures to be included in the Outline CMP are outlined in Table 31-5.
Paragraph 5.3.8: "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." Paragraph 5.3.9: "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." Paragraph 5.3.10: "The Secretary of State should give appropriate 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 must accept that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure."	The GHG assessment presented in **Section 31.2.4.2.5** provides a whole life assessment of GHG emissions arising from the Project's construction, O&M and decommissioning phases. Proposed mitigation measures considered in the GHG assessment are set out in **Section 31.2.2.3**.
NPS for Electricity Networks Infrastructure (EN-5)	
Paragraph 2.9.59: "Sulphur Hexafluoride (SF_6) is an insulating and arc-suppressant gas used in high-voltage switchgear for electricity networks." Paragraph 2.9.60: "It is also an extraordinarily potent greenhouse gas, and fugitive emissions from electricity networks infrastructure are an object of increasing environmental concern, especially in light of the UK's commitment to net zero by 2050." Paragraph 2.9.61: "Applicants should at the design phase of the process consider carefully whether the proposed development could be reconceived to avoid the use of SF6-reliant assets." Paragraph 2.9.62: "Where the development cannot be so conceived, the applicant must provide evidence of their reasoning on this point. Such evidence will include, for instance, an explanation of the alternatives considered, and a case why these alternatives are technically infeasible or require bespoke components that are grossly disproportionate in terms of cost." Paragraph 2.9.64: "Where applicants, having followed the above procedure, do propose to put new SF_6-reliant assets onto the electricity system, they should design a plan for the monitoring and control of fugitive SF_6 emissions consistent with the Fluorinated gas (F-gas) Regulation and its successors."	Fugitive SF_6 emissions from high-voltage switchgears used in the Project's infrastructure are included in the GHG assessment presented in **Section 31.2.4.2.5.** The proposed mitigation measures discussed in **Section 31.2.2.3** includes considerations of SF6-free alternatives in the design where technically and commercially feasible, and the implementation of control measures in accordance with regulatory requirements, should any SF6 equipment be required (see **Table 31-4**, Commitment ID CO99).

31.2.1.2 Other Policy and Legislation

14. Other policy and legislation relevant to the GHG assessment is summarised in the following sections.

31.2.1.2.1 International Agreements

31.2.1.2.1.1 United Nations Framework Convention on Climate Change

15. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty addressing climate change which entered into force in 1994. Its main objective is *'to stabilise GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system'*. The UNFCCC facilitated intergovernmental climate change negotiations, and its decision-making body, the Conference of the Parties (COP), meets annually to discuss and assess progress in addressing climate change.

16. The first agreement was the Kyoto Protocol which was signed in 1997 and entered into force in 2005. It commits industrialised countries to limit and reduce GHG emissions in accordance with individual targets to curb the rate and extent of global warming. The Kyoto Protocol (as amended in 2012) applies to seven GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). The Kyoto Protocol recognises the principle of *'common but differentiated responsibilities'* and therefore places a heavier burden on industrialised countries to reduce their emissions owing to their historic responsibility for the current concentrations of GHGs in the atmosphere.

17. Subsequently, COP meetings have resulted in several important and binding agreements, including the Copenhagen Accord (2009), the Doha Amendment (2012), the Paris Agreement (2015) and the Glasgow Climate Pact (2022).

18. COP21 led to the adoption of the Paris Agreement, which strengthened the global response to climate change by committing signatories to a shared target of limiting global temperature increases to well below 2°C, while pursuing efforts to limit the increase to 1.5°C above the pre-industrial average temperature. The Paris Agreement commits countries to preparing, communicating and maintaining their Nationally Determined Contributions (NDC) and taking the necessary actions to achieve their GHG emission reduction targets. Countries are required to update their NDC every five years to allow an assessment of collective progress towards meeting the purpose of the Paris Agreement, with each successive NDC having more stringent targets than the previous one. The Paris Agreement was ratified by the UK in 2016 at COP22.

19. COP28 led to first "Global Stocktake" in 2023, which provided an assessment of global action on climate change and progress towards achieving the purpose of the Paris Agreement and its long-term temperature goals, allowing gaps and opportunities to be identified. The Global Stocktake will be undertaken every five years to align with the submission cycle of the NDC. It is the intention that countries would update their NDC in line with the outcomes of each Global Stocktake.

31.2.1.2.1.2 Nationally Determined Contribution

20. The Paris Agreement was ratified by the UK in 2016 at COP22 and communicated its first NDC to the UNFCCC in 2020, committing the UK to reducing economy-wide GHG emissions by at least 68%, compared to 1990 levels, by 2030.

21. An outcome of COP26 was the Glasgow Climate Pact, which recognises the need for accelerated actions to limit global temperature increase to 1.5°C above pre-industrial average temperature. It called for countries to *"revisit and strengthen the 2030 targets in their NDC as necessary to align with the Paris Agreement temperature goal by the end of 2022, taking into account different national circumstances"*. In response, the UK submitted an updated 2030 NDC to the UNFCCC in 2022, which maintained the original emission reduction target but clarified how it intends to deliver the target by 2030 to facilitate clarity, transparency and understanding of the NDC.

22. The UK's 2035 NDC was submitted to the UNFCCC in January 2025, which commits the UK to reducing economy-wide GHG emissions by at least 81%, compared to 1990 levels, by 2035. This NDC target is in line with the UK's 6th Carbon Budget and informed by the outcomes of the first Global Stocktake.

31.2.1.2.2 National

31.2.1.2.2.1 The Climate Change Act 2008

23. The Climate Change Act 2008 provides a framework for the UK to decarbonise and meet its long-term goals of reducing GHG emissions and implements its international commitments under the UNFCCC. Following the Paris Agreement, the UK revised its previous target from 80% reduction to 100% reduction, compared to 1990 levels, by 2050 through the 2050 Target Amendment Order 2019. This new target is commonly referred to as *'net zero'*.

24. The Climate Change Act 2008 also established a system of interim Carbon Budgets to drive national emission reduction in line with achieving the long-term net zero target. The Carbon Budgets are set by the Climate Change Committee (CCC) and provide a legally binding five-year limit for GHG emissions in the UK. Six Carbon Budgets have been set to date, as shown in **Table 31-2**, which demonstrates the phased reduction in future permissible GHG emissions, with the 7th Carbon Budget proposed but yet to be approved by the UK Government. Therefore, any emission sources will have an increasing impact on the UK's ability to meet its Carbon Budget, the further they are in the future.

Table 31-2 The UK Carbon Budgets

Budget	Carbon Budget Level ($MT\ CO_2e$)	Reduction Compared to 1990 Levels	
		UK Targets	Reduction Achieved
1st (2008 to 2012)	3,018	25%	30%
2nd (2013 to 2017)	2,782	32%	38%
3rd (2018 to 2022)	2,544	38%	44%
4th (2023 to 2027)	1,950	52% by 2025	52% as of 2023
5th (2028 to 2032)	1,725	58% by 2030	
6th (2033 to 2037)	965	78% by 2035	
7th (2038 to 2042)*	535	87% by 2040	
Net Zero Target by 2050		**100%**	

*The 7th Carbon Budget was proposed by the CCC in February 2025 but is pending approval by the UK Government, which must be undertaken prior to the end of June 2026.

25. The UK has outperformed its emission reduction targets set by the 1st, 2nd and 3rd Carbon Budgets, and territorial emissions have now reduced by over 50% compared to 1990 levels (ONS, 2024), surpassing the 2025 target set by the 4th Carbon Budget.

26. In 2020, the UK set its 6th Carbon Budget, targeting a reduction in GHG emissions by 78%, compared to 1990 levels, by 2035 and accounting for the UK's share of international aviation and shipping emissions for the first time (CCC, 2020). This target was enshrined in UK law in 2021 and has been established in line with the UK's commitments under the Paris Agreement and its long-term net zero target. As part of the 6th Carbon Budget, the role of the offshore wind sector and the construction industry was highlighted as essential to meeting the UK emission reduction targets.

27. The CCC publishes annual reports on the UK's progress against its GHG emissions reduction targets to 2050. The most recently published report "Progress in Reducing Emissions: 2024 Report to Parliament" (CCC, 2024) identifies that: *"annual offshore wind installation must increase by at least three times"* by 2030 and the UK should *"now be in a phase of rapid investment and delivery"*. The CCC's 2024 report also states that provisional estimates suggest emissions have reduced by 22 $MtCO_2e$ (5.4%) between 2022 and 2023, which was largely driven by decarbonisation of the electricity supply. This reduction was significantly greater when compared to the annual average of 6 $MtCO_2e$ (1.6%) experienced in the preceding seven years. The CCC also notes that: *"from now on, emissions reductions will need to be driven by sustained decarbonisation action including the rapid roll-out of key low-carbon technologies, tree planting and peatland restoration"*.

28. The importance of the offshore wind sector in the UK's decarbonisation trajectory have also been echoed by the Government's policy positions as stated in the Offshore Wind Sector Deal (BEIS, 2019), the Net Zero Strategy (DESNZ, 2021) the British Energy Security Strategy (DESNZ, 2022), Powering Up Britian (DESNZ, 2023) and Clean Power 2030 Action Plan (UK Government, 2024). **Chapter 2 Need for the Project** and **Chapter 3 Policy and Legislative Context** provide further details on the need for the Project in contributing to achieving the UK's emission reduction targets and the policy landscape surrounding renewable energy and climate change.

31.2.1.2.2.2 Infrastructure Planning (EIA) Regulations 2017

29. The requirement to consider climate change was introduced by an amendment to the EIA Directive (2014/52/EU), which was subsequently transposed into the UK's Infrastructure Planning (EIA) Regulations in 2017. This includes the requirement to include an estimate of the GHG emissions arising from a project's activities and a description of their likely significant effects on the climate.

31.2.1.2.2.3 National Planning Policy Framework

30. The National Planning Policy Framework (NPPF) was first published in 2012 and most recently updated in 2024 (Ministry of Housing, Communities and Local Government (MHLCG), 2024). While the NPS are the predominant planning policy for NSIP such as the Project, the NPPF provides further context to England's planning policy approach and can be generally considered alongside the NPS.

31. The revised NPPF advises that the planning system should support the transition to a low-carbon future. The NPPF states in Paragraph 168 that:

"When determining planning applications for all forms of renewable and low carbon energy developments and their associated infrastructure, local planning authorities should:

[…]

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and give significant weight to the benefits associated with renewable and low carbon energy generation and the proposal's contribution to a net zero future."

31.2.1.2.2.4 Fluorinated Greenhouse Gas Regulations 2018

32. Fluorinated gases (commonly known as F gases) are a family of manufactured gases used in a range of industrial, commercial and domestic applications, which include HFC, PFC, SF_6 and NF_3. F gases are potent GHG due to their high global warming potential (GWP) – a measure of how much impact a GHG will have on atmospheric warming over a period of time compared to CO_2. As a result, F gases are a regulated substance under UK law, which was transposed from the European Union's (EU) Regulation on Fluorinated Greenhouse Gases (2014/517/EU).

33. The regulations apply to the import of F gases or equipment containing F gases to the UK and the use or service of equipment that contains F gases, including high-voltage electrical switchgears used in transmission infrastructure associated with offshore wind farms. The regulations aim to prevent and reduce emissions of F gases by establishing rules on their containment, use, recovery and disposal of F gases, including requirements for reporting and monitoring using gas leakage detection equipment.

31.2.1.2.3 Local

31.2.1.2.3.1 East Riding of Yorkshire Council

34. The East Riding of Yorkshire Council (ERYC) declared a climate emergency in 2021 and has since developed a Climate Change Strategy 2022-2030 (ERYC, 2022), which: *"establishes a strategic vision and sets priorities for rapid decarbonisation and building climate resilience across the East Riding"* and an associated Climate Change Action Plan 2024-2030 (ERYC, 2024). The approach to climate change mitigation focuses on the reduction of emissions in an attempt to lessen the extent of climate change.

35. Energy is one of the eight priority areas identified in the Climate Change Strategy and *"an increase in renewable energy production, particularly wind and solar power"*, as well as storing *"energy more effectively"*, are requirements identified by the ERYC for achieving net zero by 2050. The Climate Change Action Plan further identifies two Climate Change Strategy Objectives: *'E1 Increase rollout of renewable energy in East Riding'* and *'E2 Help create a greener and smarter local energy system'*. While an area-wide emission reduction target has not currently been set, the ERYC will continue to consult on a potential area-wide target, which could be supported and monitored at the local level.

31.2.2 Basis of the Assessment

36. The following sections establish the basis of the assessment of likely significant effects for the GHG assessment, which is defined by the Study Area, assessment scope, realistic worst-case scenarios, and development scenarios.

37. This section should be read in conjunction with **Volume 2, Appendix 1.2 Guide to PEIR**, **Volume 2, Appendix 6.2 Impacts Register** and **Volume 2, Appendix 6.3 Commitments Register**.

31.2.2.1 Study Area

38. All GHG emissions will affect the same receptor, the global atmosphere, as opposed to directly affecting any specific local receptor. Emissions which are released or avoided due to the Project will have the same effect on atmospheric GHG concentrations and its net effect on climate regardless of where they occur. Therefore, the Study Area for the GHG assessment is not geographically defined.

39. The GHG assessment quantifies the direct and indirect emissions arising from the construction, O&M and decommissioning of the Project (see **Table 31-9** for further details on the emission sources and lifecycle modules considered). The Study Area for the GHG assessment includes GHG emitting activities within the Offshore and Onshore Development Areas, such as use of construction plant and equipment, and those with no definable geographical boundary, such as the raw material extraction and manufacturing processes for wind farm components. To consider the avoided emissions enabled by the Project's supply of renewable energy and other potential carbon benefits enabled by the ESBI, the Study Area also includes the UK electricity transmission network.

40. A graphical representation of the Study Area for the GHG assessment is provided on **Plate 31-1**.

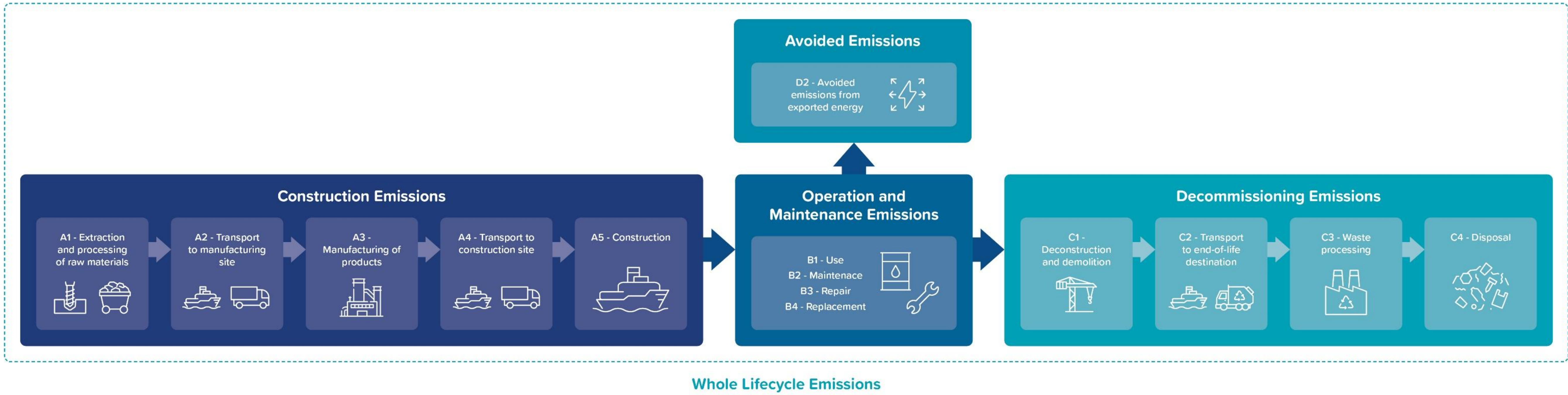


Plate 31-1 Study Area for the Greenhouse Gas Assessment

31.2.2.2 Scope of the Assessment

41. A number of impacts have been scoped out of the GHG assessment. These impacts are outlined in **Volume 2, Appendix 6.2 Impacts Register**, along with supporting justification and are in line with the Scoping Opinion (discussed in **Section 31.1.1**) and the Project description outlined in **Chapter 4 Project Description**.

42. Within the Scoping Opinion, the Planning Inspectorate agreed with scoping out emission sources from lifecycle modules B5 to B9 (i.e. refurbishment, operational energy and water use, other operational processes and user's utilisation of infrastructure) from the GHG assessment, as these sources are likely to be minimal or not relevant to the Project.

43. Impacts scoped into the GHG assessment are outlined in **Table 31-3** and discussed further in **Section 31.2.4.2.5**. The list of emission sources and lifecycle modules that comprise the impacts scoped into the GHG assessment are further discussed in **Table 31-9**.

44. A full list of impacts scoped in / out of the GHG assessment is summarised in **Volume 2, Appendix 6.2 Impacts Register**. A description of how the Impacts Register should be used alongside the PEIR chapter is provided in **Volume 2, Appendix 1.2 Guide to PEIR** and **Chapter 6 Environmental Impact Assessment Methodology**.

Table 31-3 Greenhouse Gas Assessment – Impacts Scoped into the Assessment

Impact ID	Impact and Project Activity	Rationale
Construction		
GHG-C-01	Construction GHG emissions – construction activities	Construction activities and upstream supply chain activities associated with materials used to construct the Project will result in GHG emissions. These include lifecycle modules A1 to A5 (see **Table 31-9**).
Operation and Maintenance		
GHG-O-01	O&M GHG emissions – O&M activities	O&M activities and upstream supply chain activities associated with spare parts used in repair and replacement events will result in GHG emissions. These include lifecycle modules B1 to B4 (see **Table 31-9**).
GHG-O-02	Avoided emissions – supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits enabled by the ESBI	The supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits (i.e. energy balancing and storage services) enabled by the ESBI will result in avoided emissions. This includes lifecycle module D2 (see **Table 31-9**).
Decommissioning		
GHG-D-01	Decommissioning GHG emissions – decommissioning activities not yet defined	Decommissioning activities and downstream end-of-life processes will result in GHG emissions. However, details of offshore and onshore decommissioning activities are not known at this stage. For the GHG assessment, an industry benchmark obtained from literature has been used to estimate decommissioning emissions. These include lifecycle modules C1 to C4 (see **Table 31-9**).
Whole Lifecycle		
GHG-WL-01	Whole lifecycle GHG emissions	This impact considers the net effect of the GHG emissions released across all Project phases and avoided as a result of the Project's operations and is comprised of the other impacts considered in the GHG assessment.

31.2.2.3 Embedded Mitigation Measures

45. The Project has made several commitments to avoid, prevent, reduce or, if possible, offset potential adverse environmental effects through mitigation measures embedded into the evolution of the Project Design Envelope. These embedded mitigation measures include actions that will be undertaken to meet other existing legislative requirements and those considered to be standard or best practice to manage commonly occurring environmental effects.

46. The assessment of likely significant effects has therefore been undertaken on the assumption that these measures are adopted during the construction, O&M and decommissioning phases. **Table 31-4** identifies proposed embedded mitigation measures that are relevant to the GHG assessment.

47. Full details of all commitments made by the Project are provided within **Volume 2, Appendix 6.3 Commitments Register**. A description of how the Commitments Register should be used alongside the PEIR chapter is provided in **Volume 2, Appendix 1.2 Guide to PEIR** and **Chapter 6 Environmental Impact Assessment Methodology**. In addition, a list of draft outline management plans which are submitted with the PEIR for consultation is provided in **Section 1.10** of **Chapter 1 Introduction**. These documents will be further refined and submitted along with the DCO application. See **Volume 2, Appendix 1.2 Guide to PEIR** for a list of all PEIR documents.

48. The Commitments Register is provided at PEIR stage to provide stakeholders with an early opportunity to review and comment on the proposed commitments. Proposed commitments may evolve during the pre-application phase as the EIA progresses and in response to refinements to the Project Design Envelope and stakeholder feedback. The final commitments will be confirmed in the Commitments Register submitted along with the DCO application.

Table 31-4 Embedded Mitigation Measures Relevant to the Greenhouse Gas Assessment

Commitment ID	Proposed Embedded Mitigation	How the Embedded Mitigation Will be Secured	Relevance to Greenhouse Gas Assessment	Relevance to Impact ID
CO98	A Carbon Management Plan (CMP) will be developed in accordance with the Outline CMP and will set out the approach to whole lifecycle carbon management in line with the PAS 2080 principles and practices. The approach will be proportionate to the largest emission sources and where emission reduction can be feasibly achieved. The CMP will detail carbon reduction measures to be considered during decision making and implemented where practicable at the relevant stage in the Project's lifecycle.	DCO Requirement – Carbon Management Plan	Provides an approach to carbon management across the Project's whole lifecycle and sets out measures to reduce GHG emissions where practicable.	GHG-C-01 GHG-O-01 GHG-D-01
CO99	Should any sulphur hexafluoride (SF6) containing equipment be required, an automatic gas leakage detection system will be implemented to monitor operational leakages. Control measures to manage potential for leakages will be in accordance with the relevant UK regulatory requirements on fluorinated gases. In the event of a leakage occurring, the fault will be repaired as soon as reasonably practicable. The Project will consider SF6 free electrical equipment during detailed design and procurement where alternatives are technically and commercially feasible.	DCO Requirement – Carbon Management Plan	Limits the potential for fugitive emissions arising from SF_6 leakages from electrical equipment during operation.	GHG-O-01

49. An Outline CMP will be submitted with the DCO application, which will contain measures relevant to the GHG assessment. The Outline CMP will inform the development of the CMP post-consent, which will be secured as a DCO requirement. Indicative embedded mitigation measures which are proposed to be included in the plan are set out in **Table 31-5.**

Table 31-5 Indicative Embedded Mitigation Measures to be Included in the Outline Carbon Management Plan

Outline CMP: Embedded Mitigation Measures for GHG Emissions (to be developed at ES stage)
Develop and implement a whole lifecycle carbon management approach in accordance with the principles and practices set out in the PAS 2080 guidance. The approach will include the following aspects: • Carbon management goals and principles; • Roles and responsibilities of parties involved in the Project's delivery; • Carbon baseline and reduction targets; • Identification and prioritisation of key emission sources for reduction; • Tools and processes to identify, evaluate and implement carbon reduction opportunities, including decision-making criteria; • Carbon reduction actions to be taken; and • Performance monitoring and reporting requirements.
Develop and communicate guidelines on GHG emission data collection to parties involved in the Project's delivery (e.g. collection of Environmental Production Declarations (EPD) from material suppliers).
Practice the IEMA GHG management hierarchy (i.e. eliminate, reduce, substitute and compensate) over the Project's whole lifecycle (IEMA, 2022).
Provide training and raise awareness among parties involved in the Project's delivery on key GHG emission sources and low carbon solutions.
Promote collaboration and information sharing across parties involved in the Project's delivery to encourage carbon reductions and continual improvement.

Outline CMP: Embedded Mitigation Measures for GHG Emissions (to be developed at ES stage)
The following section outlines potential carbon reduction opportunities over a project's whole lifecycle. Specific measures to be considered for the Project post-consent will be detailed in the Outline CMP submitted with the DCO application: • Optimise the efficiency of construction activities to reduce fuel and material consumption and promote resource efficiency; • Explore opportunities to reduce embodied carbon during construction and over the O&M phase; • Incorporate carbon considerations into procurement criteria, performance benchmarking and incentive mechanisms for material suppliers, contractors and other project partners; • Consider aligning fuel specifications for marine vessel, road transport and plant and equipment with latest industry standards and available proven technologies during the O&M and decommissioning phases and maximise the use of electric and low-carbon fuel alternatives where practicable; and • Consider aligning end-of-life strategies of infrastructure components with latest regulatory requirements, industry standards and available proven technologies at the time of replacement or decommissioning and maximise re-use and recycling where practicable.

31.2.2.4 Realistic Worst-Case Scenarios

50. To provide a precautionary, but robust, assessment at this stage of the Project's development process, realistic worst-case scenarios used for the GHG assessment are defined in **Table 31-6** for each impact scoped into the assessment (as outlined in **Section 31.2.2.2**). The realistic worst-case scenarios are derived from the range of parameters included in the Project Design Envelope. They ensure that the assessment of likely significant effects is based on the maximum potential impact on the environment. Should an alternative development scenario be taken forward in the final design of the Project, the resulting effects would not be greater in effect significance. Further details on the Project Design Envelope are provided in **Chapter 6 Environmental Impact Assessment Methodology**.

51. Further details on the activity data and assumptions used to inform the worst-case scenarios for the GHG assessment are provided in **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**. Following the PEIR publication, further design refinements will be made based on ongoing engineering studies and considerations of the EIA and stakeholder feedback. Therefore, realistic worst-case scenarios presented in the PEIR may be updated in the ES. The Project Design Envelope will be refined where possible to retain design flexibility only where it is needed.

