NORTH FALLS

Offshore Wind Farm

ENVIRONMENTAL STATEMENT

Chapter 33 Climate Change

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NORTH FALLS
Offshore Wind Farm

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Glossary of Acronyms

BEIS	Department of Business and Energy Industry Strategy (replaced by DESNZ)
CBS	Cement Bound Sand
CCC	Climate Change Committee
CCR	Carbon Capture Readiness
CCRA	Climate Change Resilience Assessment
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CoCP	Code of Construction Practice
COP	Conference of the Parties
COP22	22nd Climate Change Conference of the Parties
COP26	26th Climate Change Conference of the Parties
COP28	28th Climate Change Conference of the Parties
CTV	Crew Transfer Vessel
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
ECC	Essex County Council
ECAC	Essex Climate Action Commission
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
GHG	Greenhouse Gas
GW	Gigawatt
GWP	Global Warming Potential
HDD	Horizonal Directional Drilling
HFC	Hydrofluorocarbons
HGV	Heavy Goods Vehicle
HLV	Heavy Lift Vessel
HVAC	High Voltage Alternative Current

ICE	Inventory of Carbon and Energy
IEMA	Institute of Environmental Management and Assessment
JUV	Jack-up installation vessels
kt	Kilotonne
kWh	Kilowatt-hour
LCA	Life Cycle Analysis
MCCIP	Marine Climate Change Impacts Partnership
MLWS	Mean low water springs
MW	Megawatt
NAP	National Adaptation Plan
NFOW	North Falls Offshore Wind Farm Limited
NF_3	Nitrogen trifluoride
NPS	National Policy Statements
NPPF	National Planning Policy Framework
NREL	National Renewable Energy Laboratory
NRMM	Non-road mobile machinery
NSIP	Nationally Significant Infrastructure Project
N_2O	Nitrous oxide
O&M	Operation and maintenance
OCP	Offshore converter platform
OSP	Offshore substation platform
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PFC	Perfluorocarbons
RCP	Representative Concentration Pathway
SF_6	Sulphur hexafluoride
SOV	Service operation vessel
UKCP	UK Climate Projections
UNFCCC	United Nations Framework Convention on Climate Change
VEOWL	Five Estuaries Offshore Wind Farm Limited
WTG	Wind turbine generator

Glossary of Terminology

Array area	The offshore wind farm area, within which the wind turbine generators, array cables, platform interconnector cable, offshore substation platform(s) and/or offshore converter platform will be located.
Array cables	Cables which link the wind turbine generators with each other and the offshore substation platform(s).
Cable circuit (onshore)	The onshore export cables are comprised of cable 'circuits'. Each cable circuit is typically comprised of three power cables, as well as fibre cables and earth cables. It is expected that each circuit would compromise up to seven cables in total.
Climate change impact	An impact from a climate hazard which affects the ability of the receptor to maintain its functions or purpose.
Climate hazard	A weather or climate-related event or trend in climate variable, which has potential to do harm to receptors such as increased precipitation or storms.
Climate variable	A measurable, monitorable aspect of the weather or climate conditions, such as temperature and wind speed.
Climate vulnerability	Vulnerability is defined as the degree of response to a change in the environment and based on the capacity to accommodate or recover from change and considered to be a function of both sensitivity, which the potential to be affected by change, and exposure, both spatially and temporally, to climate hazards.
CO_2e	Carbon dioxide equivalent is a metric measure that is used to compare emissions from various greenhouse gases (GHGs) on the basis of their global warming potential by converting amounts of other GHGs to the equivalent amount of carbon dioxide (CO_2).
'Cradle to (factory) gate'	The extraction, manufacture and production of materials to the point at which they leave the factory gate of the final processing location
g