Table 31-6 Realistic Worst-Case Scenarios for the Greenhouse Gas Assessment

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
Construction			
GHG-C-01	Construction GHG emissions – construction activities	**Embodied carbon in construction materials (lifecycle modules A1 to A3):** • **Offshore infrastructure:** ○ The largest wind turbine scenario with monopile foundations (59 x 27 MW) was considered in the GHG assessment, as it has higher GHG emissions than the highest number of smaller wind turbine scenario (113 x 14 MW). ○ The multi-terminal Offshore Substation Platform with piled jacket foundation was considered in the GHG assessment, as it has the highest GHG emissions of the offshore platform(s) and foundation options considered. ○ Both aluminum and copper core inter-array and offshore export cables are under consideration for the Project. Copper core cables have been considered in the GHG assessment, as they have the highest GHG emissions. The maximum total length of inter-array cables (400km) and offshore export cables (800km based on two cables) have been considered in the GHG assessment. ○ Maximum quantities of construction materials required for scour and cable protection. • **Onshore infrastructure:** ○ Both aluminium and copper core onshore High Voltage Direct Current (HVDC) export cables are under consideration for the Project. Copper core cables have been considered in the GHG assessment, as they have the highest GHG emissions. The maximum total length of onshore HVDC export cables (100km based on two HVDC cables) has been considered in the GHG assessment. ○ Both aluminium and copper core onshore High Voltage Alternating Current (HVAC) export cables are under consideration for the Project. Copper core cables have been considered in the GHG assessment, as they have the highest GHG emissions. The maximum total length of onshore HVAC export cables 600km based on 12 HVAC cables) has been considered in the GHG assessment. ○ Maximum quantities of construction materials required for the OCS and ESBI, other infrastructure components such as the jointing bays and cable ducts and other material imports to support civil works.	These parameters represent the maximum amount of construction materials required.
		Marine vessels: • In transit (lifecycle module A4): ○ Maximum of 7,527 round trips during construction. ○ Maximum one-way distance of up to 1,000 km from offshore construction base port(s) has been used in the GHG assessment. • Undertaking construction activities (lifecycle module A5): ○ For seabed preparation vessels, assumed on-site construction period of up to 2 weeks per vessel. ○ For all other vessels, assumed on-site construction period of 3 weeks per vessel (as an average of 2 to 4 weeks per vessel).	These parameters represent the maximum marine vessel activities required during construction (See **Chapter 15 Shipping and Navigation** for further details).
		Road vehicles (lifecycle module A4): • Assumed as a worst-case that there would be 131,827 round trip Heavy Goods Vehicle (HGV) movements during construction, amounting to approximately 3,653,491 km in total. • Assumed as a worst-case that there would be 554,592 round trip Light Vehicle (LV) movements (e.g. passenger cars) during construction, amounting to approximately 9,115,611 km in total.	These parameters represent the maximum road vehicle movements required during construction (See **Chapter 26 Traffic and Transport** for further details).

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
		Helicopters (lifecycle module A4): • Maximum of 2,730 round trips during construction. • Maximum one-way distance of up to 1,000km from construction heliport(s) has been used in the GHG assessment.	These parameters represent the maximum helicopter movements required during construction (see **Chapter 16 Aviation, Radar and Military** for further details).

		Onshore plant and equipment (lifecycle module A5):
		• Indicative onshore construction activities:
		  ○ Landfall: Up to 39 weeks of plant and equipment activities within an estimated total construction period of 3 years.
		  ○ Per section of onshore export cable corridor (ECC): Up to 68 weeks of plant and equipment activities – 14 onshore ECC sections in total with an estimated total construction period of 4 years.
		  ○ OCS: Up to 149 weeks of plant and equipment activities, within an estimated total construction period of 5 years combined with the ESBI.
		  ○ ESBI: Up to 230 weeks of plant and equipment activities, within an estimated total construction period of 5 years combined with the OCS.
			These parameters represent the likely onshore plant and equipment activities required during construction based on project experience and design information known at this stage.

Operation and Maintenance			

GHG-O-01	O&M GHG emissions – O&M activities	**Embodied carbon in spare part materials used during repair and replacement events (lifecycle modules B3 and B4):**
		Anticipated duration of O&M phase: approximately 35 years.
		• Offshore infrastructure:
		  ○ 11km and 24km of inter-array and offshore export cable replacement, respectively, over the O&M phase.
		  ○ 10% replacement of converter valves associated with the offshore platform topside every third year.
		  ○ 11% replacement of wind turbines and other electrical equipment associated with the offshore platform topside over the O&M phase.
		  ○ No routine replacement anticipated for other offshore infrastructure components.
		• Onshore infrastructure:
		  ○ 4km and 2km of onshore HVDC and HVAC export cable replacement, respectively, over the O&M phase.
		  ○ 10% replacement of converter valves associated with the OCS every third year.
		  ○ 3 times replacement of battery units (expected lifetime of between 10 and 15 years) associated with the ESBI over the O&M phase.
		  ○ 1 time replacement of power conversion system (PCS) units associated with the ESBI over the O&M phase.
		  ○ No routine replacement anticipated for other onshore infrastructure components.
			These parameters represent the realistic replacement requirements during the O&M phase based on project experience and design information known at this stage.

		Marine vessels (lifecycle modules B2 to B4):
		• In transit and undertaking O&M activities:
		  ○ Maximum of 96 round trips per year, amounting to 3,360 round trips over the O&M phase (approximately 35 years).
		  ○ Assumed on-site O&M period of up to 2 weeks per vessel for service operation vessels (SOV), daughter craft and vessels undertaking maintenance on offshore platform(s) and major repair and replacement events.
			These parameters represent the maximum marine vessel activities required during the O&M phase (See **Chapter 15 Shipping and Navigation** for further details).

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
		○ Assumed on-site O&M period of up to 3 months per vessel for seabed and sub-sea assets survey vessels and cable repair / replacement vessels. ○ Assumed on-site O&M period of up to 4 weeks per vessel for all other vessels used for corrective maintenance. ○ For SOV and daughter craft, maximum one-way distance of up to 240km from O&M base port(s) has been used in the GHG assessment. ○ For all other vessels, maximum one-way distance of up to 550km from O&M base port(s) has been used in the GHG assessment.	
		Road vehicles (lifecycle modules B2 to B4): • Assumed as a worst-case that there would be 1 LV round trip movement per week over the O&M phase (approximately 35 years) of an assumed distance 20km each way, amounting to approximately 2,080km per annum. • With respect to the replacement of onshore infrastructure, the maximum HGV movements required during the O&M phase have been derived from the replacement of ESBI components. It is assumed that up to two HGV round trip movements per day in a replacement year would be required and that a Humber port would be the origin of component replacements for onshore infrastructure (i.e. 15 km each way)	These parameters represent the maximum road vehicle movements required during the O&M phase (See **Chapter 26 Traffic and Transport** for further details).
		Helicopters (lifecycle modules B2 to B4): • Maximum of 24 round trips per year, amounting to 840 round trips over the O&M phase (approximately 35 years). • Maximum one-way distance of up to 290km from O&M heliport(s) has been used in the GHG assessment.	These parameters represent the maximum helicopter movements required the O&M phase (see **Chapter 16 Aviation, Radar and Military** for further details).
		Fugitive emissions (lifecycle module B1): • Maximum annual SF_6 leakage rate of 0.5% of stored gas in wind turbines, offshore platform(s), OCS and ESBI electrical equipment.	These parameters represent the maximum amount of fugitive emissions during the O&M phase.
GHG-O-02	Avoided emissions – supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits enabled by the ESBI	**Avoided emissions from exported energy (lifecycle module D2):** • Assumed electricity generated by the wind farm would either displace electricity that would have otherwise been generated using natural gas (Scenario 1) or grid electricity mix at the Project's operational start year (Scenario 2) (see **Section 31.2.4.2** for further details on the parameters used to calculate avoided emissions)	To help determine the net carbon benefit of the Project from emissions avoided due to the supply of renewable energy to the UK electricity transmission network.
Decommissioning			
GHG-D-01	Decommissioning GHG emissions – decommissioning activities not yet defined	The final decommissioning strategy of the Project's offshore and onshore infrastructure has not yet been decided. For a description of potential offshore and onshore decommissioning works, refer to **Chapter 4 Project Description**. It is recognised that regulatory requirements and industry best practice change over time. Therefore, the details and scope of offshore and onshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning. For the GHG assessment, decommissioning emissions have been scaled based on the Project's whole lifecycle emissions using an industry benchmark obtained from literature, as detailed in **Section 31.2.5.3.1**.	

31.2.2.5 Development Scenarios

52. Consideration is also given to the different development scenarios with respect to the Onshore Converter Station (OCS) zones. At this stage, two OCS zone options remain in the Project Design Envelope (see **Chapter 4 Project Description** for further details). Only one option will be taken forward to development, which will be confirmed and presented in the ES. The two development scenarios are:

- Infrastructure located in OCS Zone 4; or
- Infrastructure located in OCS Zone 8.

53. With respect to the GHG assessment, it is noted that the assessment of likely significant effects is not materially affected by the two development scenarios, as the same receptor, realistic worst-case scenarios and potential effects are applicable to both OCS zone options. Therefore, the assessment outcomes presented in **Section 31.2.4.2.5** remain the same for both development scenarios.

31.2.3 Assessment Methodology

31.2.3.1 Guidance Documents

54. The following guidance documents have been used to inform the baseline characterisation, assessment methodology and mitigation design for the GHG assessment:

- Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022): This is the primary guidance document for undertaking GHG assessments in an EIA context and has been used to evaluate and determine the significance of GHG emissions released / avoided by the Project;
- Offshore Wind Industry Product Carbon Footprinting Guidance (The Carbon Trust, 2024): This guidance document provides best practice for the calculation of GHG emissions associated with offshore wind farms across its whole lifecycle and has been used to inform the GHG emission calculation methodology;
- Port Emissions Toolkit (GloMEEP, 2018) and Port Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (US EPA, 2022): These guidance documents provide a methodology for estimating vessel emissions during various operating modes and have been used to inform the GHG emission calculation methodology; and
- PAS 2080:2023 Carbon Management in Buildings and Infrastructure (BSI, 2023): This guidance document sets out best practice whole lifecycle carbon management principles to be used in the built environment industry to align with the net zero transition and have been reviewed to identify potential opportunities for reducing GHG emissions during the Project's lifecycle.

31.2.3.2 Data and Information Sources

31.2.3.2.1 Desk Study

55. A desk study has been undertaken to inform the GHG assessment using the sources of information set out in **Table 31-7**.

Table 31-7 Desk-Based Sources for the Greenhouse Gas Assessment

Data Source	Spatial Coverage	Year(s)	Summary of Data Contents
Greenhouse Gas Reporting Conversion Factors (DESNZ, 2024a)	UK	2024	Emission factors for UK-based operations for various activities such as fuel consumption.
Digest of UK Energy Statistics (DUKES): Electricity 5.14 (DESNZ, 2024b)	UK	2024	Up-to-date statistics for the UK power sector, including the operational GHG intensity of each form of electricity generation.
Contracts for Difference (CfD) Standard Terms Notice for the Sixth Allocation Round (DESNZ, 2024c)	UK	2024	Most recent predicted capacity factor for new build offshore wind farms.
Treasury Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for Appraisal and supporting data tables (DESNZ, 2023d)	UK	2023	Projected grid-average and long run marginal operational GHG intensity of the UK electricity transmission network up to 2100.
Reducing the UK Carbon Footprint (CCC, 2013)	UK	2013	Lifecycle GHG intensities of various forms of electricity generation.
Inventory of Carbon and Energy (ICE) Database v4.0 (Circular Ecology, 2024)	International	2024	Emission factors for embodied carbon in materials such as steel and concrete.
Lifecycle Costs and Carbon Emissions of Offshore Wind Power (Thompson and Harrison, 2015)	N/A	2015	Industry benchmarks for offshore wind developments to inform assumptions used in the GHG assessment regarding the likely contribution of emission sources to the Project's total emissions.

Data Source	Spatial Coverage	Year(s)	Summary of Data Contents
The Lifecycle Energy Consumption and Greenhouse Gas Emissions from Lithium-Ion Batteries (Romare and Dahllof, 2017)		2017	Industry benchmarks for battery storage developments to inform assumptions used in the GHG assessment regarding their embodied carbon content.
Environmental Product Declaration: GoodWe Inverter Valid to March 2028 (GoodWe, 2023)		2023	

31.2.3.2.2 Site-Specific Surveys

56. No site-specific surveys were undertaken for the GHG assessment.

31.2.3.3 Impact Assessment Methodology

57. The purpose of the GHG assessment is to consider the likely significant effects of the Project on climate change via the GHG emissions released and avoided by activities undertaken during the construction, O&M and decommissioning phases. Emissions and their effect significance are presented separately per project phase.

58. **Chapter 6 Environmental Impact Assessment Methodology** sets out the overarching approach to the impact assessment methodology. The topic-specific methodology for the GHG assessment is described further in this section.

59. The GHG assessment has been undertaken in accordance with IEMA's *"Assessing Greenhouse Gas Emissions and Evaluating their Significance"* guidance (2022), which provides a topic-specific methodology for assessing and determining the significance of GHG emissions associated with a project, and therefore the assessment methodology differs from the general EIA approach presented in **Chapter 6 Environmental Impact Assessment Methodology**.

60. **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology** details the methodology and assumptions used to quantify GHG emissions by emission source. As discussed in this section and in **Volume 2, Appendix 31.2**, **Greenhouse Gas Assessment Methodology** there are inherent uncertainties associated with calculating GHG emissions for offshore wind developments at an early stage in the design process. However, the approach to determining emissions from individual emission sources is well-defined and has been adopted in this assessment. The assumptions and limitations of the GHG assessment are detailed in **Section 31.2.3.6**.

31.2.3.3.1 Greenhouse Gas Assessment Approach

61. In the GHG assessment, the term "GHG", sometimes referred to in its shorthand as "carbon", encompasses CO_2 and the six other gases listed under the Kyoto Protocol (CH_4, N_2O, HFC, PFC, SF_6 and NF_3). The GHG emissions calculated and reported in the assessment are expressed in carbon dioxide equivalents (CO_2e), which is a common unit that accounts for the different GWP for each gas.

62. GHG emissions arising from the construction, O&M and decommissioning phases of the Project are assessed within a defined Study Area as described in **Section 31.2.2.1**. GHG emissions are quantified using a standard calculation-based methodology, which involves multiplying activity data gathered for the Project with the relevant emission factors, and where applicable, calorific and GWP factors. Where full details of activity data are not available, industry benchmarks and assumptions using professional judgement are utilised where information gaps exist.

63. To account for differences in emission sources, GHG emissions are firstly calculated, and their effect significance individually determined in line with EIA industry good practice. An overall effect significance is then determined by considering the Project's whole lifecycle emissions and therefore the net contribution to climate change in line with IEMA's guidance (2022). This involves a comparison of the GHG emissions released by the Project during its whole lifecycle to the avoided emissions enabled by the Project's operations through the supply of renewable energy generated by the wind farm to the UK electricity transmission network, and other potential carbon benefits (i.e. energy balancing and storage services) enabled by the ESBI.

64. Additional assessment parameters are also calculated to contextualise the outcomes of the GHG assessment, particularly with respect to the net carbon benefits of supplying renewable energy to the UK electricity transmission network, as described in **Table 31-8**.

Table 31-8 Additional Assessment Parameters for the GHG Assessment

Assessment Parameter	Project Phase	Description
Comparison to UK Carbon Budgets	Construction and O&M	GHG emissions arising from the Project's construction and O&M activities were calculated as a percentage of the UK Carbon Budget to which the project phase corresponds.

Assessment Parameter	Project Phase	Description
Operational and lifecycle GHG intensity	O&M and whole lifecycle	The amount of GHG emissions released per unit of electricity generated, typically expressed as grams (g) of CO_2e per kWh. Two types of GHG intensity parameters are calculated for the GHG assessment: • Operational GHG intensity: The current and projected GHG intensities provided by DESNZ for various forms of electricity generation only consider emissions during their operation and therefore does not account for the whole lifecycle impacts. To enable a like-for-like comparison, the Project's construction and decommissioning emissions are excluded from this calculation; and • Lifecycle GHG intensity: The CCC's GHG intensities are based on the whole lifecycle impacts of various forms of electricity generation. To enable a like-for-like comparison, the Project's whole lifecycle emissions are considered in this calculation.

31.2.3.3.2 Greenhouse Gas Emission Calculations

65. In order to account for all the relevant GHG emission sources within the Study Area, emission sources have been categorised into lifecycle modules adapted from the PAS 2080 guidance (BSI, 2023) and The Carbon Trust's guidance (2024), which advocate for a modular approach to GHG emission calculations.

66. GHG emissions sources arising from the Project are categorised by lifecycle module, and divided by source type within each module, as detailed in **Table 31-9**. Further details on the emission sources and the approach to calculating GHG emissions by source are provided in **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**.

Table 31-9 Lifecycle Modules and Emission Sources Considered in the Greenhouse Gas Assessment

Project Phase	Impact ID	Lifecycle Module	Emission Source Description
Construction*	GHG-C-01	A1 – Extraction and processing of raw materials A2 – Transport to manufacturing site A3 – Manufacturing of products	Embodied carbon in materials used to construct the Project (e.g. wind turbines, offshore and onshore export cables, OCS), comprising GHG emissions released from upstream supply chain activities. These activities include the extraction and processing of raw materials, transport to the manufacturing facility and the manufacturing and assembly of the final products supplied to the Project.
Construction*	GHG-C-01	A4 – Transport to construction site	This lifecycle module is comprised of the following emission sources: • Fuel consumption in marine vessels (e.g. jack-up and heavy lift vessels) travelling to / from the offshore construction site; • Fuel consumption in helicopters travelling to / from the offshore construction site; and • Fuel consumption in road vehicles (e.g. heavy goods vehicles (HGV) and staff travel) travelling to / from the onshore construction site.
	GHG-C-01	A5 – Construction	This lifecycle module is comprised of the following emission sources: • Fuel consumption in marine vessels undertaking offshore construction activities; • Fuel consumption in plant and equipment undertaking onshore construction activities; and • Temporary land use and land-use change (LULUC) emissions from vegetation and soil disturbance / loss during construction.
O&M	GHG-O-01	B1 – Use	This lifecycle module is comprised of the following emission sources: • Fugitive SF_6 emission from the use of electrical equipment during operation; and • Ongoing LULUC emissions from vegetation and soil loss over the O&M phase, including any landscaping and ecological mitigation / enhancement implemented by the Project.

Project Phase	Impact ID	Lifecycle Module	Emission Source Description
O&M		B2 – Maintenance B3 – Repair B4 – Replacement	This lifecycle module is comprised of the following emission sources: • Fuel consumption in marine vessels used for offshore O&M activities; • Fuel consumption in helicopters used for offshore O&M activities; • Fuel consumption in road vehicles used for onshore O&M activities; and • Embodied carbon in materials used for spare parts during repair and replacement events.
	GHG-O-02	D2 – Avoided emissions from exported energy	Avoided emissions from the supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits (i.e. energy balancing and storage services) enabled by the ESBI.
Decommissioning**	GHG-D-01	C1 – Deconstruction and demolition C2 – Transport to end-of-life destinations C3 – Waste processing C4 – Disposal	Decommissioning activities and downstream end-of-life processes.

* Lifecycle module 'A0 – Pre-construction' is assumed to be reported under 'A4 – Transport to construction site' and 'A5 – Construction'. All other non-physical pre-construction activities such as design and land activities are anticipated to be primarily office-based, and therefore their minimal emissions have been excluded.

**Decommissioning emissions have been estimated to be 1.2% of the Project's whole lifecycle GHG emissions using an industry benchmark obtained from literature (Thomson and Harrison, 2015). Therefore, specific emission sources are not specified in this table. However, decommissioning emissions are likely to arise from the disassembly of infrastructure, transport of waste to its end-of-life destinations, waste processing and disposal. Lifecycle modules 'D1 Avoided emissions from re-use, energy recovery and recycling' and 'C5 – Relandscaping' are also excluded from the GHG assessment due to lack of information availability.

31.2.3.3.3 Impact Assessment Criteria

67. The GHG assessment is undertaken in accordance with a topic-specific methodology for assessing and determining the significance of GHG emissions as provided in the IEMA (2022) guidance and set out in the following sections.

31.2.3.3.4 Receptor Sensitivity

68. The receptor for the GHG assessment is the global atmosphere. As such, it is cumulatively affected by all global sources of GHGs and is therefore considered to be of 'high' sensitivity to any additional emission across all project phases.

31.2.3.3.5 Impact Magnitude

69. The magnitude of impact is not defined, as the effect significance for the GHG assessment is not determined by the magnitude of GHG emissions alone (IEMA, 2022). However, GHG emissions released by the Project during its construction, O&M and decommissioning phases and emission avoided have been calculated as part of the assessment. GHG emissions will be presented by project phase and combined over the whole lifecycle.

70. The impact of GHG emissions is, by nature, global and long term with low reversibility, owing to the long atmospheric lifetime of GHGs and their prolonged effect on the climate system.

31.2.3.3.6 Effect Significance

71. The IEMA guidance (2022) recognises that: *"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"*.

72. 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 (2022) recommends that significance criteria align with Paris Agreement, the UK's Carbon Budgets and net zero commitments, and states that: *"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"*.

73. The IEMA guidance (2022) provides significance descriptions to assist assessments of GHG emissions specifically in an EIA context. Section VI of the guidance describes five distinct levels of significance which are not solely based on whether a project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a decarbonisation trajectory towards net zero. These are presented below in **Table 31-10**.

Table 31-10 Effect Significance Criteria for the Greenhouse Gas Assessment

Significance	Definition
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.

74. The effect significance of the Project's GHG emissions is firstly evaluated for each phase of the Project. For the construction phase, significance is determined by comparing the magnitude of emissions with the 5th Carbon Budget (2028 to 2032) and 6th Carbon Budget (2033 to 2037) and considered in terms of its effect on the UK's ability to meet its future Carbon Budgets and, by proxy, the emission reduction needed to achieve its international climate commitments and its long-term net zero target.

75. For the O&M and decommissioning phases, the relevant UK Carbon Budgets have not all been set or are no longer applicable, as the Project's O&M phase extends beyond 2042 (the latest year the Carbon Budgets extend to) and 2050, the year which the UK commits to achieving net zero. Therefore, effect significance for these phases is determined by considering the Project's effects on the UK's ability to achieve and maintain its net zero status in the long-term. The first ten years of the Project's O&M phase aligns with the 6th Carbon Budget (2033 to 2037) and 7th Carbon Budget (2038 to 2042). GHG emissions over these budget periods have also been compared to provide further context.

76. In addition to evaluating effect significance by project phase, overall effect significance is also determined by considering the Project's whole lifecycle emissions. Total emissions released across the lifecycle of the Project, and the avoided emissions enabled by its implementation are considered together to evaluate the net contribution to climate change.

77. Likely significant effects identified in the GHG assessment as major / moderate adverse or beneficial are deemed to be significant in EIA terms. Whilst only one level of significance criteria is provided where there is a net reduction in emissions, further context on the avoided emissions and the associated carbon benefits is provided in the assessment.

31.2.3.4 Cumulative Effects Assessment Methodology

78. All developments which emit, avoid or sequester GHG emissions affect global atmospheric concentrations irrespective of their location. Therefore, the effects of GHG emissions are global and cumulative by nature. This is taken into account in defining the receptor sensitivity of the global atmosphere as 'high'. The IEMA guidance (2022) states that the cumulative effects of GHG emissions from other plans and projects should therefore not be individually assessed, as there is no basis for selecting which plan or project to assess cumulatively over any other. The GHG assessment is considered to be inherently cumulative, and no additional consideration of cumulative effects is required. This topic-specific approach differs from the general approach to cumulative effect assessment (CEA) presented in **Chapter 6 Environmental Impact Assessment Methodology**.

79. As discussed in **Volume 2, Appendix 31.1 Consultation Responses for Climate Change,** the Planning Inspectorate agreed to scope out cumulative effects from the GHG assessment provided that overall emissions are considered.

31.2.3.5 Transboundary Effects Assessment Methodology

80. As noted above for cumulative effects, the receptor for the GHG assessment is the global atmosphere, and therefore GHG emissions have an indirect transboundary effect. As GHG emissions are assessed in context of the UK Carbon Budgets and long-term net zero target and, therefore, aspirations to reduce emissions in line with international climate agreements, the Project's effects on the climate commitments of other European Economic Area (EEA) Member States are inherently considered in the GHG assessment. No additional consideration of transboundary effects is therefore required. This topic-specific approach differs from the general approach to transboundary effect assessment presented in **Chapter 6 Environmental Impact Assessment Methodology**.

81. As discussed in **Volume 2, Appendix 31.1 Consultation Responses for Climate Change**, the Planning Inspectorate agreed that transboundary effects may be scoped out of the GHG assessment.

31.2.3.6 Assumptions and Limitations

82. A number of assumptions are made in the GHG assessment, as set out in **Table 31-11**. Further details on the methodology adopted to quantify GHG emissions from the Project are presented in **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**. This chapter provides a preliminary assessment of the likely significant effects of the Project in relation to climate change using information available at the time of drafting as described in **Chapter 6 Environmental Impact Assessment Methodology**. This assessment will be refined where relevant and presented in the ES to be submitted with the DCO application.

Table 31-11 Assumptions and Limitations of the Greenhouse Gas Assessment

Assumption / Limitation	Further Detail / Discussion
Availability and quality of activity data used for GHG emission calculations	Due to the design maturity at the time of the assessment, details regarding the activities that will take place during the Project's construction, O&M and decommissioning phases are not fully known. Where information gaps exist, conservative assumptions are made based on preliminary design information or proxy information from previous projects provided by the Applicant, professional judgment and / or published literature. The design process is ongoing and will continue between PEIR publication and DCO application submission and during detailed design post-consent.
Lifecycle Assessment (LCA)	Although considered appropriate and proportionate for the purposes of an EIA, this GHG assessment should not be taken as a comprehensive, detailed LCA of the Project. It is not possible to fully define the supply chain, detailed design and material and technology specifications for the Project and undertake the relevant detailed assessments at this stage in the Project. Therefore, assumptions and simplifications to the emission calculation methodology are made in certain areas.
Lack of emission factors for future year activities such as fuel consumption and material extraction	The most recent and available emissions factors are used in the GHG assessment to provide a conservative assessment. Many sectors are anticipated to decarbonise over the next 35 years, both in the UK and internationally, in line with their sectoral decarbonisation trajectories. During the Project's O&M and decommissioning phases, it is likely that the GHG intensities of manufacturing wind farm components and the movement of marine vessels will be less than the present day. Therefore, O&M and decommissioning emissions calculated for the Project are likely to be an overestimation.
Quantities for all materials to be used during construction were not available at the time of the assessment	High volume and high embodied carbon content materials are included in the GHG assessment, and where project-specific information is not available, proxy data from other similar developments or industry benchmarks are used. Furthermore, conservative assumptions are adopted for quantities of known materials (i.e. using the maximum quantity within the Project Design Envelope).
The recycled content of construction materials is unknown	As an example, it has been assumed that all steel used on the Project is virgin steel to provide a conservative assessment. It is likely that materials that will be used in construction will have a high recycled content, and thus a lower embodied carbon content than has been assumed in this assessment.
The origin port of marine vessels and manufacturing point of origin were not known at the time of the assessment	Due to the lack of information, emissions associated with the mobilisation of vessels to offshore construction and O&M base port(s) from their point of origin and the import of materials from their manufacturing point of origin have been excluded from the GHG assessment. Should further sourcing and logistics information become available, these emissions will be estimated in the ES.
LULUC emissions were not estimable at the time of the assessment	Temporary and ongoing LULUC emissions from vegetation and soil disturbance / loss during construction and operation will be addressed in the ES following refinements to the Onshore Development Area and the Project Design Envelope, and once further details on the Project's proposed landscaping and ecological mitigation / enhancement measures are known. This will be informed by baseline characterisation regarding the types of land use within the Onshore Development Area based on ecological surveys undertaken.
Electricity displaced by the Project would otherwise be generated using natural gas (Scenario 1) or grid electricity mix at the Project's operational start year (Scenario 2).	Two 'Do Nothing' scenarios are used to determine the Project's avoided emissions form the supply of renewable energy to the UK electricity transmission network. There is no standardised approach across the renewables sector on how avoided emissions of a renewables development should be derived. There is uncertainty on which form of electricity generation the electricity generated by the wind farm would displace, their operational GHG intensity at the time of supply or the extent to which it will displace other forms of electricity generation when accounting for future changes in electricity supply and demand. However, the two 'Do Nothing' scenarios derived for the GHG assessment are considered appropriate for the purpose of informing the Project's EIA and needs case. Further details are provided in **Section 31.1.1.1**.

31.2.4 Baseline Environment

31.2.4.1 Existing Baseline

83. The Project's primary function is to supply renewable energy to the UK transmission network, which would influence its operational GHG intensity in the long run. At the time of writing, the latest available operational GHG intensity for the UK grid electricity mix is approximately 207 tonnes CO_2e per GWh electricity (excluding well-to-tank emissions and transmission and distribution losses) (DESNZ, 2024a).

31.2.4.2 Predicted Future Baseline

84. To quantify the avoided emissions enabled by the Project and determine the overall effect significance of its whole lifecycle emissions, consideration of a future baseline or 'Do Nothing' scenario is required, which assumes that the Project is not constructed.

85. The UK electricity transmission network is currently supplied by several different forms of electricity generation, including natural gas, nuclear, onshore and offshore wind, bioenergy, solar and hydroelectric. Over the Project's O&M phase, the electricity mix is anticipated to evolve due to efficiency improvements and the uptake of renewables and other low-carbon technologies such as carbon capture and storage, and therefore the operational GHG intensity of the grid electricity mix is anticipated to decrease over time.

86. The scale and rate of reduction in the operational GHG intensity of the grid electricity mix are dependent on several factors such as emerging technologies and their readiness, adopted and future climate and energy policies, electricity market trends and investment decisions. However, it is recognised that the growth of renewable energy, coupled with a transition away from electricity generated using fossil fuels, is key to the UK's climate and energy policies and plans for economy-wide decarbonisation towards the long-term net zero target. In addition, the projected decrease in the operational GHG intensity of the grid electricity mix forecasted in the UK's future energy modelling inherently accounts for the roll-out of renewables developments such as the Project becoming operational.

87. Two 'Do Nothing' scenarios are established for the GHG assessment based on the assumptions described below.

31.2.4.2.1 Scenario 1: Natural Gas

88. This scenario assumes that electricity generated by the wind farm would displace generation from 'natural gas' sources, as this is the most common form of new fossil fuel combustion plant (BEIS, 2022), and is considered to be representative of the UK's transition from fossil fuel-based generation sources to renewables.

89. The approach used by RenewableUK (2024) to calculate avoided emissions uses the operational GHG intensity of electricity generated using "all non-renewable fuels" (437 tonnes CO_2 per GWh electricity (DESNZ, 2024b)). However, the operational GHG intensity of electricity generated by natural gas is lower (375 tonnes CO_2 per GWh electricity) (DESNZ, 2024b), which provides a more conservative assessment of the emissions avoided by the Project.

90. In addition, this scenario aligns with UK's climate and energy policies, specifically NPS EN-1 (DESNZ, 2023a), which expects the *"demand for oil and natural gas to decline while overall, energy demand reduces significantly through increased efficiency and fossil fuels are replaced by new sources of energy*." Furthermore, the Clean Power 2030 Action Plan states the UK Government's commitment to deliver a clean power system in Great Britain by 2030, with clean energy sources producing at least as much power as the total annual electricity demand and at least 95% of its total generation, and therefore "significantly reducing fossil fuel dependency". (UK Government, 2024).

31.2.4.2.2 Scenario 2: Long Run Marginal Electricity at Operational Start Year

91. The long run marginal factor reflects the change in operational GHG intensity of grid electricity mix that would be affected by small but sustained changes in electricity supply or demand (i.e. a new renewable energy supply to the electricity transmission network would be considered small at a national scale) (DESNZ, 2023d). The marginal electricity source(s) represents the last dispatchable power that would increase or decrease their supply to meet changes in demand and therefore would vary at any given time. The choice of marginal electricity will depend on the availability of supply, the flexibility to ramp up / down supply and commercial factors such as electricity prices. The long run marginal factor is considered to be more suitable for estimating avoided emissions compared to the grid-average factor, as this represents the source(s) that would be displaced with the additional electricity supplied by the Project.

92. Historically, the marginal electricity source(s) was fossil fuel-based generation due to their availability as a source of dispatchable generation, however in the long run, based on the UK's climate and energy policies, marginal electricity will likely be primarily sourced from renewables generation combined with energy storage, with residual demand supplied by other sources, including nuclear, interconnectors, combined cycle gas turbines (CCGT) with carbon capture and storage technologies, hydrogen-fired turbines and some degree of unabated CCGT (NESO, 2024; CCC, 2025).

93. This scenario assumes that electricity generated by the wind farm would displace all forms of generation sources in the UK grid electricity mix at the Project's operational start year (i.e. 2033 at the earliest). The long run marginal factor for generated electricity in 2033 is estimated to be 38 tonnes CO_2 per GWh electricity (DESNZ, 2023d). Compared to Scenario 1, this scenario provides a more conservative assessment of the emissions avoided by the Project for the purpose of the EIA.

94. The long run marginal factor for the operational start year was used to represent the value of avoided emissions at the point when the Project starts to provide electricity. Over the Project's O&M phase, the long run marginal factor is projected to reduce to a value of 2 tonnes CO_2 per GWh electricity, which is derived from DESNZ's future energy scenario modelling. This modelling assumes a high decarbonisation rate in the UK electricity transmission network from the roll out of renewable energy schemes such as the Project becoming operational. Beyond the Project's operational start year, continuing to use the long run marginal factor projections for each operational year to estimate avoided emissions has inherent limitations, as it presents a scenario whereby renewable energy is primarily displacing other future sources of renewable energy, including the Project itself.

31.2.4.2.3 Energy Generated by the Wind Farm

95. The approximate quantity of electricity generated by the wind farm is quantified in accordance with the approach in The Carbon Trust's offshore wind guidance (2024), which is similar to the approach advocated by RenewableUK (2024) for offshore wind farms. The equation used to calculate the electricity generated per year and over the Project's O&M phase are detailed in **Table 31-12**.

Table 31-12 Anticipated Annual and Lifetime Electricity Output by the Wind Farm

Estimated Installed Capacity (MW) x Hours per Year (hours) x Capacity Factor (%) x Annual Availability Factor (%) x (1 – Electrical Transmission Losses (%))

Annual Electricity Output: *1,582 MW x 8, 760 hours x 0.623 x 0.97 x (1 – 0.0175) = 8,228,164 MWh/year*

↓

Annual Electricity Output (MWh/year) x Duration of O&M Phase (years)

Lifetime Electricity Output: *8,228,164 MWh/year x 35 years = 287,985,731 MWh*

96. The capacity factor for the Project is assumed to be 62.3%, which aligns with DESNZ's CfD Round 6 Allocation and provides the most recent predicted capacity factors for new build offshore wind farms delivered between 2028 and 2029. The most recently available five-year (2019 to 2023) rolling average capacity factor for offshore wind farms is 40.58% (DESNZ, 2024d), and the capacity factors have been increasing over time due to technological innovations and operational improvements (BEIS, 2019). The annual availability factor which accounts for operational downtime is assumed to be 97%, and electrical transmission losses is assumed to be 1.75% based on available design information and the Applicant's previous project experience.

31.2.4.2.4 Greenhouse Gas Emissions from the 'Do Nothing' Scenarios

97. GHG emissions produced to generate an equivalent amount of electricity under the two 'Do Nothing' scenarios are presented in **Table 31-13**. These emissions have been quantified by multiplying the anticipated electricity generated by the wind farm by the operational GHG intensity of the displaced electricity generated using natural gas (Scenario 1) or all forms of generation in the UK grid electricity mix at the Project's operational start year (Scenario 2).

Table 31-13 Do Nothing Scenarios – Greenhouse Gas Emissions

Timeframe	Anticipated Electricity Generated by the Wind Farm (GWh)	GHG Emissions Produced under Scenario 1 (Natural Gas) (tonnes CO2)	GHG Emissions Produced under Scenario 2 (Long Run Marginal Electricity at Operational Start Year (tonnes CO2)
Per year	8,228	3,085,561	312,670
Over O&M phase (35 years)	287,986	107,994,649	10,943,458

98. It is also noted that the emission factors used to calculate GHG emissions under the 'Do Nothing' scenarios only account for operational emissions from the generation of electricity and do not account for emissions across the whole lifecycle of those alternative forms of generation (e.g. upstream emissions to construct the generation plant). Therefore, it is a conservative approach to compare GHG emissions that would be produced under these scenarios (i.e. emissions that would occur in the absence of the Project being developed and therefore the emissions avoided by the Project) to emissions generated across the Project's whole lifecycle.

31.2.4.2.5 Other Potential Carbon Benefits

99. In addition to the electricity generated by the wind farm, there are additional potential carbon benefits enabled by the ESBI aspects of the Project such as energy balancing and storage services, which are further discussed in **Section 31.2.5.2.2.2**. However, it is not possible to quantify the magnitude of avoided emissions resulting from the energy balancing and storage functions enabled by the ESBI at this stage, and therefore, these aspects have not been considered as part of the 'Do Nothing' scenarios.

100. To estimate avoided emissions from the ESBI, real-time monitoring data is required to determine the operational GHG intensity and the quantity of the stored electricity supplied to the electricity transmission network at the time of supply. More importantly, there is potential for double counting of avoided emissions. The ESBI is not a generation plant, but rather ancillary electrical infrastructure that supports the delivery of a low-carbon energy system. Any avoided emissions resulting from the stored electricity would have been accounted for at the point of generation by other renewable and low-carbon energy developments.

31.2.5 Assessment of Effects

101. The likely significant effects with respect to GHG emissions that may occur during construction, O&M and decommissioning of the Project are assessed in the following sections, both individually by project phase and combined over the whole lifecycle. The assessment follows the methodology set out in **Section 31.2.2.5** and detailed in **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**. It is based on the realistic worst-case scenarios defined in **Section 31.2.2.4**, with consideration of embedded mitigation measures identified in **Section 31.2.2.3**.

102. As noted in **Section 31.2.2.5**, the assessment of likely significant effects for the OCS zone infrastructure will remain the same for both development scenarios.

31.2.5.1 Potential Effects during Construction

31.2.5.1.1 Construction Greenhouse Gas Emissions (GHG-C-01)

103. Construction GHG emissions cover lifecycle modules A1 to A5 (see **Table 31-9**), and the emission sources during construction that were identified and quantified for the Project include embodied carbon in construction materials, marine vessels, road vehicles, helicopters and onshore plant and equipment. Their GHG emissions are provided in **Table 31-14**.

104. Temporary LULUC emissions from vegetation and soil disturbance / loss during construction have been excluded from the GHG assessment at this stage and will be considered in the ES (as discussed in **Section 31.2.3.6**).

105. Emissions released during the Project's construction are estimated to be approximately 3.75 million tonnes CO_2e. Embodied carbon in materials is expected to be the largest emission source during construction, contributing approximately 56.6% of emissions during this phase. The next largest emission source is marine vessels, comprising approximately 41.3% of total construction emissions.

Table 31-14 Construction Greenhouse Gas Emissions from the Project

Lifecycle Module	Emission Source	GHG Emissions (tonnes CO_2e)	Percentage of Construction GHG Emissions
A1 – Extraction and processing of raw materials A2 – Transport to manufacturing site A3 – Manufacturing of products	Embodied carbon	2,120,254	56.6%
A4 – Transport to construction site	Marine vessel movements	110,859	3.0%
	Road vehicle movements	8,664	0.2%
	Helicopter movements	21,241	0.6%
A5 – Construction	Marine vessel construction activities	1,436,082	38.3%
	Onshore plant and equipment construction activities	48,298	1.3%
Total (over entire construction phase)		**3,745,398**	

31.2.5.1.1.1 Comparison to UK Carbon Budget

106. The Project's earliest construction phase (2029 to 2033) falls primarily under the 5th Carbon Budget period (2028 to 2032), with one year in the 6th Carbon Budget (2033 to 2037) (see **Table 31-2**). Assuming that an equal portion of emissions is released during each year of construction, estimated construction GHG emissions would constitute 0.17% and 0.08% of the 5th Carbon Budget and 6th Carbon Budget respectively, which form a relatively small proportion. In addition, construction emissions would occur over a short duration as a single occurrence.

107. It should be noted that some of the construction GHG emissions estimated in **Table 31-14** are likely to occur outside the territorial boundary of the UK, given the international nature of supply chains. Therefore, these emissions would fall outside the scope of the UK's national Carbon Budgets, policy and governance. However, given that GHG emissions affect the climate wherever they occur and the need to avoid 'carbon leakage' overseas when reducing UK emissions, all emission sources released during construction have been included in the GHG assessment.

31.2.5.1.1.2 Effect Significance

108. Based on their negligible contribution to the 5th Carbon Budget and 6th Carbon Budgets, GHG emissions arising from the Project's construction are unlikely to adversely affect the UK's ability to meet future Carbon Budgets and progress towards achieving its long-term net zero target. It should also be noted that emissions during construction are required to enable the development of the Project and the supply of renewable energy to decarbonise the UK energy system in the long-run (see **Section 31.2.5.2.2**).

109. In addition, through the provision of the Outline CMP and adoption of whole lifecycle carbon management principles and practices in line with the PAS 2080 guidance (see **Table 31-4**, Commitment ID CO98), which are considered as best practice in the delivery of infrastructure developments, opportunities for further reductions in construction GHG emissions can be considered as the Project develops and implemented where reductions can be feasibly achieved.

110. Therefore, construction GHG emissions from the Project are considered to have a **minor adverse** effect and is **not significant** in EIA terms.

31.2.5.2 Potential Effects during Operation

31.2.5.2.1 Operation and Maintenance Greenhouse Gas Emissions (GHG-O-01)

111. GHG emissions released from activities during the O&M phase cover lifecycle modules B1 to B4 (see **Table 31-9**). The emission sources during operation that were identified and quantified for the Project include fugitive emissions associated with SF_6 leakage from electrical equipment, embodied carbon in spare parts used during repair and replacement events, marine vessels, road vehicles and helicopters. Their GHG emissions are provided in **Table 31-15**.

112. Ongoing LULUC emissions from vegetation and soil loss over the O&M phase, including any landscaping and ecological mitigation / enhancement implemented by the Project, have been excluded from the GHG assessment at this stage and will be considered in the ES (as discussed in **Section 31.2.3.6**).

Table 31-15 Operation and Maintenance Greenhouse Gas Emissions from the Project

Lifecycle Module	Emission Source	GHG Emissions (tonnes CO_2e)		Percentage of Lifetime O&M GHG Emissions
		Per Year*	Over O&M Phase (35 Years)	
B1 – Use	Fugitive SF_6 emissions	3,076	107,661	6.2%
B2 – Maintenance B3 – Repair B4 – Replacement	Embodied carbon – spare parts	20,518	718,120	41.3%
	Marine vessel movements and O&M activities	25,964	908,746	52.3%
	Helicopter movements	75	2,629	0.2%
	Road vehicle movements	2	70	< 0.01%
Total		**49,635**	**1,737,227**	

*As discussed in **Volume 2, Appendix 31.2 Greenhouse Gas Assessment Methodology**, some emission sources have some years with more intensive O&M activities (e.g. spare parts, road vehicle movements). In order to estimate annual GHG emissions, the lifetime O&M GHG emissions was divided by the duration of the O&M phase (35 years).

113. Emissions released during the O&M phase of the Project are estimated to be approximately 1.74 million tonnes CO_2e over the 35-year period and 49,635 tonnes CO_2e per year on average. The majority of O&M GHG emissions are due to marine vessels and embodied carbon in spare parts used during repair and replacement events, accounting for approximately 52.3% and 41.3% of lifetime O&M emissions respectively.

114. Another key source of O&M emissions is from fugitive SF_6 emissions, comprising 6.2% of lifetime O&M emissions, due to the high GWP of SF_6. SF_6 is commonly used in the electrical industry as an insulating and circuit-breaking medium for high-voltage switchgears and other electrical equipment that are required for energy developments such as the Project. SF_6-containing electrical equipment is designed in accordance with stringent regulations and engineering standards to avoid the release of SF_6 into the atmosphere, however, leakage can occur over its lifetime due to unforeseen faults.

115. SF_6-free alternatives are currently being developed by electrical equipment manufacturers but are not yet readily available for higher voltage requirements, and there remain challenges with respect to cost uncertainty and technological readiness. Therefore, it is assumed that SF_6-containing electrical equipment will be used for the Project as a worst-case scenario. Recognising the potency of SF_6 emissions, the Applicant will consider SF_6-free electrical equipment, should opportunities arise the during detailed design and procurement stages post-consent, and evaluate the suitability of their use based on technical and commercial feasibility (see **Table 31-4**, Commitment ID CO99). Should SF_6-containing equipment be required, control measures in accordance with the relevant UK regulatory requirements on fluorinated gases will be adhered to, including the implementation of an automatic gas leakage detection system.

31.2.5.2.1.1 Comparison to UK Carbon Budget

116. The first ten years of the Project's O&M phase (2033 to 2042) falls under the 6th Carbon Budget (2033 to 2037) and the 7th Carbon Budget (2038 to 2042) periods (see **Table 31-2**). Based on the annual emissions during the O&M phase, estimated GHG emissions that would be released over this period would constitute around 0.03% and 0.05% of the 6th Carbon Budget and 7th Carbon Budget respectively, which forms a relatively small proportion. In addition, although emissions would occur continuously over the Project's O&M phase, the magnitude of emissions would likely remain negligible in comparison to the future Carbon Budgets leading up to the long-term net zero target in 2050.

117. As noted in **Table 31-11**, conservative assumptions have been adopted in the calculation of O&M GHG emissions, as the emission factors used are representative of present-day conditions. Wider decarbonisation trends over the Project's O&M phase, such as reductions in the GHG intensities of manufacturing processes for spare parts and fuel consumption for transport, have not been considered. Therefore, the estimated GHG emissions during the O&M phase are likely to present an overestimation.

31.2.5.2.1.2 Effect Significance

118. Based on their negligible contribution to the 6th and 7th Carbon Budgets and likely negligible contributions to future Carbon Budgets once set from 2042 onwards, the Project's O&M GHG emissions are unlikely to adversely affect the UK's ability to achieve and maintain its net zero status in the long-term. In addition, when considering the Project's supply of renewable energy to the UK electricity transmission network over its O&M phase (see **Section 31.2.5.2.2**), any O&M emissions released by the Project would be offset by the avoided emissions it enables.

119. Similar to the construction phase, whole lifecycle carbon management measures (see **Table 31-4**, Commitment ID CO98) are also applicable to O&M activities, which will allow opportunities for further reductions in O&M GHG emissions to be considered and implemented where they can be feasibly achieved.

120. Therefore, O&M GHG emissions from the Project are considered to have a **negligible** effect and is **not significant** in EIA terms.

31.2.5.2.2 Avoided Emissions (GHG-O-02)

121. Avoided emissions cover lifecycle module D2 (see **Table 31-9**) and consider the benefits of supplying renewable energy to the UK electricity transmission network. Electricity generated by the wind farm is less GHG intensive than other forms of generation such as natural gas or alternative non-renewable energy sources considered in the future UK grid electricity mix, resulting in avoided emissions over the Project's O&M phase.

122. **Table 31-16** presents the quantity of GHG emissions which would have otherwise been produced under the two 'Do Nothing' scenarios (see **Section 31.2.4.2**). These figures are used to determine the range of avoided emissions as result of the Project's supply of renewable energy to the UK electricity transmission network, accounting for emissions released over its O&M phase. It is anticipated that the true value of avoided emissions enabled by the Project would lie within the range provided.

123. Avoided emissions are further discussed in **Section 31.2.5.4** in the context of the Project's whole lifecycle emissions.

Table 31-16 Avoided Emissions from Energy Generated by the Wind Farm (Less Lifetime Operation and Maintenance Emissions)

'Do Nothing' Scenario	Lifetime O&M Emissions (tonnes CO_2e)	Lifetime GHG Emissions Produced under the 'Do Nothing' Scenario (tonnes CO_2e)	Avoided Emissions (tonnes CO_2e)
Scenario 1: Natural Gas	1,737,227	107,994,649	106,257,423
Scenario 2: Long Run Marginal Electricity at Operational Start Year		10,943,458	9,206,231

124. Under Scenario 1, assuming electricity generated by the wind farm displaces electricity that would have otherwise been generated using natural gas, approximately 106 million tonnes CO_2e would be avoided with the Project in operation. Although the operational GHG intensity of natural gas-based electricity generation is in the units of CO_2 rather than CO_2e, the estimated avoided emissions is still considered representative, as the majority of GHG emissions from fossil fuel combustion is from CO_2. Were other types of GHG to be included, the GHG intensity would be higher.

125. Under Scenario 2, assuming electricity generated by the wind farm would displace all forms of generation in the UK grid electricity mix at the Project's operational start year (i.e. 2033 at the earliest), approximately 9.2 million tonnes CO_2e would be avoided with the Project in operation.

126. In addition, the operational GHG intensity used to establish the 'Do Nothing' scenarios (DESNZ, 2024b) does not account for emissions related to maintenance, repair and replacement activities and the fuel supply chain (i.e. well-to-tank emissions). Therefore, **Table 31-16** is considered to provide a conservative assessment of the emissions avoided by the Project during the O&M phase.

31.2.5.2.2.1 Operational Greenhouse Gas Intensity

127. Based on the Project's anticipated lifetime electricity output and O&M GHG emissions, the operational GHG intensity per unit of electricity generated by the wind farm is estimated to be 6g CO_2e/kWh.

31.2.5.2.2.2 Other Potential Carbon Benefits

128. As discussed in **Section 31.2.4.2.5**, avoided emissions resulting from the energy balancing and storage services enabled by the ESBI are not estimated at this stage. However, the ESBI will deliver other carbon benefits to the UK energy system in addition to the Project's supply of renewable energy generated by the wind farm such as energy balancing and storage services. Moreover, the ESBI is also an electrical infrastructure supported by national energy policies. NPS EN-1 (DESNZ, 2023a) notes that while new generating infrastructure is required to deliver a low carbon and reliable energy system, new storage infrastructure is also required to meet the UK's energy objectives with respect to decarbonisation of the power sector and ensuring security of supply.

129. Integrating energy storage infrastructure with offshore wind generation would minimise reductions in the Project's electricity generation during periods of excess supply by allowing surplus electricity to be stored and therefore maximising the use of renewable energy. In addition, energy storage infrastructure complements offshore wind generation by mitigating the issue of intermittent supply (National Grid, 2023). When generation at the wind farm is low or during periods of operational downtime, the electricity stored by the ESBI would be released to the UK electricity transmission network to ensure a continuous supply of renewable energy and avoid the need to ramp up a more GHG intensive form of dispatchable generation (e.g. natural gas) that would be required to meet the excess demand.

31.2.5.2.2.3 Effect Significance

130. The Project would contribute to the UK meeting the projected increase in electricity demand over the years due to population and economy growth (BEIS, 2022), as well as ensuring the supply of renewable energy to decarbonise the power sector and support emission reductions in other economic sectors. Given the low operational GHG intensity of the electricity generated by the wind farm, the avoided emissions from the supply of renewable energy and other potential carbon benefits (i.e. energy balancing and storage services) enabled by the ESBI, the Project's operations are considered to have a **beneficial** effect, which is **significant** in EIA terms.

31.2.5.3 Potential Effects during Decommissioning

31.2.5.3.1 Decommissioning Greenhouse Gas Emissions (GHG-D-01)

131. No decision has been made regarding the final decommissioning strategy for the offshore and onshore infrastructure, as it is recognised that statutory requirements and industry best practice change over time.

132. The detailed activities and methodology for decommissioning will be determined later within the Project's lifetime, but would be expected to include:

- Offshore infrastructure:
  - Removal of all the wind turbine components and part of the offshore foundations (those above seabed level);
  - Removal of some or all of the inter-array and offshore export cables; and
  - The inter-array and offshore export cables will likely be cut at the cable ends and left in-situ below the seabed, and scour and cable protection would likely be left in-situ other than where there is a specific condition for its removal.
- Onshore infrastructure:
  - Deinstallation and removal of electrical equipment, buildings and other infrastructure for the OCS and ESBI;
  - Removal of above-ground link boxes along the onshore ECC;
  - Inspection of underground infrastructure to be left in-situ along the onshore ECC and at the landfall (i.e. TJB, jointing bays, underground link boxes, onshore export cables and ducting) to ensure they are safe to remain in place. If considered unsuitable to be left in-situ at the time of decommissioning, these components will be removed; and
  - Site reinstatement and landscaping.

133. Whilst a detailed quantification of GHG emissions from decommissioning activities and end-of-life processes associated with the Project has not been undertaken, it is anticipated that decommissioning emissions are likely to arise from plant and equipment, marine vessels and road vehicles used in the disassembly of infrastructure and transport of waste to end-of-life destinations and process emissions from waste processing and disposal.

134. An industry benchmark obtained from literature (Thomson and Harrison, 2015) has therefore been used to estimate the Project's decommissioning emissions in the absence of detailed activity data, which represent approximately 1.2% of the Project's whole lifecycle emissions. Decommissioning GHG emission cover lifecycle modules C1 to C4 (see **Table 31-9**) and are presented in **Table 31-17**.

Table 31-17 Decommissioning Greenhouse Gas Emissions from the Project

Lifecycle Module	Emission Source	GHG Emissions (tonnes CO_2e)
C1 – Deconstruction and demolition C2 – Transport to end-of-life destinations C3 – Waste processing C4 – Disposal	Decommissioning activities and end-of-life processes	66,591

135. It is also recognised that regulatory requirements and industry best practice with respect to the decommissioning of offshore wind developments change over time. It is anticipated that a large proportion of wind farm components would be recycled, re-used or incinerated for energy recovery at the end-of-life stage, as opposed to being sent to landfill, with current estimates for wind turbine recyclability ranging from 85% to 90% (Schmid *et al.*, 2020). There are also alternatives to decommissioning of offshore wind farms with potentially lower GHG emissions (Spyroudi *et al.,* 2021), such as repowering and life extension strategies, that could be explored as part of determining the final decommissioning strategy for the Project. In addition, battery units associated with the ESBI are regulated under the UK's waste legislation, and therefore their end-of-life strategies are required to involve recycling and re-use, as opposed to landfill disposal or incineration (DESNZ, 2024e).

136. Decommissioning GHG emissions estimated for the Project at this stage are likely to be an overestimate, as they do not account for high levels of economy-wide decarbonisation that would be achieved in the future, with the UK's net zero target being 2050, and new end-of-life strategies that may become commercially available.

31.2.5.3.1.1 Effect Significance

137. Decommissioning would result in a single occurrence of GHG emissions and is an inherent process in the lifecycle of offshore wind developments. However, as the UK economy is likely to decarbonise over the Project's O&M phase, actual GHG emissions at the time of decommissioning are unlikely to adversely affect the UK's ability to maintain its net zero status in the long-term.

138. Similar to the construction phase, whole lifecycle carbon management measures (see **Table 31-4**, Commitment ID CO98) are also applicable to decommissioning activities, which will allow opportunities for further reductions in decommissioning GHG emissions to be considered and implemented where they can be feasibly achieved.

139. Therefore, decommissioning GHG emissions from the Project are considered to have a **negligible** effect and is **not significant** in EIA terms.

31.2.5.4 Potential Effects during the Whole Lifecycle

31.2.5.4.1 Whole Lifecycle Greenhouse Gas Emissions (GHG-WL-01)

140. The Project's whole lifecycle GHG emissions are presented in **Table 31-18**. The total GHG emissions resulting from the Project's construction, O&M and decommissioning are estimated to be approximately 5.6 million tonnes CO_2e. Construction emissions contributed to the largest proportion of the Project's whole lifecycle emissions, accounting for around 67.5%.

Table 31-18 Whole Lifecycle Greenhouse Gas Emissions from the Project

Lifecycle Module	Project Phase	GHG Emissions (tonnes CO_2e)	Percentage of Whole Lifecycle GHG Emissions
A1 – Extraction and processing of raw materials A2 – Transport to manufacturing site A3 – Manufacturing of products A4 – Transport to construction site A5 – Construction	Construction	3,745,398	67.5%

Lifecycle Module	Project Phase	GHG Emissions (tonnes CO_2e)	Percentage of Whole Lifecycle GHG Emissions
B1 – Use B2 – Maintenance B3 – Repair B4 – Replacement	O&M	1,737,227	31.3%
C1 – Deconstruction and demolition C2 – Transport to end-of-life destinations C3 – Waste processing C4 – Disposal	Decommissioning	66,591	1.2%
Total		**5,549,216**	

141. **Table 31-19** presents a range of avoided emissions as a result of the Project's supply of renewable energy to the UK electricity transmission network, accounting for its whole lifecycle emissions. These figures are derived based on the two 'Do Nothing' scenarios (as previously discussed in **Section 31.2.5.2.2**), and the true value of avoided emissions enabled by the Project is likely to lie within the range provided. **Table 31-19** indicates that the Project's whole lifecycle emissions are far exceeded by its avoided emissions, and any GHG emissions released by the Project would be fully offset within its operational lifetime.

Table 31-19 Avoided Emissions from Energy Generated by the Wind Farm (Less Whole Lifecycle Emissions)

'Do Nothing' Scenario	Whole Lifecycle Emissions (tonnes CO_2e)	Lifetime GHG Emissions Produced under the 'Do Nothing' Scenario (tonnes CO_2e)	Avoided Emissions (tonnes CO_2e)
Scenario 1: Natural Gas	5,549,216	107,994,649	102,445,433
Scenario 2: Long Run Marginal Electricity at Operational Start Year		10,943,458	5,394,242

142. As discussed in **Section 31.2.4.2**, the emission factors used to calculate emissions for the 'Do Nothing' scenarios only account for the generation of electricity to the point of use and do not account for other emission sources across the whole lifecycle of alternative forms of generation (e.g. upstream emissions to construct the generation plant), which have been accounted for when estimating lifecycle emissions for the Project. Therefore, the comparison presented in **Table 31-19** is considered to be conservative.

31.2.5.4.2 Lifecycle Greenhouse Gas Intensity

143. Based on the Project's anticipated lifetime electricity output and whole lifecycle GHG emissions, the lifecycle GHG intensity per unit of electricity generated by the wind farm is estimated to be 19gCO_2e/kWh. When compared to the lifecycle GHG intensities of other forms of fossil fuel-based electricity generation (CCC, 2013), the Project's lifecycle GHG intensity compares favourably, as shown below:

- Unabated CCGT: 380 to 500g CO_2e/kWh;
- Abated CCGT with carbon capture and storage: 90 to 245g CO_2e/kWh; and
- Abated Coal with carbon capture and storage: 80 to 310g CO_2e/kWh.

144. Considering trends in efficiency improvements and emerging carbon capture and storage technologies, the lifecycle GHG intensity of abated CCGT is predicted to range from 22 to 110g CO_2e/kWh assuming between 80% and 100% carbon capture rate (IEA, 2020; Bui *et al.*, 2023; Cownden and Lucquiaud, 2025). It should be noted that these intensity figures are forward-looking and account for significant improvements in the performance of abated CCGT. Nevertheless, the Project's lifecycle GHG intensity would still outperform electricity supplied by future abated CCGT.

31.2.5.4.2.1 Overall Effect Significance

145. As discussed in **Section 31.3.1.2**, implementation of offshore wind developments such as the Project aligns with the UK's climate and energy policies, which emphasises the importance of rapid offshore wind deployment to enable sustained decarbonisation in the UK power sector and other economic sectors to meet the long-term net zero target.

146. This is evident in the UK Clean Power 2030 Action Plan, which targets the delivery of a fully decarbonised power system by 2030 and aims to reduce the operational GHG intensity of electricity generation from 171gCO_2e/kWh in 2023 to well below 50gCO_2e/kWh in 2030. Achieving this reduction by 2030 and maintaining it thereafter would be a key enabler to replacing the use of fossil fuels in other economic sectors with low-carbon electricity, especially difficult-to-decarbonise sectors such as transport, heating and industry, and therefore locking in further GHG emission reductions (UK Government, 2024).

147. The CCC's advice to the UK Government in support of the 7th Carbon Budget acknowledges an existing gap in the current offshore wind deployment rate to achieve national energy and climate targets (CCC, 2025). The rate of deployment of new offshore wind developments would need to increase from the current average rate of 1 to 2 GW to 5.7GW per year out to 2030, before maintaining an average of 4GW per year out to 2050 in addition to repowering existing developments that are reaching the end of their operational lifetime. The report also acknowledges the importance of increasing energy storage capacity in the UK, along with the increasing share of renewable energy, to 35GW of short-duration (i.e. up to nine hours) storage and 7GW medium-duration (i.e. days to weeks) storage by 2050.

148. The role of offshore wind energy in delivering the UK's climate and energy policies are also supported by future energy scenario modelling undertaken by National System Energy Operator (NESO). NESO's advice to the UK Government in support of the Clean Power 2030 Action Plan notes that to achieve a clean power system by 2030, up to 82% of electricity generation would need to be supplied by renewable energy, with an additional 28 to 35GW of new offshore wind capacity required (NESO, 2024). Moreover, in NESO's Future Energy Scenarios modelling (2024), offshore wind energy accounts for the majority share of the new renewable energy capacity required to achieve and maintain the UK's decarbonisation trajectory towards net zero by 2050 across all modelled scenarios, ranging from 81GW installed capacity by 2050 under a conservative scenario to 100GW installed capacity by 2046 under an optimistic scenario.

149. The Clean Power 2030 Action Plan includes a Clean Power Capacity Range for operational offshore wind energy of 43 to 50GW by 2030 and 72 to 89GW by 2035. As of May 2024, the current figure for the total operational offshore wind capacity in the UK is approximately 15GW (CCC, 2025), with an additional 93GW capacity in the pipeline (The Crown Estate, 2024). The Project would supply approximately 1.58GW of additional offshore wind capacity, which would be equivalent to at least 3% of the 2030 Clean Power Capacity Range, approximately 2% of the 2035 Capacity Range and around 1.7% of the UK's current offshore wind pipeline. Furthermore, the Action Plan also includes a Capacity Range of 23 to 27GW of battery storage by 2030, primarily from grid-scale batteries, to deliver flexible capacity and ensure security of supply as part of a clean power system, which the ESBI element of the Project would also contribute to.

150. Given that the Project will supply the UK electricity transmission network with renewable energy and provide other potential carbon benefits (i.e. energy balancing and storage services) enabled by the ESBI over its operational lifetime, the overall effect significance of the Project is considered to be **beneficial**, which is **significant** in EIA terms. The Project will ultimately contribute positively to the UK's emission reduction targets and its ability to achieve and maintain its net zero status in the long-term.

31.2.5.5 Additional Mitigation Measures

151. No additional mitigation measures have been proposed with respect to GHG emissions.

31.2.6 Cumulative Effects

152. As noted in **Section 31.2.3.4**, the GHG assessment is considered to be inherently cumulative, and no additional consideration of cumulative effects with other plans and projects is required with respect to GHG emissions.

31.2.7 Transboundary Effects

153. As discussed in **Section 31.2.3.5**, the effects considered in the GHG assessment is considered to be global by nature, and no additional consideration of transboundary effects is required with respect to GHG emissions.

31.2.8 Inter-Relationships and Effects Interactions

31.2.8.1 Inter-Relationships

154. The receptor for the GHG assessment is the global atmosphere. There are no other EIA topics which have direct effects on this receptor, and therefore there are no inter-relationships to consider with respect to GHG emissions.

31.2.8.2 Interactions

155. The GHG assessment, as presented in **Section 31.2.5.4**, inherently considers the interactions of GHG emissions from various sources over the Project's whole lifecycle, and the interactions between the emissions released and avoided by the Project. Therefore, no additional consideration of interactions is required with respect to GHG emissions.

31.2.9 Monitoring Measures

156. No monitoring measures have been proposed with respect to the GHG assessment.

31.2.10 Summary

157. **Table 31-20** presents a summary of the preliminary results of the assessment of likely significant effects with respect to GHG emissions during the construction, O&M and decommissioning of the Project.

Table 31-20 Summary of Potential Effects Assessed for Greenhouse Gas Emissions

Impact ID	Impact and Project Activity	Embedded Mitigation Measures	Receptor	Receptor Sensitivity	Impact Magnitude	Effect Significance	Additional Mitigation Measures	Residual Effect	Monitoring Measures
Construction									
GHG-C-01	Construction GHG emissions – construction activities	CO98	Global atmosphere	**High**	N/A*	**Minor Adverse (Not Significant)**	N/A	**Minor Adverse (Not Significant)**	N/A
Operation and Maintenance									
GHG-O-01	O&M GHG emissions – O&M activities	CO98 CO99	Global atmosphere	**High**	N/A*	**Negligible (Not Significant)**	N/A	**Negligible (Not Significant)**	N/A
GHG-O-02	Avoided emissions – supply of renewable energy generated by the wind farm to the UK electricity transmission network and other potential carbon benefits enabled by the ESBI	N/A	Global atmosphere	**High**	N/A*	**Beneficial (Significant)**	N/A	**Beneficial (Significant)**	N/A
Decommissioning									
GHG-D-01	Decommissioning GHG emissions – decommissioning activities not yet defined	CO98	Global atmosphere	**High**	N/A*	**Negligible (Not Significant)**	N/A	**Negligible (Not Significant)**	N/A
Whole Lifecycle**									
GHG-WL-01	Whole lifecycle GHG emissions	N/A	Global atmosphere	**High**	N/A*	**Beneficial (Significant)**	N/A	**Beneficial (Significant)**	N/A

* Impact magnitude is not specified as part of the topic-specific assessment methodology to GHG assessment.

** This impact considers the net effect of the GHG emissions released across all project phases and avoided as a result of the Project's operations and is comprised of the other impacts considered in the GHG assessment.

31.2.11 Next Steps

158. It is not anticipated that significant updates to the GHG assessment will be required at ES stage. However, additional or more refined project information (i.e. refinements to the Project Design Envelope) may become available, which will enable refinements to the GHG emission calculations to be undertaken, where required, at ES stage. Any refinement to the GHG assessment between PEIR and ES is unlikely to change the effect significance concluded in this assessment.

159. Temporary and ongoing LULUC emissions during the Project's construction and O&M phases have been excluded from the GHG assessment presented in this chapter and will be considered in the ES following site selection refinements to the Onshore Development Area and once further details on the Project's proposed landscaping and ecological mitigation / enhancement measures are known. This will be informed by baseline characterisation of land use types within the Onshore Development Area based on ecological surveys undertaken.

160. Should further sourcing and logistics information become available, marine vessel emissions associated with the mobilisation of vessels to port(s) from their point of origin and the import of materials from their manufacturing point of origin will be estimated in the ES.

161. As discussed in **Chapter 18 Other Marine Users**, losses in annual energy production at proximal offshore wind farm(s) may occur due to wake effects arising from the presence of the Project's wind turbines. Wake effect losses would result in changes in avoided emissions of these affected offshore wind farm(s), which would be considered as an indirect GHG emission source for the Project during the O&M phase. At the time of this PEIR publication, a final government position / guidance on wake effects was imminently expected, therefore pending the confirmation of a settled position on the approach, it is not considered practicable to complete a meaningful assessment at this preliminary stage. Instead, the Project will look to complete a detailed assessment of the likely significant effects of wake effects on other offshore wind farm(s), including any change in their avoided emissions, at ES stage, based on, and subject to, the settled government position / guidance.

162. An Outline CMP will be produced at ES stage and submitted with the DCO application and will expand on the indicative whole lifecycle carbon management measures provided in **Table 31-5**.

31.3 Climate Change Resilience Assessment

31.3.1 Policy and Legislation

31.3.1.1 National Policy Statements

163. Planning policy on energy NSIP is set out in the NPS. The following NPS are relevant to the CCR assessment:

- Overarching NPS for Energy (EN-1) (DESNZ, 2023a);
- NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023c); and
- NPS for Electricity Networks Infrastructure (EN-5) (DESNZ, 2023b).

164. The CCR assessment has been prepared with reference to specific requirements in the above NPS. The relevant parts of the NPS are summarised in **Table 31-21**, along with how and where they have been considered in this PEIR chapter.

165. In addition, relevant NPS requirements with respect to coastal erosion and flood risk are discussed in **Chapter 8 Marine Physical Processes** and **Chapter 21 Water Resources and Flood Risk** respectively.

Table 31-21 Summary of Relevant National Policy Statement Requirements for Climate Change

NPS Reference and Requirement	How and Where Considered in the PEIR
Overarching NPS for Energy (EN-1)	
Paragraph 4.10.8: “New energy infrastructure will typically need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the direct (e.g. site flooding, limited water availability, storms, heatwave and wildfire threats to infrastructure and operations) and indirect (e.g. access roads or other critical dependencies impacted by flooding, storms, heatwaves or wildfires) impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure.” Paragraph 4.10.9: “The ES should set out how the proposal will take account of the projected impacts of climate change, using government guidance and industry standard benchmarks such as the Climate Change Allowances for Flood Risk Assessments, Climate Impacts Tool, and British Standards for climate change adaptation, in accordance with the EIA Regulations.” Paragraph 4.10.10: “Applicants should assess the impacts on and from their proposed energy project across a range of climate change scenarios, in line with appropriate expert advice and guidance available at the time.” Paragraph 4.10.11: “Applicants should demonstrate that proposals have a high level of climate resilience built-in from the outset and should also demonstrate how proposals can be adapted over their predicted lifetimes to remain resilient to a credible maximum climate change scenario. These results should be considered alongside relevant research which is based on the climate change projections.” Paragraph 4.10.12: “Where energy infrastructure has safety critical elements, the applicant should apply a credible maximum climate change scenario. It is appropriate to take a risk-averse approach with elements of infrastructure which are critical to the safety of its operation.” Paragraph 4.10.13: “The Secretary of State 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 and associated research and expert guidance (such as the EA’s Climate Change Allowances for Flood Risk Assessments [or the Welsh Government’s Climate change allowances and flood consequence assessments)] 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, including any decommissioning period.”	The impacts of climate change on the Project are considered in the CCR assessment, which is provided in **Section 31.3.5** and **Volume 2, Appendix 31.3 Climate Vulnerability Assessment**. The CCR assessment is informed by the predicted future baseline based on climate change projection data as summarised in **Section 31.1.1.1**. Embedded mitigation measures to incorporate climate change resilience into the design are considered as part of the CCR assessment and summarised in **Section 0**. Monitoring measures to ensure the Project can adapt and remain resilient over its O&M phase are also considered as part of the CCR assessment and summarised in **Section 31.3.9.**

<table>
<tr><th>NPS Reference and Requirement</th><th>How and Where Considered in the PEIR</th></tr>
<tr><td colspan="2">NPS for Renewable Energy Infrastructure (EN-3)</td></tr>
<tr><td>Paragraph 2.4.2:
“Section 4.10 of EN-1 sets out generic considerations that applicants and the Secretary of State should take into account to help ensure that renewable energy infrastructure is safe and resilient to climate change, and that necessary action can be taken to ensure the operation of the infrastructure over its estimated lifetime.”
Paragraph 2.4.3:
“Section 4.10 of EN-1 advises that the resilience of the Project to climate change should be assessed in the Environmental Statement (ES) accompanying an application.”
Paragraph 2.4.8:
“Whilst offshore wind farms will not be affected by flooding, applicants should demonstrate that any necessary land-side infrastructure (such as cabling and onshore substations) will be appropriately resilient to climate-change induced weather phenomena. Similarly, applicants should particularly set out how the proposal would be resilient to storms.”</td><td>As detailed above, the impacts of climate change on the Project are considered in the CCR assessment, which is provided in Section 31.3.5 and Volume 2, Appendix 31.3 Climate Vulnerability Assessment.</td></tr>
<tr><td colspan="2">NPS for Electricity Networks Infrastructure (EN-5)</td></tr>
<tr><td>Paragraph 2.3.1:
“Section 4.10 of EN-1 sets out the generic considerations that applicants and the Secretary of State should take into account in order to ensure that electricity networks infrastructure is resilient to the effects of climate change.”
Paragraph 2.3.2:
“As climate change is likely to increase risks to the resilience of some of this infrastructure, from flooding for example, or in situations where it is located near the coast or an estuary or is underground, applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to:
• flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change;
• the effects of wind and storms on overhead lines;
• higher average temperatures leading to increased transmission losses;
• earth movement or subsidence caused by flooding or drought (for underground cables); and
• coastal erosion – for the landfall of offshore transmission cables and their associated substations in the inshore and coastal locations respectively.”
Paragraph 2.3.3:
“Section 4.10 of EN-1 advises that the resilience of the project to the effects of climate change must be assessed in the Environmental Statement (ES) accompanying an application. For example, future increased risk of flooding would be covered in any flood risk assessment (see Sections 5.8 in EN-1). Consideration should also be given to coastal change (see sections 5.6 in EN1).”</td><td>As detailed above, the impacts of climate change on the Project are considered in the CCR assessment, which is provided in Section 31.3.5 and Volume 2, Appendix 31.3 Climate Vulnerability Assessment.</td></tr>
</table>

31.3.1.2 Other Policy and Legislation

166. Other policy and legislation relevant to the CCR assessment is summarised in the following sections.

31.3.1.2.1 International Agreements

31.3.1.2.2 United Nations Framework Convention on Climate Change

167. The UNFCCC, as referenced in **Section 31.2.1.2.1.1** also addresses climate resilience, aiming to enhance the ability of countries to anticipate, absorb, and recover from climate-related shocks and stresses. The UNFCCC's decision-making body, the COP meets annually to discuss and assess progress in building climate resilience.

168. The Paris Agreement, adopted at COP21 in 2015, established a global goal on climate adaptation to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. This goal is integral to sustainable development and aims to ensure an adequate adaptation response in the context of the temperature goals set by the Paris Agreement.

169. The United Arab Emirates Framework for Global Climate Resilience, adopted at COP28 in 2023, includes a range of thematic and dimensional targets for climate adaptation and resilience across all nations. This framework emphasises the importance of integrating climate resilience into national development plans and encourages countries to implement context-specific climate risk management actions.

170. Building climate resilience involves a combination of mitigation and adaptation actions across various sectors, including agriculture, water, cities, coastal zones, and infrastructure. Key steps include conducting climate risk assessments, developing and implementing climate risk management actions, mobilising financial resources, and sharing knowledge and best practices.

31.3.1.2.3 National

31.3.1.2.4 Infrastructure Planning (EIA) Regulations 2017

171. The requirement to consider climate change was introduced by an amendment to the EIA Directive (2014/52/EU), which was subsequently transposed into the UK's Infrastructure Planning (EIA) Regulations in 2017. This includes the requirement to assess the vulnerability and resilience of a project to climate change impacts.

31.3.1.2.5 Climate Change Act 2008

172. 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). The Climate Change Act 2008 also requires the devolved governments to produce a National Adaptation Programme (NAP) every five years to accompany the Climate Change Risk Assessment.

173. The UK Government produced its latest Climate Change Risk Assessment in 2022 (Department for Environment, Food and 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.

174. The third NAP was published by Defra in 2023, which sets the actions that will be undertaken in England and for a number of reserved sectors across the UK to adapt to the challenges of climate change as identified in the 2022 Climate Change Risk Assessment. The third NAP details the range of climate risks and opportunities which may affect infrastructure, the natural environment, health, communities and the built environment, business and industry and international affairs and covers key actions from 2023 to 2028.

31.3.1.2.6 Marine Policy Statement

175. The UK Marine Policy Statement (MPS) (HM Government, 2011) establishes the national framework for preparing regional Marine Plans and for decision-making on activities and developments that affect the marine environment. Paragraph 2.6.7.8 of the MPS states that:

"Marine plan authorities should take account of the findings of the latest UK Climate Change Risk Assessment, relevant national adaptation programmes and the latest set of UK Climate Projections, as well as any other relevant research. Marine plan authorities should also consider the opportunities to increase the resilience of the marine environment to adapt to the impacts of climate change including by:

...

- *Encouraging development / projects to take account of the impacts of climate change over their estimated lifetime, in particular taking account of risks such as increased land and sea temperatures and sea level rise and possible increase in risk from extreme events such as flooding and coastal erosion."*

31.3.1.2.7 National Planning Policy Framework

176. While the NPS are the predominant planning policy for NSIP such as the Project, the NPPF provides further context to England's planning policy approach and can be generally considered alongside the NPS. The revised NPPF (MHCLG, 2024) advises that the planning system should minimise vulnerability and improve resilience to the changing climate. The NPPF states in Paragraph 164 that:

"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 incorporating green infrastructure and sustainable drainage systems."

31.3.1.2.8 Local

31.3.1.2.8.1 East Riding of Yorkshire Council

177. As discussed in **Section 31.2.1.2.3.1,** the policy documents for ERYC that are relevant to climate change are the Climate Change Strategy 2022-2030 (ERYC, 2022) and Climate Change Action Plan 2024-2030 (ERYC, 2024). The adaptation approach in responding to climate change involves becoming better prepared for, and more resilient to the impacts of, a changing climate. Of relevance are Climate Change Strategy Objectives *'CR2 Deliver flood and coastal schemes to manage the risks and reduce the impacts of climate change'* and *'CR3 Embed climate risk management within the authority'*.

31.3.2 Basis of the Assessment

178. The following sections establish the basis of the assessment of likely significant effects for the CCR assessment, which is defined by the Study Area, assessment scope, realistic worst-case scenarios and development scenarios.

179. This section should be read in conjunction with **Volume 2, Appendix 1.2 Guide to PEIR**, **Volume 2, Appendix 6.2 Impacts Register** and **Volume 2, Appendix 6.3 Commitments Register**.

31.3.2.1 Study Area

180. The CCR assessment evaluates the vulnerability and resilience of the Project to the projected effects of climate change. Therefore, the Study Area for the CCR assessment geographically encompasses both the Offshore and Onshore Development Areas (see **Figure 4-1** and **Figure 4-2**). The key infrastructure components (see **Chapter 4 Project Description** for further details) considered in the assessment include:

- Offshore components:
  - Wind turbines;
  - Offshore platform(s);
  - Inter-array cables and offshore export cables; and
  - Cable and scour protection.
- Onshore components:
  - Transition joint bay (TJB) and associated link box at landfall;
  - Onshore export cables, jointing bays and associated link boxes;
  - OCS; and
  - ESBI.

181. The temporal scope of the CCR assessment covers the construction, O&M and decommissioning phases of the Project and is used to define the climate conditions that are likely to be experienced during the relevant project phases:

- The construction phase is anticipated to start at the earliest in 2029 and finish in 2033, with a total construction duration of approximately five years;
- The O&M phase is anticipated to start in 2033 and finish in 2068, with an anticipated duration of approximately 35 years; and
- The decommissioning phase is assumed to start at the end of the O&M phase, and its duration will depend on the Project's final decommissioning strategy. For purpose of the CCR assessment, this is assumed to be similar in timescales as the construction phase.

31.3.2.2 Scope of the Assessment

182. No impacts have been scoped out of the CCR assessment. All impacts have been scoped into the assessment, as outlined in **Table 31-22** and discussed further in **Section 31.3.5**.

183. A full list of impacts scoped in / out of the CCR assessment is summarised in **Volume 2, Appendix 6.2 Impacts Register**. A description of how the Impacts Register should be used alongside the PEIR chapter is provided in **Volume 2, Appendix 1.2 Guide to PEIR** and **Chapter 6 Environmental Impact Assessment Methodology**.

184. As the CCR assessment considers the effects of climate change on the Project, the scope of the assessment differs from other EIA topics, which considers the effects of the Project on the receiving environment. Therefore, the Project's activities outlined in **Table 31-22** are receptors identified to have the potential to be affected by climate change during the construction, O&M and decommissioning phases (see **Section 31.1.1.1** for further details).

185. The impacts presented in the CCR assessment have been summarised for each phase of the Project, and the location of the identified receptors. They are further divided into specific climate change impacts in the assessment, based on the type of climate hazard and the nature of the resulting impact on the identified receptors, as outlined in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** and **Section 31.2.4.2.5**.

Table 31-22 Climate Change Resilience Assessment – Impacts Scoped into the Assessment

Impact ID	Impact and Project Activity	Rationale
Construction		
CCR-C-04	Climate change impacts from marine climate hazards during construction – offshore human, infrastructure and environmental receptors	The Project's offshore construction activities have the potential to be vulnerable to marine climate hazards such as storms, sea-level rise, and extreme weather events. Assessing resilience ensures that the Project's offshore construction can withstand these conditions, minimising delays, costs, and safety risks.
CCR-C-05	Climate change impacts from land-based climate hazards during construction – onshore human, infrastructure and environmental receptors	The Project's onshore construction activities have the potential to be vulnerable to land-based climate hazards such as flooding, heatwaves, and extreme weather events. Assessing resilience ensures that the Project's onshore construction can withstand these conditions, minimising delays, costs, and safety risks.
Operation and Maintenance		
CCR-O-04	Climate change impacts from marine climate hazards during operation – offshore human, infrastructure and environmental receptors	During operation, the Project's offshore infrastructure and O&M activities have the potential for continuous exposure to marine climate hazards. Evaluating resilience informs the development of robust maintenance plans and emergency response plans and ensures the longevity and reliability of offshore infrastructure and the safety of O&M personnel.
CCR-O-05	Climate change impacts from land-based climate hazards during operation – onshore human, infrastructure and environmental receptors	During operation, the Project's offshore infrastructure and O&M activities have the potential for continuous exposure to land-based climate hazards. Evaluating resilience informs the development of robust maintenance plans and emergency response plans and ensures the longevity and reliability of offshore infrastructure and the safety of O&M personnel.
Decommissioning		
CCR-D-04	Climate change impacts from marine climate hazards during decommissioning – offshore human, infrastructure and environmental receptors	Details of offshore and onshore decommissioning activities are not known at this stage. Climate change impacts during decommissioning will be assessed in detail through the Offshore Decommissioning Programme and Onshore Decommissioning Plan (see **Table 31-23**, Commitment ID CO95) where relevant. The Project's offshore and onshore decommissioning activities have the potential to be vulnerable to marine and land-based climate hazards respectively. In the CCR assessment, it is assumed that decommissioning activities would be the reverse of their construction counterparts, and that the type of climate hazards posed to receptors would be similar to those identified during the construction phase. Assessing resilience ensures that offshore and onshore decommissioning plans are adaptable to changing conditions, reducing risks and ensuring safe conditions.
CCR-D-05	Climate change impacts from land-based climate hazards during decommissioning – onshore human, infrastructure and environmental receptors	

31.3.2.3 Embedded Mitigation Measures

186. The Project has made several commitments to avoid, reduce or offset potential adverse environmental effects through mitigation measures embedded into the evolution of the Project Design Envelope. These measures include actions that will be undertaken to meet other existing legislative requirements and those considered to be standard or best practice to manage commonly occurring environmental effects.

187. The assessment of likely significant effects has therefore been undertaken on the assumption that these measures are adopted during the construction, O&M and decommissioning phases. **Table 31-23** identifies proposed embedded mitigation measures that are relevant to the CCR assessment.

188. Full details of all commitments made by the Project are provided within **Volume 2, Appendix 6.3 Commitments Register**. A description of how the Commitments Register should be used alongside the PEIR chapter is provided in **Volume 2, Appendix 1.2 Guide to PEIR** and **Chapter 6 Environmental Impact Assessment Methodology**. In addition, a list of draft outline management plans which are submitted with the PEIR for consultation is provided in **Section 1.10** of **Chapter 1 Introduction**. These documents will be further refined and submitted along with the DCO application. See **Volume 2, Appendix 1.2 Guide to PEIR** for a list of all PEIR documents.

Table 31-23 Embedded Mitigation Measures Relevant to Climate Change Resilience Assessment

Commitment ID	Proposed Embedded Mitigation	How the Embedded Mitigation Will be Secured	Relevance to Climate Change Resilience Assessment	Relevance to Impact ID
CO7	The Project will ensure compliance with Marine Guidance Note (MGN) 654 and its annexes, where applicable, including implementation of an Emergency Response Cooperation Plan (ERCoP) for all phases of the Project and completion of a Search and Rescue (SAR) checklist.	DML Condition - Emergency Response and Cooperation Plan	Ensures the implementation of response protocols in the event of emergencies for offshore activities.	CCR-C-04 CCR-O-04 CCR-D-04
CO43	A Construction Surface Water Drainage Plan will be provided as part of the Code of Construction Practice (CoCP) and will be developed in accordance with the Outline CoCP. The Construction Surface Water Drainage Plan will detail measures to minimise water within the temporary works area, to ensure the required ongoing drainage of surrounding land (including appropriate climate change allowances) and that the existing land drainage system is not adversely compromised by construction works. Site-specific construction drainage measures and post-construction drainage reinstatement and maintenance requirements will be detailed in the Construction Surface Water Drainage Plan based on land drainage survey undertaken by a suitably qualified expert prior to construction and in consultation with landowners.	DCO Requirement - Code of Construction Practice	Mitigates the risk of flooding at the construction site by ensuring land drainage is maintained and accounting for appropriate climate change allowances. Flood risk can be exacerbated by extreme weather events such as heavy rainfall and storms, which are becoming more frequent and intense due to climate change and can lead to overwhelming of the land drainage capacity.	CC-C-05
CO44	An Operational Drainage Strategy will be provided for permanent infrastructure in the Onshore Converter Station (OCS) zone in accordance with the Outline Operational Drainage Strategy. The Operational Drainage Strategy will include measures to ensure that existing land drainage is reinstated and / or maintained, discharge rates are limited and flows are attenuated to maintain greenfield run-off rates.	DCO Requirement - Operational Drainage Strategy	Mitigates the risk of flooding at areas of permanent infrastructure over the O&M phase by ensuring land drainage is maintained and accounting for appropriate climate change allowances. Flood risk can be exacerbated by extreme weather events such as heavy rainfall and storms, which are becoming more frequent and intense due to climate change and can lead to overwhelming of the land drainage capacity.	CC-O-05
CO45	Where reasonably practicable, topsoil and subsoil stockpiling within a floodplain (defined as areas of Flood Zones 2 or 3, as identified in the Environment Agency's Flood Map for Planning) of any main river will be avoided. Where soil storage in Flood Zones 2 and 3 is unavoidable, storage areas will be located such that they minimise impact to existing surface water flow paths.	DCO Requirement - Code of Construction Practice	Mitigates the risk of flooding at the construction site by ensuring land drainage is maintained and accounting for appropriate climate change allowances. Flood risk can be exacerbated by extreme weather events such as heavy rainfall and storms, which are becoming more frequent and intense due to climate change and can lead to overwhelming of the land drainage capacity.	CC-C-05

Commitment ID	Proposed Embedded Mitigation	How the Embedded Mitigation Will be Secured	Relevance to Climate Change Resilience Assessment	Relevance to Impact ID
CO59	Where possible, hedgerows and trees will be retained through micro-siting and the use of trenchless installation techniques. Where hedgerows and / or trees require removal, this will be undertaken prior to topsoil removal, and removal of hedgerow sections will be kept to a minimum as required for the construction works. Protection of veteran or ancient trees and ancient woodlands will be prioritised to avoid the losses of irreplaceable habitats through micro-siting and use of trenchless installation techniques where reasonably practicable. Trees identified to be retained will be fenced off, and root protection zones established according to the latest relevant best practice. Where trees require removal, they will be replanted or replaced if replanting is not practicable. Replanting / planting of replacement trees will be undertaken in a suitable location within the Onshore Development Area but not directly over the onshore export cables. Replacement planting of sections of hedgerows and trees removed for construction works will be undertaken during reinstatement post-construction using more diverse and locally appropriate native species. The specification of mitigation / replacement planting will ensure reinstated habitats can be effectively established.	DCO Requirement - Landscape Management Plan DCO Requirement - Ecological Management Plan	Ensures that reinstated or created habitats are effectively established and remain resilient in the long-term. Climate change will result in impacts such as increasing temperatures and drought conditions that may affect the growing season of vegetation and their ability to tolerate environmental conditions.	CCR-O-05
CO79	A Battery Safety Management Plan (BSMP) will be developed in accordance with the Outline BSMP. The BSMP will provide a health and safety risk assessment of the Energy Storage and Balancing Infrastructure (ESBI) and detail appropriate prevention, monitoring and contingency measures for any identified hazards, including fire and chemical leak containment, to ensure compliance with latest relevant regulations and standards. The BSMP will also include measures for provision of information to the local community on ESBI risks and how these risks are appropriately mitigated and managed.	DCO Requirement - Battery Safety Management Plan	Mitigates the risk of thermal runway at the ESBI during the O&M phase through safety in design and provision of fire fire prevention and containment measures. Fire risks can be exacerbated by increasing temperatures and extreme weather events such as heatwaves, which are becoming more frequency and intense due to climate change.	CC-O-05
CO93	Climate change resilience measures to ensure occupational health and safety standards are maintained under future climate conditions during construction will be included in the Project Environmental Management Plan (PEMP) for offshore construction works and the Code of Construction Practice (CoCP) for onshore construction works. The PEMP and CoCP will be developed in accordance with the Outline PEMP and Outline CoCP respectively. Risk assessments, health and safety protocols and guidelines on safety working practices for the works will take into consideration site-specific weather and metocean conditions and potential for relevant extreme weather events at the time of construction to ensure appropriate preparation and response measures are in place.	DCO Requirement - Code of Construction Practice DML Condition - Project Environmental Management Plan	Mitigates the risk of climate change impacts on construction site personnel, plant and equipment and other assets and the risk of delays to the construction programme due to extreme weather events, which are becoming more frequent and intense due to climate change. Ensures the implementation of response protocols in the event of emergencies for offshore and onshore activities. Specific measures are detailed further in **Table 31-24**.	CCR-C-04 CCR-C-05
CO94	An appropriate Project Emergency Response Plan or similar will be provided as part of the Project Environmental Management Plan (PEMP) and Emergency Response and Contingency Plan (ERCoP) for offshore construction works and the Code of Construction Practice (CoCP) for onshore construction works. The PEMP and CoCP will be developed in accordance with the Outline PEMP and Outline CoCP respectively. The Project Emergency Response Plan will detail protocols that would be undertaken in the event of an emergency, including occupational health and safety and environmental incidents, and set out clear roles and responsibilities, emergency contacts and reporting and escalation pathways. Protocols for extreme weather events will also be included.	DCO Requirement - Code of Construction Practice DML Condition - Project Environmental Management Plan		CCR-C-04 CCR-C-05

Commitment ID	Proposed Embedded Mitigation	How the Embedded Mitigation Will be Secured	Relevance to Climate Change Resilience Assessment	Relevance to Impact ID
CO95	During operation and maintenance (O&M) and decommissioning works, a review of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to ensure risk assessments, health and safety protocols and guidelines on safe working practices for the works are suitable for future climate conditions.	DML Condition – Offshore Operations and Maintenance Plan DCO Requirement– Onshore Operations and Maintenance Plan DCO Requirement – Offshore Decommissioning Programme DCO Requirement – Onshore Decommissioning Plan	Mitigates the risk of climate change impacts on O&M and decommissioning site personnel, plant and equipment and other assets and the risk of delays to the O&M and decommissioning programme due to extreme weather events, which are becoming more frequent and intense due to climate change. Specific measures are detailed further in **Table 31-24**.	CCR-O-04 CCR-O-05 CCR-D-04 CCR-D-05
CO96	The detailed design will ensure that the Project remain resilient to current and future climate conditions during the Project's operational lifetime. The design will be informed by relevant climate change projection data and include sufficient safety margins to withstand foreseeable extreme weather events.	DCO Requirement - Detailed Design (Onshore) DML Condition (Offshore)	Ensures that climate change resilience is built into the design from the outset to mitigate the risk of climate change impacts on the conditions and performance of the Project's infrastructure during the operational lifetime. Specific design measures are detailed further in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** and **Section 31.3.5**.	CCR-C-04 CCR-C-05 CCR-O-04 CCR-O-05
CO97	Regular and periodic inspections and maintenance of all infrastructure will be undertaken over the operational lifetime of the Project to identify and remediate any damage and deterioration and where necessary to maintain good working condition. Monitoring of site-specific weather metocean conditions, recent extreme weather events and up-to-date climate change projection data will be undertaken to provide a dynamic risk assessment of climate change impacts and inform operation and maintenance (O&M) planning.	DML Condition – Offshore Operations and Maintenance Plan DCO Requirement– Onshore Operations and Maintenance Plan	Mitigates the risks of climate change impacts on the conditions and performance of the Project's infrastructure and ensures that the Project can adapt to future climate conditions and remain resilient over its operational lifetime. The Project's O&M strategy will be adaptive, with the frequency of maintenance, repair and replacement activities being adjusted based on need (i.e. increasing planned O&M visits for components with higher deterioration rates than anticipated). Specific measures are detailed further in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** and **Section 31.3.5**.	CCR-O-04 CCR-O-05
CO108	A site-specific Flood Warning and Evacuation Plan will be included in the Project Emergency Response Plan provided as part of the Code of Construction Practice (CoCP). The Flood Warning and Evacuation Plan will be developed in accordance with the Outline CoCP and will include a series of actions to be adopted should adverse weather or flooding be forecast.	DCO Requirement - Code of Construction Practice	Mitigates the risk of impacts on construction site personnel, plant and equipment and other assets and the risk of delays to the construction programme due to flood events, which are becoming more frequent and intense due to climate change. Ensures the implementation of response protocols in the event of flood emergencies.	CCR-C-05

189. The Commitments Register is provided at PEIR stage to provide stakeholders with an early opportunity to review and comment on the proposed commitments. Proposed commitments may evolve during the pre-application phase as the EIA progresses and in response to refinements to the Project Design Envelope and stakeholder feedback. The final commitments will be confirmed in the Commitments Register submitted along with the DCO application.

190. Draft versions of the **Outline Code of Construction Practice** (document reference 8.9) and **Outline Project Environmental Management Plan** (document reference 8.6) are provided with the PEIR for consultation, which detail climate change resilience measures to be implemented during the construction phase (see **Table 31-23**, Commitment IDs CO93 and CO94) and are considered in the CCR assessment. The Outline CoCP and Outline PEMP will be further refined post-PEIR and submitted with the DCO application and will inform the development of the CoCP and PEMP post-consent respectively. Indicative embedded mitigation measures which are included in the Outline CoCP and Outline PEMP are set out in **Table 31-24.**

191. While the climate change resilience measures included in the Outline CoCP and Outline PEMP cover onshore and offshore construction activities respectively, these measures are considered applicable for inclusion in the relevant management plans for O&M and decommissioning activities to ensure appropriate preparation and emergency response measures are in place prior to the commencement of works to minimise health and safety risks to site personnel, damage to assets and disruptions due to extreme weather events (see **Table 31-23**, Commitment ID CO95).

Table 31-24 Indicative Embedded Mitigation Measures Included in Outline Code of Construction Practice and Outline Project Environmental Management Plan

Outline CoCP and Outline PEMP: Embedded Mitigation Measures for Climate Change Resilience
As part of health and safety planning, the Principal Contractor(s) will include provisions for the monitoring of site weather (and metocean) conditions and severe weather alert services such as The Met Office's extreme weather warnings and Shipping Forecast and the Environment Agency's flood alert / warning services.
Construction activities will be scheduled considering seasonality and short to medium range weather forecasts from the Met Office and other approved providers. Impacts of extreme weather events on construction activities will be included in risk assessments prepared by the Principal Contractor(s).
A severe weather protocol will be developed by the Principal Contractor(s) for relevant extreme weather events at the time of works and included in the Project Emergency Response Plan. Potential management measures include but are not limited to the following, which will vary depending on the site and nature of works: • Adjusting the construction programme to delay affected activities until working conditions are deemed safe and / or in response to extreme weather forecasts; • Incorporating severe weather considerations into site safety bulletins, toolbox talks and PPE specifications; • Altering shift patterns within the core working hours to cooler times during the day and providing additional rest breaks during heatwaves; • Inspecting marine vessels and construction plant and equipment for physical damage regularly and following extreme weather events; • Adhering to the Flood Warning and Evacuation Plan included in the Project Emergency Response Plan; • Implementing permissible thresholds above which construction activities would be halted until site conditions are determined to be safe, e.g. halting marine vessel operations or working at height when wave heights or wind speeds exceed the safe threshold; • Securing stored equipment and materials and delaying crane operations during high wind and wave events; • Limiting operations requiring the use of fresh water during periods of drought; and • Specifying use of de-icing equipment during cold spells.

31.3.2.4 Realistic Worst-Case Scenarios

192. To provide a precautionary, but robust, assessment at this stage of the Project's development process, realistic worst-case scenarios used for the CCR assessment are defined in **Table 31-25** for each impact scoped into the assessment (as outlined in **Section 31.3.2.2**). As the CCR assessment considers the effects of climate change on the Project, the realistic worst-case scenarios are derived from credible, conservative climate change projections to ensure the assessment of likely significant effects is based on the maximum potential impact on the Project. This approach to defining the realistic worst-case scenarios differs from the Project Design Envelope approach discussed in **Chapter 6 Environmental Impact Assessment Methodology**.

193. There is uncertainty surrounding the scale and rate climate change due to complex interactions between various natural and human factors that influence the Earth's climate system. Predicting "worst-case" scenarios with respect to climate change impacts is challenging because of the variability in future GHG emissions, socio-economic developments and technological advancements. Representative Concentration Pathways (RCP) represent different possible trajectories of GHG atmospheric concentrations, with each pathway involving assumptions about future human behaviour and policy decisions (van Vuuren *et al.*, 2011). This inherent uncertainty makes it difficult to pinpoint a single "worst-case" scenario, as the outcomes depend on a wide range of unpredictable variables.

194. As discussed in **Section 31.3.2.2**, the timeframes for the Project's construction, O&M and decommissioning phases align with different climate periods. Therefore, for the CCR assessment, realistic worst-case scenarios have been defined for each project phase and the likely relevant RCP scenario. More details about the various RCP scenarios are provided in **Table 31-27**.

31.3.2.5 Development Scenarios

195. Consideration is also given to the different development scenarios with respect to the OCS zones. At this stage, two OCS zone options remain in the Project Design Envelope (see **Chapter 4 Project Description** for further details). Only one option will be taken forward to development, which will be confirmed in the ES. The two development scenarios are:

- Infrastructure located in OCS Zone 4; or
- Infrastructure located in OCS Zone 8.

196. With respect to the CCR assessment, it is noted that the assessment of likely significant effects is not materially affected by the two development scenarios, as the same broad receptors, realistic worst-case scenarios and potential effects are applicable to both OCS zone options. Therefore, the assessment outcomes presented in **Section 31.3.5** remain the same for both development scenarios.

Table 31-25 Realistic Worst-Case Scenarios for the Climate Change Resilience Assessment

Impact ID	Impact and Project Activity	Realistic Worst-Case Scenario	Rationale
Construction			
CCR-C-04	Climate change impacts from marine climate hazards during construction – offshore human, infrastructure and environmental receptors	Earliest construction phase: 2029 to 2033 (total construction duration of approximately five years), which aligns with the climate period of 2030s (2020 to 2039). The existing baseline is considered to provide a suitable representation of the expected climate conditions during the construction phase of the Project.	The degree of climatic change up to and during the construction phase, as distinct from standard weather fluctuations, is not likely to result in significant changes from present-day conditions, particularly when compared to the operational timeframe where change in climate hazards is more likely.
CCR-C-05	Climate change impacts from land-based climate hazards during construction – onshore human, infrastructure and environmental receptors		
Operation and Maintenance			
CCR-O-04	Climate change impacts from marine climate hazards during operation – offshore human, infrastructure and environmental receptors	Earliest O&M phase: 2033 to 2068 (duration of approximately 35 years), which aligns with the climate periods of 2040s (2030 to 2049) and 2060s (2050 to 2069). RCP scenario: RCP8.5 (very high emission scenario).	For the O&M phase, RCP8.5 scenario has been selected as the realistic worst-case scenario to provide a conservative assessment.
CCR-O-05	Climate change impacts from land-based climate hazards during operation – onshore human, infrastructure and environmental receptors		
Decommissioning			
CCR-D-04	Climate change impacts from marine climate hazards during decommissioning – offshore human, infrastructure and environmental receptors	The final decommissioning strategy of the Project's offshore and onshore infrastructure has not yet been decided. For a description of potential offshore and onshore decommissioning works, refer to **Chapter 4 Project Description**. It is recognised that regulatory requirements and industry best practice change over time. Therefore, the details and scope of offshore and onshore decommissioning works will be determined by the relevant regulations and guidance at the time of decommissioning. Climate change impacts during decommissioning will be assessed in detail through the Offshore Decommissioning Programme and Onshore Decommissioning Plan (see **Table 31-23**, Commitment ID CO95) where relevant. For the CCR assessment, it is assumed that decommissioning is likely to operate within the parameters identified for construction (i.e. any activities are likely to occur within the temporary construction working areas and require no greater amount or duration of activity than assessed for construction). The decommissioning sequence will generally be the reverse of the construction sequence. It is therefore assumed that the type of climate hazards posed to receptors would be similar to those identified during the construction phase. The decommissioning phase is assumed to start at the end of the Project's O&M phase. This aligns with the climate period of 2070s (2060 to 2079). The RCP8.5 scenario has been selected as the realistic worst-case scenario to provide a conservative assessment.	
CCR-D-05	Climate change impacts from land-based climate hazards during decommissioning – onshore human, infrastructure and environmental receptors		

31.3.3 Assessment Methodology

31.3.3.1 Guidance Documents

197. The primary guidance document that has been used to inform the baseline characterisation, assessment methodology and mitigation design for the CCR assessment is IEMA's *"Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation"* (2020). This guidance document provides a framework for the consideration of climate change resilience and adaptation in the EIA process and advises that future climate conditions within a development's study area should be identified and assessed with consideration of how adaptation and resilience measures have been built into the design of a development.

31.3.3.2 Data and Information Sources

31.3.3.2.1 Desk Study

198. A desk study has been undertaken to inform the CCR assessment using the sources of information set out in **Table 31-26**.

Table 31-26 Desk-Based Sources for the Climate Change Resilience Assessment

Data Source	Spatial Coverage	Year(s)	Summary of Data Contents
IPCC Sixth Assessment Report	Global	Various	Overview of the current state of climate change including the current knowledge base and possible future emissions scenarios.
Marine Climate Change Impacts Partnership (MCCIP) Reports	UK	Various	Evidence reviews and summary reports describing climate change effects in the marine environment. Various sources, including Horsburgh *et al.* (2020), Masselink *et al.* (2020) and Wolf *et. al.* (2020)
Met Office UK Climate Averages and Regional Climate Summaries	UK	Various	Historical climate observations and current climate conditions for the UK. *Note: Met Office data is based on observations made over land recorded by onshore climate stations.*
Met Office UK Climate Projections (UKCP) Database	UK	2022	Climate change projection data. IEMA guidance (2020) recommends the use of UKCP in CCR assessments. *Note: These climate change projection data is most applicable to coastal and onshore areas.*
Offshore Wind Climate Adaptation and Resiliency Study (Weisenfeld *et al.*, 2021)	USA (but considered best practice that can be applied across the offshore wind sector)	2021	Review of key climate factors relevant to the offshore wind sector and opportunities for offshore wind resilience.

31.3.3.2.2 Site-Specific Surveys

199. No site-specific surveys were undertaken for the CCR assessment.

31.3.3.3 Impact Assessment Methodology

200. The purpose of the CCR assessment is to evaluate the resilience and vulnerability of the Project to the projected effects of climate change over the construction, O&M and decommissioning phases.

201. **Chapter 6 Environmental Impact Assessment Methodology** sets out the overarching approach to the impact assessment methodology. The topic-specific methodology for the CCR assessment is described further in this section.

202. The methodology adopted for the CCR assessment is informed by the IEMA's guidance on climate change resilience and adaptation (2020). As the CCR assessment considers climate change impacts on the Project, as opposed to vice versa, the assessment methodology differs from the general EIA approach presented in **Chapter 6 Environmental Impact Assessment Methodology**.

203. For the purpose of the CCR assessment, the following key terms are adopted:

- **Receptor**: an entity or system with potential to be affected by climate hazards and therefore vulnerable to experiencing climate change impacts such as infrastructure and site personnel;
- **Climate variable**: a measurable, monitorable aspect of the weather or climate conditions such as temperature and wind speed;
- **Climate hazard**: a weather or climate-related event or trend in climate conditions, which has potential to do harm to receptors such as increased precipitation or storms; and
- **Climate change impact**: the resulting impact from a climate hazard which affects the ability of the receptor to achieve or maintain its functions or purpose.

204. A three-step methodology has been adopted for the CCR assessment (see **Plate 31-2**) in line with industry good practice for assessments of climate change resilience. The initial stages of the assessment aim to identify the climate hazards to which the Project's receptors could be vulnerable to during each project phase and the potential for climate change impacts. If deemed necessary, a more detailed climate risk assessment is then undertaken on climate change impacts considered to be material to the Project, which assess the level of risk each impact posed to the Project's receptors. The step-by-step approach undertaken for the CCR assessment is set out below.

31.3.3.3.1 Step 1: Identifying Receptors, Climate Variables and Hazards

205. The first step of the CCR assessment is to identify receptors related to the Project which may potentially be affected by climate change. The identified receptors include those known to have already experienced a climate-related event (e.g. receptors in known flood zones) and unknown receptors which are likely but are yet to be impacted according to available data and literature. Receptor types considered in the CCR assessment include infrastructure (temporary and permanent), human and environmental receptors based on the IEMA's guidance (2020).

206. Key climate hazards relevant to the Study Area are identified from desk-based sources, along with climate variables which could be used to quantify or contextualise the climate hazard under current and future climate conditions, and the receptors which they affect.

207. Climate change projection data was obtained from the UKCP18 database, which was used to provide an understanding of trends in climate variables within the Study Area over the Project's construction, O&M and decommissioning phases for the two RCP scenarios considered in the CCR assessment (RCP4.5 and RCP8.5) (see **Section 31.1.1.1**).

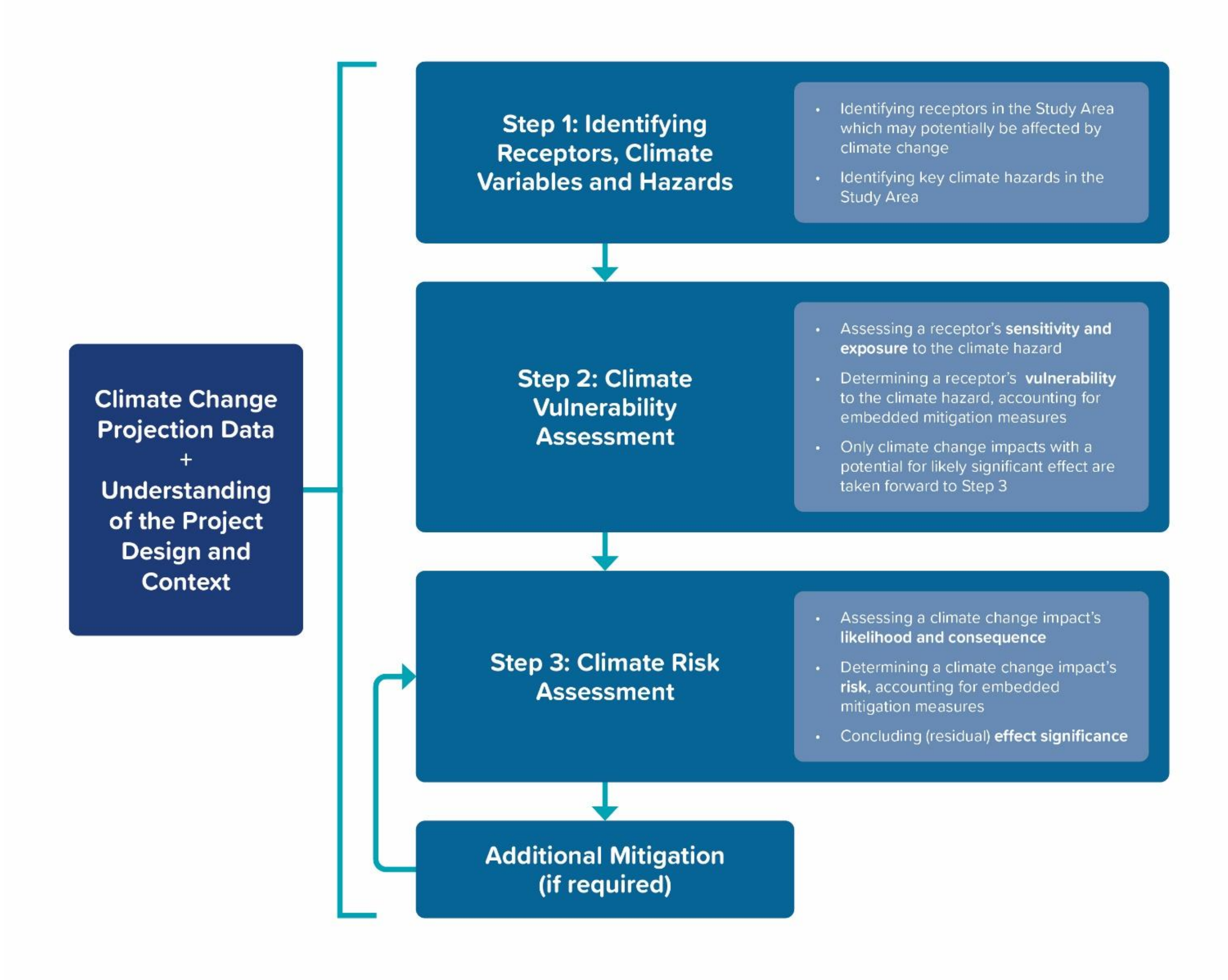


Plate 31-2 Climate Change Resilience Assessment Methodology Flowchart

208. RCP scenarios are based on recent assumptions about future population, economy, and global targets to cut GHG emissions. The RCP scenarios considered in the assessment, and how they relate to the Shared Socio-Economic Pathways (SSP) scenarios in the IPCC's Sixth Assessment Report are described in **Table 31-27**.

209. RCP8.5 is used as a realistic worst-case scenario for climate change projection data relevant to the Project's O&M and decommissioning phases, whilst RCP4.5 projection data is included to provide a comparison with the RCP8.5 data.

210. For each RCP scenario, where relevant and available, climate change projection data was obtained for three probabilities: 10% (unlikely), 50% (central estimate of projections) and 90% (projections unlikely to be less than). This is in accordance with the requirements of NPS EN-1 (DESNZ, 2023a) and best practice in IEMA's guidance (2020) to consider impacts cross a range of climate change scenarios.

211. Climate change projection data has also been supplemented with other literature sources and future baseline trends in other relevant technical chapters in the PEIR, including **Chapter 8 Marine Physical Processes** and **Volume 2, Appendix 21.3 Flood Risk Assessment**, to further characterise climate hazards within the Study Area.

Table 31-27 Representative Concentration Pathway and Shared Socio-Economic Pathway Scenarios

RCP Scenario	RCP Scenario Description	SSP Scenario	SSP Scenario Description	Increase in Global Mean Surface Temperature by 2081-2100
RCP4.5	Stabilisation scenario, aiming for stabilisation without overshoot pathways to 4.5 W/m^2 by 2100.	SSP2-4.5	Middle of the Road, intermediate emissions.	2.7°C (2.1°C to 3.5°C)
RCP8.5	High emissions scenario, leading to high greenhouse gas concentrations by 2100.	SSP5-8.5	Fossil-fueled Development, very high emissions.	4.4°C (3.3°C to 5.7°C)

31.3.3.3.2 Step 2: Climate Vulnerability Assessment

212. The second step consists of a qualitative vulnerability assessment of the Project's receptors to the identified climate hazards, informed by professional judgement and supporting literature. The climate vulnerability assessment is used to identify the potential for climate change impacts to the receptors as a result of the climate hazard and ensures that only impacts with a potential for likely significant effect are taken forward in the CCR assessment.

213. Vulnerability is defined by the receptor's degree of response to the climate hazard, considering its capacity to withstand, adapt to or recover from change, and is a function of:

- **Sensitivity**: The potential of the receptor to be affected by the climate hazard. The assessment of sensitivity depends on the specific hazards and risks and considers the amount of change in the climate hazard that the receptor is able to tolerate, and any mitigation measures implemented to reduce sensitivity.
- **Exposure**: The receptor's spatial and temporal exposure to the climate hazard. The assessment of exposure depends on the specific hazards and risks and considers the location of the receptor, its inherent resilience to the hazard and any mitigation measures implemented to reduce exposure.

214. Based on the sensitivity and exposure of the receptor to the climate hazard and accounting for the embedded mitigation measures, the climate vulnerability assessment attributes a high, moderate, or low vulnerability rating to each climate change impact, as set out in **Table 31-28**. Alongside the vulnerability rating, the nature of the climate change impact is also described to specify how the Project's receptors are likely to experience the climate hazard and the outcomes.

Table 31-28 Sensitivity-Exposure Matrix for Determining Climate Vulnerability

Sensitivity	Exposure		
	Low	Moderate	High
Low	Low	Low	Low
Moderate	Low	Moderate	Moderate
High	Low	Moderate	High

215. Climate change impacts on the Project's receptors are only considered to have a potential for likely significant effect where the climate vulnerability assessment identifies a moderate or high vulnerability, and therefore, these impacts are taken forward through Step 3 of the CCR assessment.

216. Where low vulnerability has been identified, these climate change impacts have been screened out from further assessment, and a non-significant effect is concluded in the CCR assessment. This is in line with risk assessment approach proposed by the European Commission (EC) in its guidance note whereby only potentially significant risks from climate change are taken forward for detailed analysis (EC, 2021).

217. Where relevant, further information related to the vulnerability of the Project to the projected effects of climate change were obtained from other technical chapters including **Chapter 8 Marine Physical Processes** and **Volume 2, Appendix 21.3 Flood Risk Assessment**.

218. The assessment carried out at Step 2 is detailed in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment**. Only climate change impacts which have moderate or high vulnerability rating have been taken forward for further assessment in Step 3, as presented in **Section 31.3.5**.

31.3.3.3.3 Step 3: Climate Risk Assessment

219. For climate change impacts determined to have a moderate or high vulnerability rating during Step 2, the risk from climate change on the Project's receptors are qualitatively assessed based on the likelihood and consequence of the climate change impact, accounting for the embedded mitigation measures. The degree of climate risk is then used to determine the effect significance.

220. The definitions of likelihood and consequence are provided in **Table 31-29** and **Table 31-30.** The matrix used to determine the climate risk is provided in **Table 31-31**. Definitions of the climate risk ratings are provided in **Table 31-32**.

Table 31-29 Definitions of Likelihood of a Climate Change Impact

Likelihood	Description
Almost Certain	The climate change impact on the receptor is almost certain to occur numerous times during the construction, O&M or decommissioning phase.
Likely	The climate change impact on the receptor is likely to occur on several occasions during the construction, O&M or decommissioning phase.
Moderate	The climate change impact on the receptor will occur on limited occasions during the construction, O&M or decommissioning phase.
Unlikely	The climate change impact on the receptor will occur infrequently during the construction, O&M or decommissioning phase.
Very Unlikely	The climate change impact on the receptor is unlikely to occur during the construction, O&M or decommissioning phase.

Table 31-30 Definitions of Consequences of a Climate Change Impact

Consequence	Description
Catastrophic	The climate change impact will result in: • Permanent damage / deterioration / loss of infrastructure or other assets; • Severe and prolonged disruptions to critical activities or decline in performance of infrastructure or other assets integral to their function; • Severe cost implications; and / or • Severe and irreversible health and safety implications.
Major	The climate change impact will result in: • Major and extensive damage / deterioration of infrastructure or other assets; • Major and extensive disruptions to activities or decline in performance of infrastructure or other assets; • Major cost implications; and / or • Major and long-term health and safety implications.
Moderate	The climate change impact will result in: • Moderate but recoverable damage / deterioration of infrastructure or other assets; • Moderate but recoverable disruptions to activities or decline in performance of infrastructure or other assets; • Moderate cost implications; and / or • Moderate health and safety implications.
Minor	The climate change impact will result in: • Minor and localised damage / deterioration of infrastructure or other assets; • Minor and localised disruptions to activities or decline in performance of infrastructure or other assets; • Minor cost implications; and / or • Minor health and safety implications.
Negligible	The climate change impact will result in: • No or negligible damage / deterioration of infrastructure or other assets; • No or negligible disruptions to activities or decline in performance of infrastructure or other assets; • No or negligible cost implications; and / or • No or negligible health and safety implications.

Table 31-31 Likelihood-Consequence Matrix for Determining Climate Risk and Effect Significance

Likelihood	Consequence				
	Negligible	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain	Low (NS)	Moderate (NS)	High (S)	Extreme (S)	Extreme (S)
Likely	Low (NS)	Moderate (NS)	Moderate (NS)	High (S)	Extreme (S)
Moderate	Low (NS)	Low (NS)	Moderate (NS)	High (S)	Extreme (S)
Unlikely	Low (NS)	Low (NS)	Moderate (NS)	Moderate (NS)	High (S)
Very Unlikely	Low (NS)	Low (NS)	Low (NS)	Moderate (NS)	Moderate (NS)
(S) represents a significant effect, (NS) represents a non-significant effect.					

Table 31-32 Definitions of Climate Risk Ratings

Level of Risk	Description
Extreme (S)	The climate risk is not mitigated accounting for embedded mitigation measures. Significant impacts on the Project could occur without additional mitigation.
High (S)	The climate risk is not fully mitigated accounting for embedded mitigation measures. Impacts on the Project could occur without additional mitigation.
Moderate (NS)	The embedded mitigation measures are sufficient to address this climate risk. The risk is not significant in EIA terms.
Low (NS)	The embedded mitigation measures greatly reduce this climate risk. The risk is not significant in EIA terms.
(S) represents a significant effect, (NS) represents a non-significant effect.	

221. For the purpose of the CCR assessment, climate change impacts determined to have a High or Extreme risk rating are considered to be significant in EIA terms. Where significant effects are identified, additional mitigation measures are identified, and a residual risk rating is then determined. Although climate change impacts with moderate risk are non-significant in EIA terms, additional mitigation measures may be identified as best practice based on professional judgment.

31.3.3.4 Cumulative Effects Assessment Methodology

222. The cumulative effect assessment (CEA) within the context of a CCR assessment considers the potential for other projects or plans to act collectively to exacerbate a development's climate vulnerability to a climate hazard and associated risk from the climate change impact. Likewise, there is also potential for the development to influence the climate change resilience of other projects or plans.

223. The only climate hazard with a potential for cumulative effects related to climate change resilience is surface water flooding, as nearby projects may cumulatively alter the land drainage capacity within the Onshore Development Area. Cumulative effects related to surface water flooding are discussed in **Chapter 21 Water Resources and Flood Risk**. Therefore, no additional consideration of cumulative effects is required for the CCR assessment.

224. Cumulative effects with respect to interdependencies between the Project and other critical infrastructure will be undertaken at ES stage. This assessment will consider the potential for cascading impacts, such as the Project's interface with the UK electricity transmission network, and their cumulative effects on the Project's climate change resilience, ensuring that the broader implications of climate change on the Project are evaluated.

31.3.3.5 Transboundary Effects Assessment Methodology

225. The CCR assessment considers the effects of climate change on the Project as a receptor. No transboundary effects are anticipated on the basis that the effects of climate change are specific to the Project and will not affect other EEA Member States. Therefore, transboundary effects are scoped out of the assessment, as agreed by the Planning Inspectorate in the Scoping Opinion (see **Volume 2, Appendix 31.1 Consultation Responses for Climate Change**).

31.3.3.6 Assumptions and Limitations

226. The assumptions made in the CCR assessment are set out in **Table 31-33**. This chapter provides a preliminary assessment of the likely significant effects of the Project in relation to climate change using information available at the time of drafting as described in **Chapter 6 Environmental Impact Assessment Methodology**. This assessment will be refined where relevant and presented in the ES to be submitted with the DCO application.

Table 31-33 Assumptions and Limitations of the Climate Change Resilience Assessment

Assumption / Limitation	Further Detail / Discussion
Climate change projections	A key assumption of the climate change projection data from UKCP18 is that the model is strongly dependent on the future global GHG atmospheric concentrations and emission trajectories. 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 that they are based upon a different set of assumptions. The two RCP scenarios presented within the CCR assessment (RCP4.5 and RCP8.5) are considered the most likely to occur over the O&M and decommissioning phases of the Project and present a range of possible outcomes with respect to the predicted future baseline. However, the UKCP18 guidance cautions that the scientific community cannot reliably place probabilities on which scenario of GHG emissions is most likely. Due to the intrinsic uncertainty within climate change projection data, the UKCP data is based upon probabilistic projections, generating a normally distributed model per output. The model outputs values for the 10th, 50th and 90th percentiles, which represents the range of uncertainty, and is therefore presented in CCR assessment. In addition, UKCP data do not cover all climate variables which may be relevant to the Study Area. Where information gaps exist, these are supplemented with other available literature sources.
Spatial resolution of the climate baseline	Climate change projection data are provided for defined grid cells in the UKCP18 database. The size of the grid cell determines the spatial resolution of the projection data and how it corresponds to the Study Area. It is assumed that the climate baseline across the Study Area is adequately described by the selected grid cell. It should be noted that limited quantitative climate data is available for offshore locations and therefore the most appropriate onshore data has been used.
Temporal resolution of the climate baseline	Climate change projection data are provided as a time series. For the purpose of the CCR assessment, the data is summarised, and average values are presented by time slices, which are selected based on the project phase, as set out in **Section 31.3.2.1** It is assumed that these time slices are representative of current and future conditions within the Study Area and provide sufficient temporal coverage.

31.3.4 Baseline Environment

31.3.4.1 Existing Baseline

227. The existing baseline for the CCR assessment is the representative present-day climate conditions within the Study Area, namely the Offshore and Onshore Development Areas (see **Figure 4-1** and **Figure 4-2** in **Chapter 4 Project Description**).

228. The existing baseline is considered to provide a suitable representation of the expected climate conditions during the construction phase of the Project, which is likely to be completed within the next 10 years. The degree of climate change over this period, as distinct from standard weather fluctuations, is not likely to result in significant changes from present-day conditions, when compared to the O&M and decommissioning phases where change in climate hazard is more likely. In addition, the existing baseline is used to provide context to the projected changes in climate conditions and their impacts during the O&M and decommissioning phases of the Project.

229. Annual average temperatures for the UK for 2009 to 2018 were on average 0.2°C warmer than the 1981-2000 average and 0.9°C warmer than the 1961-1990 average. All of the top 10 warmest years for the UK, in the series from 1884, have occurred since 2002. The period from 2009 to 2018 was on average 1% wetter than 1981-2000 and 5% wetter than 1961-1990 for the UK overall (Met Office, 2022).

230. The Offshore Development Area is located primarily within the Southern North Sea, with some areas located within the Northern North Sea. The Southern North Sea is characterised by relatively shallow waters, typically ranging from 0 to 50m in depth, and experiences significant tidal currents and large river inputs, leading to a well-mixed water column throughout the year. The Northern North Sea is characterised by deeper waters, typically ranging from 0 to 500m in depth, and a seasonally stratified water column. The Greater North Sea region is also subject to dynamic environmental conditions, including variations in sea surface temperatures and frequent storms, and is strongly influenced by the Atlantic Ocean inflow (ICES, 2024).

231. Air temperatures at the Southern North Sea are generally lowest in January and February (averaging between 4°C to 6°C) and highest in July and August (averaging around 16 °C). Annual rainfall at sea is expected to be between 201 to 400mm. Winds in the Southern North Sea generally originate from between the south and the north-west, with wind speeds between 1 to 11m/s in the summer months. A greater proportion of strong to gale force winds with speeds between 14 to 32m/s are observed in the winter months. Air temperatures at the Northern North Sea tend not to vary beyond the range of 0°C to 19°C. Annual rainfall at sea varies between 340 and 550mm. Winds in the Northern North Sea are prevailing from the south-west and north-east. Wind speeds in the winter are typically between 6 and 11m/s, with strong winds of 17 to 32m/s occurring less frequently (BEIS, 2022).

232. The Onshore Development Area is located in the county of the East Riding of Yorkshire. The current climate for the area in which the onshore elements of the Project are located is described in the Met Office's *"Eastern England Regional Climate Summary"* (2016). This summary describes the climate conditions based on 30-year averages within the 1981-2010 period as follows:

- The mean annual temperature for Eastern England varies from 9.5°C to 10.5°C, with cooler temperatures experienced nearer to the coast. This can be compared to the mean annual temperature for the UK, which varies from about 7°C in Shetland to over 11°C in the south-west of England and the Channel Islands;
- January and February are the coldest months with mean daily minimum temperatures of between 0°C and 2°C, with warmer temperatures experienced near to the coast;
- Maximum temperatures occur in July or August, with mean daily maximum temperatures of 20°C to 23°C. Many of the UK maximum temperature records are held by meteorological recording stations in Eastern England;
- Sea temperatures off the coast of Eastern England vary from 5-6°C in February and early March to 15-16°C in August; and
- Average annual rainfall in the north of the region is about 800mm. Periods of prolonged rainfall can lead to widespread flooding, especially in winter and early spring when soils are usually near saturation.

233. Eastern England is one of the more sheltered parts of the UK. Mean wind speed and gusts (short duration peak values) are strongest in autumn to spring (September to March). The coastal areas of East Yorkshire and Humberside experience about ten days of gale on average each year (average wind speed of more than 34 knots for more than ten minutes). The prevailing wind direction is from the south-west.

234. In addition to the regional climate summary, existing climate data for the 1991-2020 period has also been obtained from the Leconfield Sar (East Riding of Yorkshire) meteorological recording station, which is the closest recording station to the Onshore Development Area. The Met Office's *"UK Climate Averages"* (2024) are only available for onshore meteorological sites. Climate data for Leconfield Sar station, England and the UK are provided in **Table 31-34**.

235. The climate data in **Table 31-34** indicates the following characteristics within the Onshore Development Area:

- Coastal regions can be affected by sea breezes which result in lower maximum temperatures than further inland from late spring through the summer and milder temperatures in winter. Annual average maximum and minimum temperatures are both higher than the East and North East of England, England and UK averages, and there are fewer days of air frost;
- As the Onshore Development Area is located on the east coast of England, it experiences less average rainfall than the rest of England and the UK. This is due to the predominant weather patterns in the UK whereby wetter conditions are typically experienced in the west due to the influence of south-west prevailing winds from the Atlantic Ocean; and
- The mean wind speed (at 10m) at the Leconfield Sar Station is less than the East and North East of England, England, and UK averages.

Table 31-34 Climate Data for Leconfield Sar Station, England and the UK (Met Office, 2024)

Climate Variable	Units	Annual Average			
		Leconfield Sar	East and North East of England	England	UK
Maximum temperature (average over 12 months)	°C	13.85	12.99	13.82	12.79
Minimum temperature (average over 12 months)	°C	6.19	5.49	6.12	5.53
Days of air frost	days	40.06	51.99	45.14	53.36
Rainfall	mm	661	793	870	1,163
Days of rainfall ≥ 1 mm	days	124.0	133.8	135.2	159.1
Mean wind speed at 10 m	knots	8.20	8.92	8.33	9.27

31.3.4.2 Predicted Future Baseline

236. The potential effects of climate change are projected to increase over time. On land, the key trend is towards warmer, wetter winters and hotter, drier summers (Met Office, 2019). Offshore, warming seas, reduced oxygen levels, ocean acidification and sea-level rise are described as key risks for the future baseline in UK seas (MCCIP, 2020).

237. Climate change projection data is used to characterise the predicted future baseline within the Study Area for the CCR assessment. Where information gaps exist, these are supplemented with other available literature sources.

238. The Met Office's UKCP18 database provides probabilistic climate change projections for the UK at a spatial resolution of 25km grid squares from the time period of 1961 to 2100. Probabilistic projections are based on possible changes in future climate based on an assessment of climate model uncertainties and are most suitable for characterising future extremes in risk assessments, as they provide the broadest range of climate outcomes.

239. The most relevant UKCP18 grid cells were used to obtain the relevant climate change projection data to represent the spatial scope of predicted future climate conditions within the Study Area. The grid cells used for the UKCP18 land-based projections are shown on **Figure 31-1**. The grid cell used for the UKCP18 marine projections is shown on **Figure 31-2**.

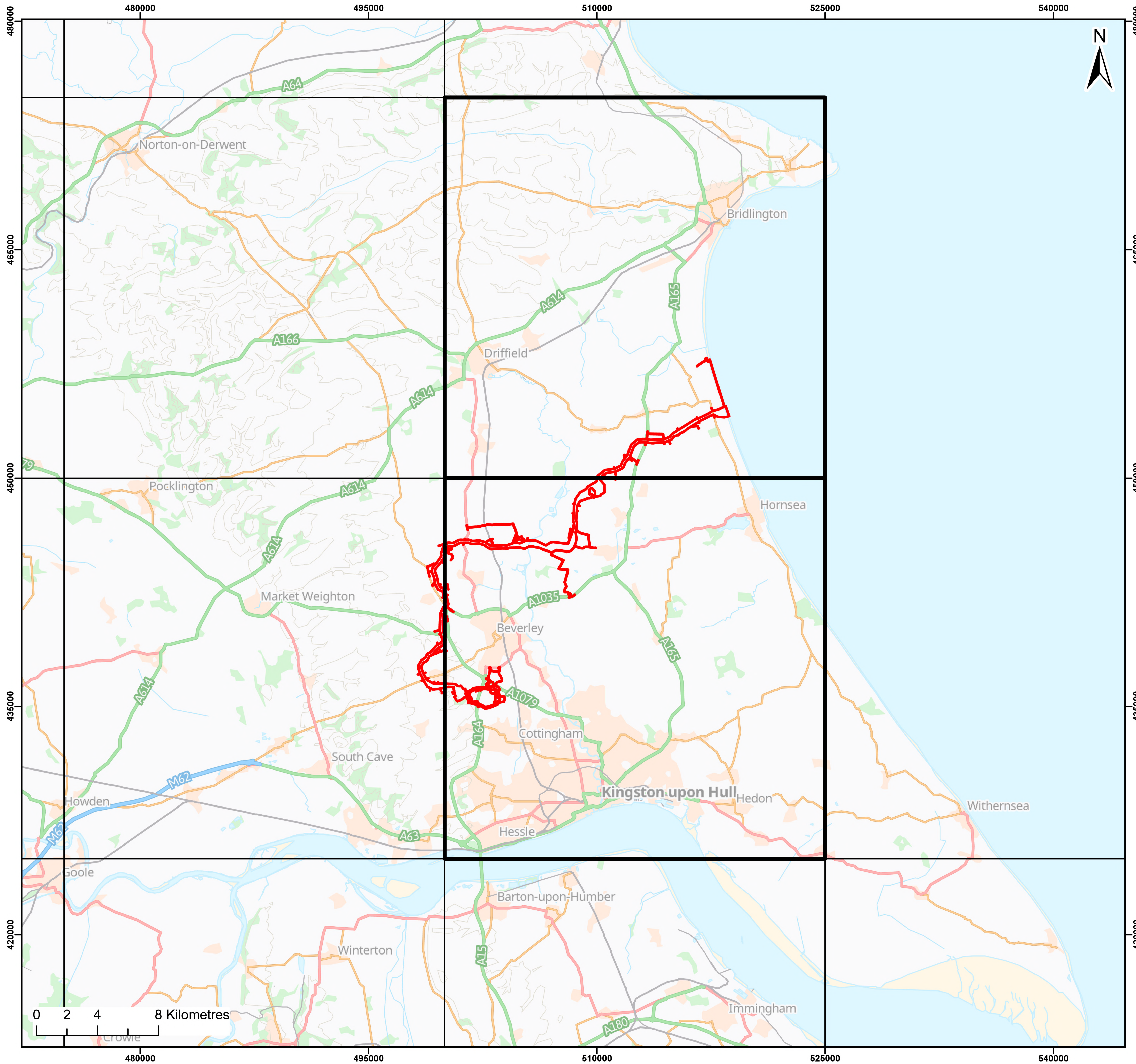
240. The majority of UKCP18 probabilistic projections are land-based and therefore only provide direct coverage for the Onshore Development Area. The land-based projection data shows limited spatial variation over the grid cells closest to the Offshore Development Area. Therefore, this land-based data is considered to provide an appropriate representation of the temperature anomaly and precipitation anomaly for the Offshore Development Area.

241. UKCP18 probabilistic projections for 20-year time slices relative to the 1981 to 2000 baseline have been obtained for the 2040s (2030-2049), 2060s (2050-2069) and 2070s (2060-2079) periods in line with the construction, O&M and decommissioning phases of the Project, which represent the temporal scope of predicted future climate conditions within the Study Area.

242. The UKCP database uses RCP scenarios which align with the emission scenarios used in the IPCC's Fifth Assessment Report (2014). The RCP scenarios used for the climate change projection data are defined in **Table 31-27**.

243. The predicted future baseline is based on the anomaly relative to conditions for the baseline period of 1981-2010 (Met Office, 2018).

244. Future climate projections are modelled projections and are strongly dependent on future global GHG emissions, and uncertainties associated with these are detailed in **Table 31-27**. In some cases, projections to the year 2100 (or later) are presented, as this is the only data available for some climate variables.



Legend:

- Onshore Development Area
- UKCP18 Land-Based Data Grid Cells
- Relevant Grid Cells

Project: Dogger Bank D Offshore Wind Farm

DOGGER BANK WIND FARM

Title: Grid Cell Used for UKCP18 Land-Based Data Extraction

Figure:	31-1	Drawing No:	PC6250-RHD-XX-ON-DR-GS-0224		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	16/05/2025	JH	AB	A3	1:250,000
01	13/11/2024	JH	AB	A3	1:250,000

Co-ordinate system: British National Grid

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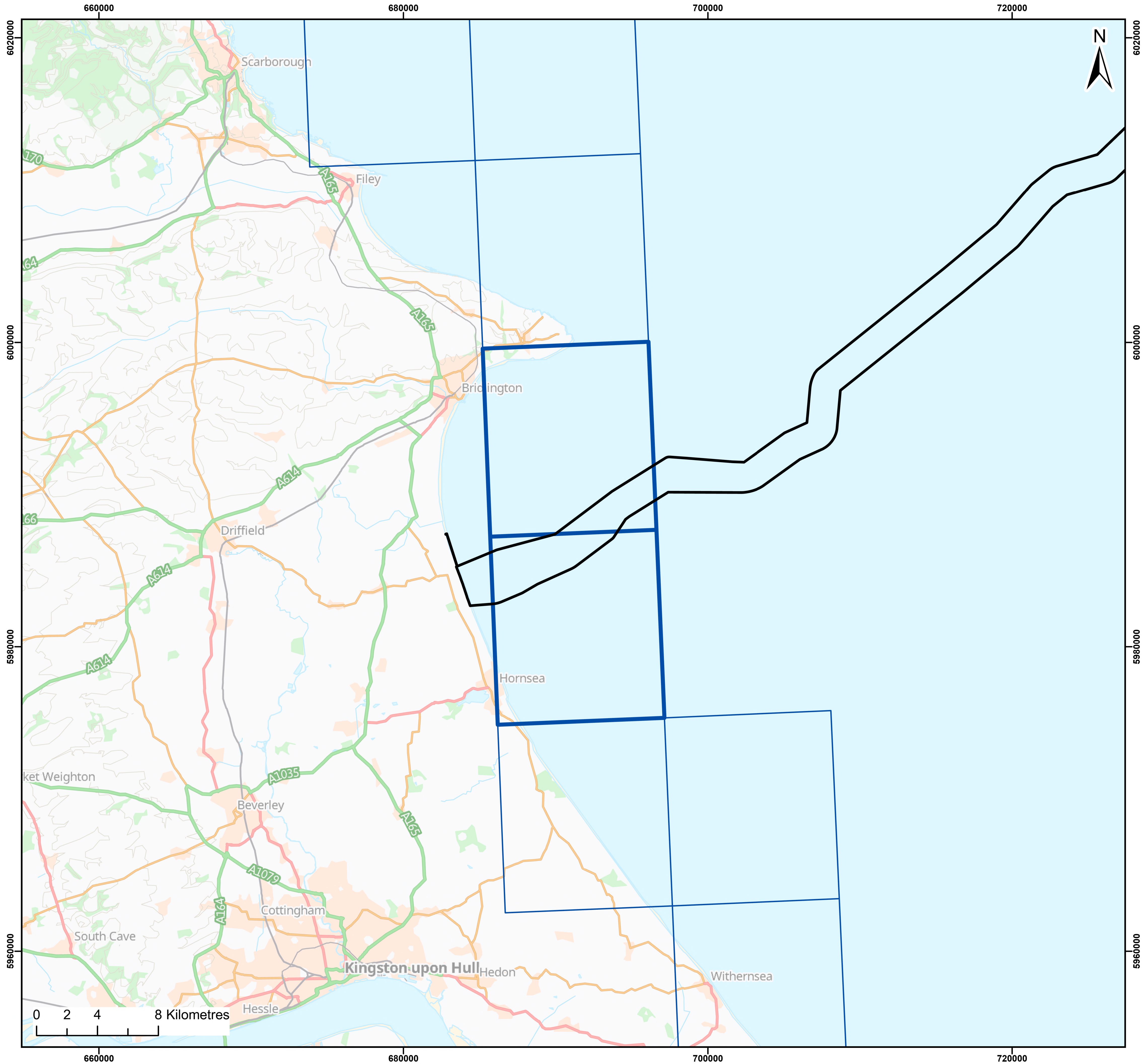

Legend:

- Offshore Development Area
- UKCP18 Marine Data Grid Cells
- Relevant Grid Cells

Source: © Haskoning DHV UK Ltd, 2024. © JNCC, 2024. © Natural England, 2024.
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Project:	
Dogger Bank D Offshore Wind Farm	DOGGER BANK WIND FARM

Title:

Grid Cells Used for UKCP18 Marine Data Extraction

Figure:	31-2	Drawing No:	PC6250-RHD-XX-OF-DR-GS-0225		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/11/2024	JH	AB	A3	1:250,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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31.3.4.2.1 Land-Based Climate Projections – Temperature, Precipitation and Wind

245. In the UK, winters are projected to become warmer and wetter, with summers becoming hotter and drier over the 21st century, although some dry winters and wet summers will still occur (Met Office, 2022).

246. 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, 2019). Under RCP8.5, 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, 2022). Under an 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).

247. By 2070 under RCP8.5, the probabilistic projections show that UK average changes in rainfall range from a decrease of -1% to an increase of +35% in winter and from a decrease of -47% to an increase of +2% in summer when compared against the 1981-2000 baseline average. Overall, precipitation levels are likely 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, 2022).

248. 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 accompanied by an increase in the frequency of winter storms (Met Office, 2021). The most recent climate projections for the UK suggest there is still uncertainty regarding the relationship between storminess and future climate change (Met Office, 2021).

249. Research indicates that climate change is expected to alter lightning patterns across Europe during the 21st century, with more frequent lightning strikes predicted for Northern Europe (Kahraman *et al., 2022*).

250. Changes in temperature and rainfall are modelled with a high confidence, while other climate parameters considered in the CCR assessment such as wind speed have more uncertainty.

251. Changes in the annual average temperature and precipitation rate anomalies compared to the 1981-2000 baseline are presented for the Study Area in **Table 31-35** for the RCP4.5 (intermediate emission) scenario and in **Table 31-36** for the RCP8.5 (very high emission) scenario (Met Office, 2022). These scenarios are considered the most likely to occur during the construction, O&M and decommissioning phases of the Project and present a range of outcomes in terms of climate change projection data.

252. **Table 31-35** and **Table 31-36** show that under both RCP4.5 and RCP8.5 scenarios, annual, summer and winter temperatures in the Onshore Development Area are likely to increase during the Project's O&M (2040s to 2060s) and decommissioning (2070s) phases. For the O&M phase of the Project, under RCP8.5, the annual mean temperature is predicted to increase by between 1.1°C and 3.2°C (10th and 90th percentile respectively) by the 2060s compared to the 1981-2000 baseline. The mean annual maximum temperature is projected to increase by 4.0°C for the decommissioning phase of the Project (2070s) under the RCP8.5 scenario (90th percentile).

253. Under the RCP8.5 scenario set out in **Table 31-36**, the annual precipitation anomaly projection is more variable than the air temperature anomaly projection. For the O&M phase (2060s), the annual mean precipitation is projected to change by between -8.9% and 7.0% (10th and 90th percentile). For the decommissioning phase (2070s), the annual mean precipitation is projected to change by between -8.8% and 7.7% (10th and 90th percentile).

Table 31-35 Temperature and Precipitation Projections within the Study Area under RCP4.5 Relative to the 1981 to 2000 Baseline Period

Climate Variable	Season	Unit	2040s (2030-2049)			2060s (2050-2069)			2070s (2060-2079)		
			10th Percentile	50th Percentile	90th Percentile	10th Percentile	50th Percentile	90th Percentile	10th Percentile	50th Percentile	90th Percentile
25km land-based grid cell: (coordinates 437500, 512500)											
Air temperature anomaly	Annual Mean	°C	0.46	1.07	1.74	0.69	1.48	2.36	0.81	1.72	2.73
	Annual Maximum	°C	0.27	0.94	1.68	0.54	1.45	2.40	0.67	1.70	2.78
	Annual Minimum	°C	0.41	1.04	1.74	0.63	1.46	2.42	0.73	1.70	2.82
	Summer Maximum	°C	-0.17	1.00	2.22	0.32	1.79	3.35	0.56	2.19	3.98
	Summer Minimum	°C	0.39	1.13	1.90	0.70	1.68	2.75	0.78	1.93	3.19
	Winter Maximum	°C	-0.01	0.85	1.73	0.26	1.26	2.35	0.25	1.39	2.60
	Winter Minimum	°C	-0.09	0.86	1.90	0.25	1.40	2.74	0.25	1.52	3.02
Precipitation rate anomaly	Annual	%	-4.6	0.3	5.5	-8.5	-1.6	5.9	-8.4	-1.5	5.5
	Summer	%	-17.1	-1.3	15.8	-28.4	-10.8	7.4	-29.1	-11.1	6.5
	Winter	%	-3.7	5.3	15.6	-5.3	5.4	17.6	-6.1	6.0	20.4
25km land-based grid cell: (coordinates 462500, 512500)											
Air temperature anomaly	Annual Mean	°C	0.30	0.92	1.61	0.58	1.39	2.27	0.68	1.61	2.61
	Annual Maximum	°C	0.27	0.93	1.65	0.54	1.43	2.36	0.66	1.67	2.73
	Annual Minimum	°C	0.31	0.96	1.69	0.59	1.43	2.37	0.68	1.63	2.72
	Summer Maximum	°C	-0.15	0.98	2.16	0.32	1.74	3.24	0.56	2.13	3.85
	Summer Minimum	°C	0.31	1.07	1.86	0.62	1.62	2.66	0.72	1.86	3.05
	Winter Maximum	°C	-0.01	0.84	1.71	0.26	1.25	2.33	0.25	1.37	2.57
	Winter Minimum	°C	-0.07	0.88	1.92	0.25	1.40	2.75	0.25	1.52	3.03
Precipitation rate anomaly	Annual	%	-4.4	0.8	6.2	-7.5	-0.9	6.2	-7.6	-0.7	6.3
	Summer	%	-17.6	-1.0	15.6	-27.9	-10.0	7.9	-29.1	-11.1	7.1
	Winter	%	-3.6	5.5	15.7	-5.0	5.7	17.9	-6.2	6.4	21.3

Table 31-36 Temperature and Precipitation Projections within the Study Area under RCP8.5 Relative to the 1981 to 2000 Baseline Period

Climate Variable	Season	Unit	2040s (2030-2049)			2060s (2050-2069)			2070s (2060-2079)		
			10th Percentile	50th Percentile	90th Percentile	10th Percentile	50th Percentile	90th Percentile	10th Percentile	50th Percentile	90th Percentile
25km land-based grid cell: (coordinates 437500, 512500)											
Air temperature anomaly	Annual Mean	°C	0.65	1.34	2.06	1.13	2.13	3.20	1.44	2.66	3.92
	Annual Maximum	°C	0.45	1.22	2.00	0.97	2.09	3.25	1.24	2.59	4.02
	Annual Minimum	°C	0.59	1.29	2.06	1.03	2.09	3.26	1.31	2.61	4.02
	Summer Maximum	°C	0.03	1.35	2.65	0.80	2.61	4.51	1.14	3.35	5.64
	Summer Minimum	°C	0.60	1.42	2.26	1.19	2.43	3.75	1.47	2.98	4.61
	Winter Maximum	°C	0.13	1.03	1.99	0.54	1.75	3.05	0.62	2.10	3.65
	Winter Minimum	°C	0.01	1.06	2.23	0.47	1.94	3.59	0.55	2.29	4.26
Precipitation rate anomaly	Annual	%	-5.0	0.5	5.8	-8.9	-1.3	6.5	-8.8	-1.2	6.8
	Summer	%	-20.2	-3.1	14.7	-35.0	-15.3	5.7	-38.4	-17.8	4.0
	Winter	%	-3.1	6.3	17.5	-4.6	7.9	23.3	-5.1	9.9	28.5
25km land-based grid cell: (coordinates 462500, 512500)											
Air temperature anomaly	Annual Mean	°C	0.47	1.17	1.91	1.00	2.00	3.05	1.26	2.46	3.76
	Annual Maximum	°C	0.45	1.20	1.96	0.96	2.05	3.19	1.22	2.55	3.94
	Annual Minimum	°C	0.46	1.21	1.99	0.97	2.03	3.18	1.21	2.49	3.88
	Summer Maximum	°C	0.04	1.32	2.57	0.78	2.52	4.36	1.12	3.25	5.46
	Summer Minimum	°C	0.51	1.36	2.20	1.12	2.33	3.58	1.42	2.88	4.40
	Winter Maximum	°C	0.13	1.02	1.96	0.53	1.73	3.02	0.62	2.07	3.60
	Winter Minimum	°C	0.03	1.09	2.25	0.47	1.95	3.60	0.55	2.30	4.28
Precipitation rate anomaly	Annual	%	-4.7	0.9	6.6	-7.9	-0.6	7.0	-8.2	-0.3	7.7
	Summer	%	-19.9	-2.7	15.9	-34.4	-14.0	6.5	-38.2	-16.8	4.7
	Winter	%	-2.9	6.5	17.4	-4.2	8.3	23.3	-5.2	10.4	28.9

31.3.4.2.2 Marine Climate Projections – Temperature, Sea Level Rise, Storm Surge and Coastal Erosion

254. Climate change is expected to affect sea surface and near-bottom temperatures, which in addition to a decline in sea ice formation, melting ice sheets and glaciers, contribute to global sea level rise due to thermal expansion of seawater (Fox-Kemper *et al.,* 2021). Over the last 40 years, average sea surface temperature around the UK has shown a significant warming trend of around 0.3°C per decade, with marked local and regional variations, as shown on **Plate 31-3** (sourced from Tinker *et al.*, 2023).

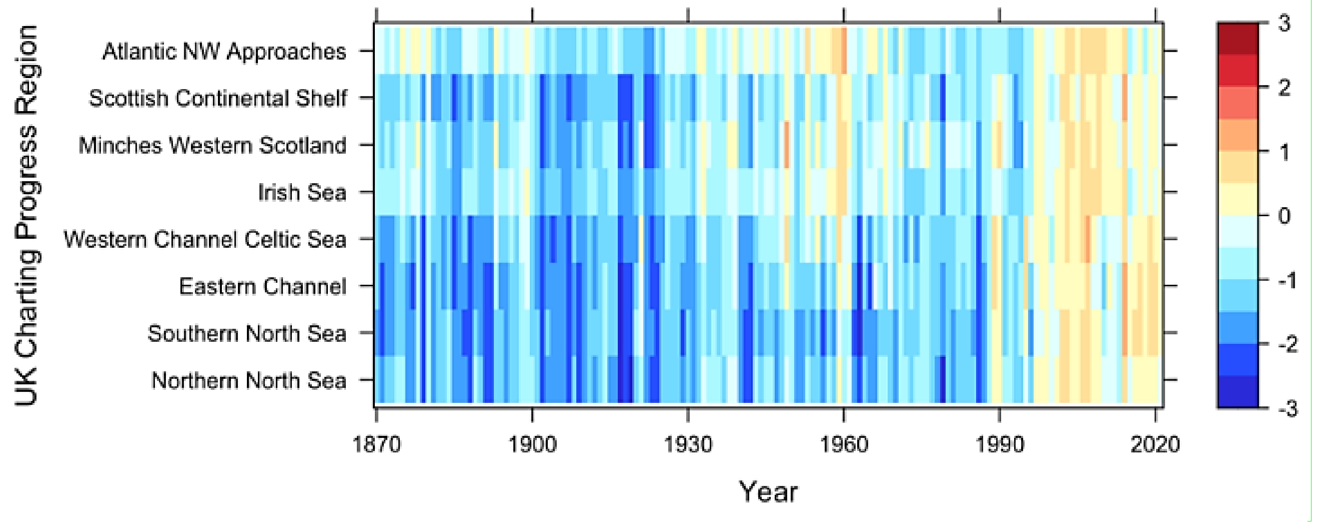

Plate 31-3 Observed Changes in UK Sea Temperatures

255. Across all regions in the last 40 years, the Southern North Sea has experienced the strongest surface warming trend of up to 0.5°C per decade. From the mid-1980s, sea temperatures have generally been higher in the Southern North Sea than the long-term average. The region has also experienced a significant increase in autumn bottom-temperatures (the warmest season) between 1993-2021. A strong increase in surface water temperature since the mid-1980s is also observed for the Northern North Sea, although temperatures may be influenced by the inflowing oceanic water from the North Atlantic (Cornes *et al.*, 2023).

256. Marine heat waves are periods of localised abnormally high sea temperatures above the long-term warming trend of the upper ocean. They last for several days or weeks, and potentially for several months, and can have significant adverse effects on the marine ecosystem. Marine cold waves represent the other end of the extreme of sea temperature conditions. A comparison of observations, recorded between 1982 to 1998 and 2000 to 2016 indicate the marine heat waves have increased in frequency by an average of 3.8 events per year around the British Isles. Larger increases occurred to the north of the British Isles, where an increase of up to six additional events are experienced on average in the 2000 to 2016 period compared to 1982 to 1998 (Cornes *et al.*, 2023).

257. The UKCP18 database does not provide information on changes to other coastal water properties such as sea surface temperature and acidification may be affected by climate change. However, climate projection data is not available for these hazards from the UKCP18 database. Any climate change risks to the project relating to these hazards will be assessed qualitatively.

258. 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, 2022), and sea levels are projected to continue rising beyond 2100 even with large reductions in GHG emissions over the 21st century (Met Office, 2019).

259. The UKCP marine climate change projection data are most applicable to onshore and coastal areas. Average sea level rise data for the nearest coastal grid square to the Project's landfall (coordinates 53.94, -0.08) were obtained for the RCP4.5 and RCP8.5 scenarios for the period between 2020 and 2080, as displayed in **Plate 31-4** and **Plate 31-5** respectively.

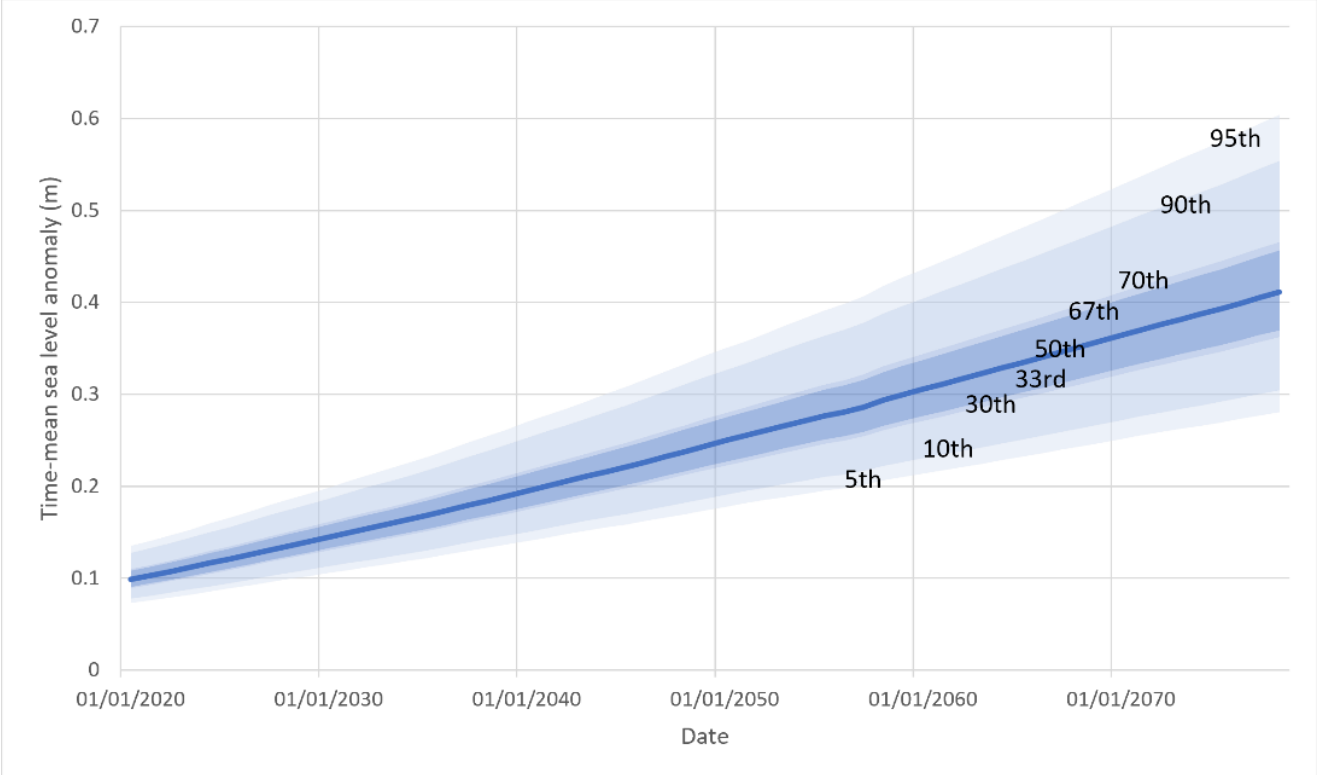

Plate 31-4 Time Mean Sea Level Anomaly (m) within the Study Area under RCP4.5 Relative to the 1981 to 2000 Baseline Period (Met Office, 2019)

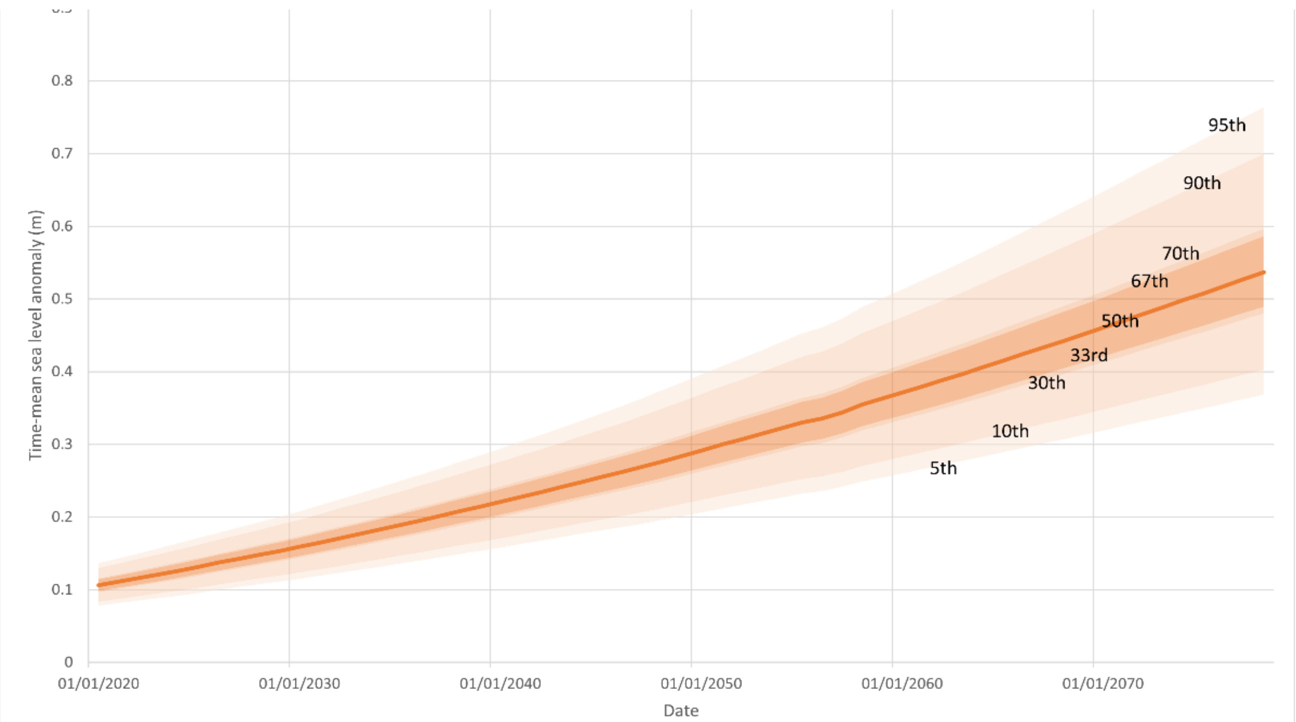

Plate 31-5 Time Mean Sea Level Anomaly (m) within the Study Area under RCP8.5 Relative to the 1981 to 2000 Baseline Period (Met Office, 2019)

260. As shown in **Plate 31-4** and **Plate 31-5**, it is projected that the average sea level in the coastal area of the Study Area would increase over the construction, O&M and decommissioning phases for both RCP4.5 and RCP8.5 scenarios.

261. Under RCP4.5, average sea level rise by 2030 (construction phase) is predicted to be between 0.11 and 0.20m (5^{th} and 95^{th} percentile respectively) compared to the 1981-2000 baseline.

262. Under RCP8.5, average sea level rise by 2060 (O&M phase) is predicted to be between 0.16 and 0.51m (5^{th} and 95^{th} percentile respectively) compared to the 1981-2000 baseline. By 2070 (decommissioning phase), average sea level rise is predicted to be between 0.32 and 0.64m (5^{th} and 95^{th} percentile respectively) compared to the 1981-2000 baseline.

263. It is predicted that future extreme sea levels will be driven by changes in mean sea level and not by the storm surge component or changes to tides. It is estimated that current regional rates of sea level rise around the UK are between 1 to 2mm per year. 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).

264. Models and observations suggest that there has been an increase in the frequency of severe storms and in significant wave heights in UK waters since the 1950s (MCCIP, 2020). However, 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 simulations for storm surges over the 21^{st} century suggest that there are likely to be no significant changes to storm surges in the UK. The 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 includes significant uncertainty. In the near future, natural variability dominates any climate-related trends in storms and waves. Towards the end of the 21^{st} century, there is some consensus that mean significant wave height is decreasing while the most extreme wave heights are increasing.

265. Sea level rise, in addition to other factors such as storms, anthropogenic disturbance and reduced sediment supply, will also result in more erosion of the coast. Approximately 17% of the UK coastline is undergoing erosion and approximately 28% of the 3,700km England and Wales coastline is experiencing erosion greater than 10 cm per year (Masselink *et al.*, 2020). The future baseline within the Study Area with respect to coastal erosion is discussed further in **Chapter 8 Marine Physical Processes** and **Volume 2, Appendix 31.4 Coastal Erosion Report**.

266. Ocean pH is decreasing due to climate change, through a process known as ocean acidification, which means that seas globally are becoming more acidic. The oceans absorb atmospheric CO_2, which dissolves and reacts with seawater to form carbonic acid. It is projected that ocean acidification will continue to occur during the 21^{st} century. (IPCC, 2019).

31.3.5 Assessment of Effects

267. The likely significant effects with respect to climate change resilience that may occur during construction, operation and decommissioning of the Project are assessed in the following sections. The CCR assessment follows the three-step methodology set out in **Section 31.3.3.3** and is based on the realistic worst-case scenarios defined in **Section 31.3.2.4**, with consideration of embedded mitigation measures identified in **Section 0**.

268. As noted in **Section 31.3.2.5**, the assessment of likely significant effects for the OCS zone infrastructure will remain the same for both development scenarios.

31.3.5.1 Step 1: Identifying Receptors, Climate Variables and Hazards

269. The receptors related to the Project considered to have potential vulnerabilities to climate hazards and therefore may experience climate change impacts during the construction, O&M and decommissioning phases are listed in **Table 31-37**.

Table 31-37 Project Receptors within the Study Area

Receptor Type	Receptor Description		Project Phase
	Onshore	Offshore	
Human	Site personnel	Site personnel	Construction O&M Decommissioning*
Infrastructure (Temporary)	Temporary assets such as compounds, accesses and plant and equipment	Temporary assets such as marine vessels and plant and equipment	Construction Decommissioning*
Infrastructure (Permanent)	Condition and performance of permanent infrastructure, including: • TJB and associated link box at landfall; • Onshore export cables, jointing bays and associated link boxes; • OCS; and • ESBI.	Condition and performance of permanent infrastructure, including: • Wind turbines; • Offshore platform(s); • Inter-array cables and offshore export cables; and • Cable and scour protection.	Construction O&M
Environmental	Mitigation and enhancement planting associated with the Project		O&M

* The final decommissioning strategy for the Project's onshore and offshore infrastructure has not yet been confirmed. However, decommissioning activities are considered the CCR assessment based on the assumption that the receptors would be similar to the construction phase. It is anticipated that a CCR assessment or similar will be undertaken during the preparation of the Offshore Decommissioning Programme and Onshore Decommissioning Plan prior to decommissioning (see **Table 31-23**, Commitment ID CO95) based on a review of recent extreme weather events and the latest climate change projection data.

270. Based on the existing and predicted future baseline information presented in **Section 31.1.1.1**, the main climate variables which could be affected by climate change that are relevant to the Study Area are extreme temperatures, extreme precipitation, extreme storms, sea level rise, lightning and changes to average precipitation and temperatures. The key climate hazards that have the potential to adversely affect the Project's receptors are shown in **Table 31-38**.

Table 31-38 Climate Variables and Hazards Relevant to the Study Area

Climate Variable	Climate Hazard
Extreme high temperatures	Increased frequency and severity of heatwaves
Extreme low temperatures	Change in frequency of ice conditions
Extreme low temperatures	Change in frequency and quantity of snowfall
Average temperature increase	Increase in average temperatures
Combined environmental change	Combined change in environmental conditions, e.g. dry spells and increase in temperatures can wildfires, subsidence and dust creation risks and affect vegetation health
Combined environmental change	Combined change in environmental conditions, e.g. increase in average sea surface temperatures, strong waves and increasing sea salinity can increase corrosion risks
Combined environmental change	Increased frequency and / or severity of all types of extreme weather event or climate hazard
Extreme precipitation	Increase in extreme river flows and levels (fluvial flooding)
Extreme precipitation	Increase in extreme surface water flows and levels (pluvial flooding)
Extreme precipitation	Increase in frequency and intensity of extreme precipitation events
Reduced average precipitation	Increased frequency and severity of drought conditions
Sea level rise	Tidal flooding
Sea level rise	Increased tidal range
Sea level rise	Increased coastal erosion
Extreme storms	Increase in storm intensity (wind speed)
Extreme storms	Increase in extreme wave height
Extreme storms	Increase in frequency of storm conditions

Climate Variable	Climate Hazard
Extreme storms	Change in storm patterns, e.g. wind direction
Lightning	Change in the frequency of lightning events

271. The Project may be exposed to a range of climate hazards, defined as extreme weather events and chronic climatic changes which have the potential to harm human, environmental or infrastructure receptors (IEMA, 2020). Exposure to climate hazards may lead to climate change impacts on the Project's receptors. The nature of the climate change impact will depend on the type of climate hazard and receptor but may include impacts such as physical damage, loss or deterioration of infrastructure and other assets, disruptions to activities resulting in delays, decline in performance of infrastructure and other assets, adverse working conditions posing health and safety risks and cost implications.

31.3.5.2 Step 2: Climate Vulnerability Assessment

272. The identified climate variables, hazards and the Project's receptors identified in Step 1 have been taken forward to the climate vulnerability assessment, which is provided in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment**. The climate vulnerability assessment is undertaken to identify the how climate hazards could result in potential climate change impacts on receptors and ensure that only impacts with a potential for likely significant effect is taken forward in the CCR assessment. Vulnerability has been determined based on the sensitivity and exposure of the Project's receptor to the climate hazard.

273. Within **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** a total of 59 potential climate change impacts across the Project's construction, O&M and decommissioning phases have been identified and assessed in the climate vulnerability assessment. Given the implementation of embedded mitigation measures, 51 of these impacts have been determined to have a low vulnerability rating. Therefore, they have been screened out from a detailed climate risk assessment, and a non-significant effect have been concluded from these impacts.

274. A total of eight climate change impacts have been determined to have a moderate vulnerability rating and therefore have been taken forward to Step 3 of the CCR assessment outlined below.

31.3.5.3 Step 3: Climate Risk Assessment

275. A climate risk assessment was undertaken on the climate change impacts determined to have a moderate vulnerability rating to evaluate the degree of climate risk to the Project's receptor based on the likelihood and consequence of climate change impact and determine the effect significance. The results of the climate risk assessment are presented for the construction (**Table 31-39**), O&M (**Table 31-40**) and decommissioning (**Table 31-41**) phases.

Table 31-39 Climate Risk Assessment – Construction Phase

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
Climate Change Impacts from Marine Climate Hazards during Construction (CCR-C-04)								
• Increase in storm intensity (wind speed) • Increase in extreme wave height • Increase in frequency of storm conditions • Change in storm patterns, e.g. wind direction	Offshore construction personnel	Extreme storminess can lead to unsafe working conditions.	CO93: Appropriate preparation and response measures will be implemented in accordance with the Outline PEMP to ensure occupational health and safety standards are maintained during periods of extreme storminess. As general practice, monitoring site conditions and severe weather alert services, scheduling construction activities based on weather forecasts and developing a severe weather protocol for extreme storm events will be undertaken. Specific to storms, measures may include designating safe shelter on board vessels for personnel, securing loose equipment and stored materials during periods of high winds and waves and determining safe limits for working conditions above which vessel activities and crane and rig operations would be halted. CO7 and CO94: Emergency response protocols will be implemented in accordance with the ERoCP and the Outline PEMP to enable fast recovery and continuity of offshore construction activities following emergency incidents. The protocol will also ensure offshore construction personnel have timely access to rescue and medical services.	**Moderate**	**Unlikely**	**Minor**	**Low (Not Significant)**	Not required.

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
Climate Change Impacts from Land-Based Climate Hazards during Construction (CCR-C-05)								
• Increase in extreme river flows and levels (fluvial flooding) • Increase in extreme surface water flows and levels (pluvial flooding) • Increase in frequency and intensity of extreme precipitation events	Onshore plant and equipment and temporary construction facilities	Flooding of the construction site and access roads may prevent site access.	CO43: Implementation of the Construction Surface Water Drainage Plan will ensure ongoing drainage to the surrounding land and minimise entrapment of water within the construction site. Climate change allowances are considered in the design of temporary construction drainage, which will mitigate the risk of overwhelming land drainage capacity during extreme precipitation events. CO45, CO93, CO94 and CO108: Appropriate preparation and response measures, including provision of the site-specific Flood Warning and Evacuation Plan and Project Emergency Response Plan, will be implemented in accordance with the Outline CoCP to protect plant and equipment, compounds and material storage areas from physical damage due to flooding. Flooding risks and extreme precipitation can be managed by: • Monitoring of short to medium-term flood warning services; • Implementation of a flood evacuation protocol; • Siting compounds and material storage areas outside of floodplains where possible; and • Waterproofing plant and equipment ahead of periods of heavy rainfall. Further details on mitigation measures against flooding are provided in **Volume 2, Appendix 21.3 Flood Risk Assessment**.	**Moderate**	**Moderate**	**Moderate**	**Moderate (Not Significant)**	Not required.

Table 31-40 Climate Risk Assessment – Operation and Maintenance Phase

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
Climate Change Impacts from Land-Based Climate Hazards during Operation (CCR-O-05)								
• Increase in extreme river flows and levels (fluvial flooding) • Increase in extreme surface water flows and levels (pluvial flooding) • Increase in frequency and intensity of extreme precipitation events	Condition and performance of above-ground link boxes, OCS and ESBI	Water ingress due to extreme precipitation events and flooding can lead to physical damage and deterioration of above-ground electrical infrastructure and decline in operational performance due to shutdowns.	CO44 and CO96: Implementation of the Operational Drainage Strategy will ensure ongoing drainage to the surrounding land and minimise entrapment of water within areas of permanent infrastructure. Climate change allowances are considered in the design of operational drainage and are informed by an FRA (see **Volume 2, Appendix 21.3**), which will mitigate the risk of overwhelming land drainage capacity during extreme precipitation events. Critical electrical infrastructure will be raised above the predicted flood level as required to ensure protection from water ingress. Further details on mitigation measures against flooding are provided in **Volume 2, Appendix 21.3 Flood Risk Assessment.** CO97: Regular and periodic inspections and maintenance of the onshore above-ground infrastructure will be undertaken over the O&M phase to ensure good conditions and performance. Monitoring of exposure to climate hazards will inform the planning of major repair and replacement events.	**Moderate**	**Moderate**	**Moderate**	**Moderate (Not Significant)**	Not required.

Table 31-41 Climate Risk Assessment – Decommissioning Phase

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
Climate Change Impacts from Marine Climate Hazards during Decommissioning (CCR-D-04)								
• Increase in storm intensity (wind speed) • Increase in frequency of storm conditions • Increase in extreme wave height • Change in storm patterns, e.g. wind direction	Marine vessels and offshore plant and equipment	High winds and waves during extreme storm events can result in physical damage to marine vessels and plant and equipment.	CO7 and CO95: Appropriate preparation and response measures implemented in accordance with decommissioning management plans will safeguard the occupational health and safety of personnel and prevent damage to vessels and plant and equipment. As general practice, monitoring site conditions and severe weather alert services, scheduling decommissioning activities based on weather forecasts and developing a severe weather protocol for extreme storm events will be undertaken. Specific to storms, measures may include designating safe shelter on board vessels for personnel, securing loose equipment and stored materials during periods of high winds and waves and determining safe limits for working conditions above which vessel activities and crane and rig operations would be halted. Emergency response protocols will be implemented to enable fast recovery and continuity of offshore decommissioning activities following emergency incidents. The protocol will also ensure offshore decommissioning personnel have timely access to rescue and medical services.	**Moderate**	**Likely**	**Moderate**	**Moderate (Not Significant)**	Not required.
	Offshore decommissioning personnel	Extreme storminess can lead to unsafe working conditions.		**Moderate**	**Likely**	**Moderate**	**Moderate (Not Significant)**	Not required.

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
• Increased frequency and / or severity of all types of extreme weather event, including heatwaves, storms and wave heights	Offshore decommissioning personnel, marine vessels and plant and equipment	Increased risk of disruption to offshore decommissioning activities during extreme weather events can lead to programme delays and associated cost implications. Prolonged or successive disruptions can result in impacts on the Project's overall decommissioning programme.	CO7 and CO95: Implementation of standard climate change resilience measures and emergency response protocols in decommissioning management plans will ensure that decommissioning activities are scheduled considering weather conditions and safe working limits. The management plans will enable decommissioning activities to adapt to deal with extreme weather events and will require that suitable contingencies are built into the programme to allow for unforeseen disruptions. Specific mitigation measures to manage direct impacts due to each type of extreme weather event on personnel, vessels, plant and equipment are discussed further in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** in relation to the relevant climate change impacts.	**Moderate**	**Likely**	**Moderate**	**Moderate (Not Significant)**	Not required.
Climate Change Impacts from Land-Based Climate Hazards during Decommissioning (CCR-D-05)								
• Increase in extreme river flows and levels (fluvial flooding) • Increase in extreme surface water flows and levels (pluvial flooding) • Increase in frequency and intensity of extreme precipitation events	Onshore plant and equipment and temporary decommissioning facilities	Flooding of the construction site and access roads may prevent site access.	CO95: Appropriate preparation and response measures implemented in accordance with decommissioning management plans will protect plant and equipment, compounds and material storage areas from physical damage due to flooding. Flooding risks and extreme precipitation can be managed by: • Monitoring of short to medium-term flood warning services; • Implementation of a flood evacuation protocol; • Siting compounds and material storage areas outside of floodplains where possible; and • Waterproofing plant and equipment ahead of periods of heavy rainfall. Further details on mitigation measures against flooding are provided in **Volume 2, Appendix 21.3 Flood Risk Assessment**.	**Moderate**	**Moderate**	**Moderate**	**Moderate (Not Significant)**	Not required.

Climate Hazard	Receptor	Potential Climate Change Impact	Proposed Embedded Mitigation Measure	Vulnerability	Likelihood	Consequence	Climate Risk and Effect Significance	Additional Mitigation and Residual Risk
• Increased frequency and / or severity of all types of extreme weather event, including flooding, heatwaves and storms	Onshore decommissioning personnel, plant and equipment and temporary decommissioning facilities	Increased risk of disruption to onshore decommissioning activities during extreme weather events can lead to delays and associated cost implications. Prolonged or successive disruptions can result in impacts on the Project's overall decommissioning programme.	CO95: Implementation of standard climate change resilience measures and emergency response protocols in decommissioning management plans will ensure that decommissioning activities are scheduled considering weather conditions and safe working limits. The management plans will enable decommissioning activities to adapt to deal with extreme weather events and will require that suitable contingencies are built into the programme to allow for unforeseen disruptions. Specific mitigation measures to manage direct impacts due to each type of extreme weather event on personnel, plant and equipment and other temporary decommissioning facilities are discussed further in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** in relation to the relevant climate change impacts. Regular inspections should be undertaken to ensure that any damage due to extreme weather is identified and addressed as soon as possible. Real-time monitoring of weather conditions and flood warnings will enable construction activities to be adjusted as needed.	**Moderate**	**Likely**	**Moderate**	**Moderate (Not Significant)**	Not required.

31.3.5.4 Additional Mitigation Measures

276. No additional mitigation measures are proposed with respect to climate change resilience.

31.3.6 Cumulative Effects

277. As discussed in **Section 31.3.3.4**, the only climate hazard with a potential for cumulative effects related to climate change resilience is surface water flooding, which is discussed in **Chapter 21 Water Resources and Flood Risk**. Further consideration of cumulative effects due to interdependencies between the Project and other critical infrastructure will be addressed at ES stage.

31.3.7 Transboundary Effects

278. As discussed in **Section 31.3.3.5**, the effects considered in the CCR assessment are from climate change on the Project as a receptor, therefore transboundary effects have been scoped out of the assessment.

31.3.8 Inter-Relationships and Effects Interactions

31.3.8.1 Inter-Relationships

279. As the CCR assessment considers effects of climate change on the Project, while other topics consider the effects of the Project on receptors in the surrounding environment, there are not considered to be any inter-relationships with other environmental effects with respect to climate change resilience.

31.3.8.2 Interactions

280. The CCR assessment presented in **Section 31.3.5** and **Volume 2, Appendix 31.3 Climate Vulnerability Assessment** inherently considers the potential for different climate hazards to interact, where relevant, and result in synergistic climate change impacts on receptors such as the combined impact of extreme precipitation events and surface water flooding, drought conditions and extreme temperatures, or storms and extreme temperatures or flooding.

281. In addition, the embedded mitigation measures identified through the CCR assessment ensure that the Project as a whole remains resilient to both current and future climate conditions during the construction, O&M and decommissioning phases, and these mitigation measures remain appropriate if more than one climate change impact occurs at the same time. Combined impacts due to multiple extreme weather events are not expected to change the effect significance presented in the CCR assessment. Therefore, no additional consideration of interactions is required with respect to climate change resilience.

31.3.9 Monitoring Measures

282. Monitoring is an inherent part of the embedded mitigation measures (see **Table 31-23**, Commitment IDs CO93 to CO97) to ensure the Project's climate change resilience during the construction, O&M and decommissioning phases. Therefore, no additional monitoring measures are proposed with respect to climate change resilience.

283. NPS EN-1 (DESNZ, 2023a) and the IEMA's guidance (2020) recognises the need for developments with long operational lifetimes to adopt an adaptive management approach, given the uncertainties in longer-term climate change projections and the potential for climate change impacts to change over time. Through monitoring of site-specific weather and metocean conditions, recent extreme weather events and up-to-date climate change projection data, remedial actions may be identified and implemented as part of ongoing maintenance as and when required to ensure that the Project can adapt to future climate conditions and maintain its climate change resilience. As such, Commitment ID CO97 (see **Table 31-23**) refers to the requirement for the Project's O&M strategy to be adaptive.

31.3.10 Summary

284. A three-step assessment process has been undertaken to evaluate future trends in climate change impacts and the effect on the Project's vulnerability and resilience to such changes. The CCR assessment has been informed by considerations of the existing baseline and predicted future baseline climates based on observed meteorological and climate conditions and climate change projection data.

285. Relevant climate variables, hazards and receptors within the Study Area have been identified in Step 1, which were taken forward to a climate vulnerability assessment (Step 2). The vulnerability assessment considered whether and how the Project's receptors may be potentially vulnerable to climate hazards and therefore experience climate change impacts during the construction, O&M and decommissioning phases.

286. A total of 59 potential climate change impacts have been identified and assessed in the climate vulnerability assessment (Step 2). 51 impacts were determined to have a low vulnerability rating due to the implementation of embedded mitigation measures, and therefore they were screened out from further assessment. A non-significant effect has been concluded for low vulnerability impacts, as shown in **Volume 2, Appendix 31.3 Climate Vulnerability Assessment**.

287. Eight climate change impacts were determined to have a moderate vulnerability rating and therefore were taken forward to a detailed climate risk assessment (Step 3). The assessment, as presented in **Section 31.3.5.3**, determined that these impacts range from low to moderate risk with the implementation of embedded mitigation measures. A non-significant effect has been concluded for all eight impacts, and no additional mitigation measures are therefore required.

288. The CCR assessment has concluded that there are no likely significant effects on the Project as a result of climate change impacts during the construction, O&M and decommissioning phases.

31.3.11 Next Steps

289. The CCR assessment will be updated as required at the ES stage to account for more refined project information (i.e. refinements to the Project Design Envelope and Offshore and Onshore Development Areas). This is expected to include information to inform an assessment of cumulative effects with respect to interdependencies between the Project and other critical infrastructure.

290. Any refinement to the CCR assessment between PEIR and ES is unlikely to change the effect significance concluded in this assessment. As the Project develops, the climate change resilience measures included in the Outline CoCP and Outline PEMP may be further refined and updated for the DCO application submission.

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Acronym	Definition
BEIS	Department for Business, Energy and Industrial Strategy
BSI	British Standard Institution
BSMP	Battery Safety Management Plan
CCC	Climate Change Committee
CCGT	Combined Cycle Gas Turbine
CCR	Climate Change Resilience
CEA	Cumulative Effect Assessment
CMP	Carbon Management Plan
CoCP	Code of Construction Practice
COP	Conference of the Parties
DCO	Development Consent Order
DESNZ	Department of Energy Security and Net Zero
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ERoCP	Emergency Response and Cooperation Plan
ERYC	East Riding of Yorkshire Council
ES	Environmental Statement
ESBI	Energy Storage and Balancing Infrastructure
FRA	Flood Risk Assessment
GHG	Greenhouse Gas
GLoMEEP	Global Maritime Energy Efficiency Partnerships Project
GWP	Global Warming Potential
HGV	Heavy Goods Vehicle

Acronym	Definition
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICE	Inventory of Carbon and Energy
ICES	International Council for the Exploration of the Sea
IEMA	Institute of Environmental Management and Assessment
IPCC	Intergovernmental Panel on Climate Change
LCA	Lifecycle Assessment
LULUC	Land Use and Land Use Change
MCA	Maritime and Coastguard Agency
MCCIP	Marine Climate Change Impacts Partnership
MGN	Marine Guidance Note
MHLCG	Ministry of Housing, Local Communities and Government
MPS	Marine Policy Statement
NAP	National Adaptation Programme
NDC	Nationally Determined Contribution
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and Maintenance
OCS	Onshore Converter Station
ONS	Office of National Statistics
PCS	Power Conversion System
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan

Acronym	Definition
PPE	Personal Protective Equipment
RCP	Representative Concentration Pathway
SOV	Service Operation Vessel
SSP	Shared Socio-Economic Pathway
TJB	Transition Joint Bay
UKCP	UK Climate Projection
UNFCCC	United Nations Framework Convention on Climate Change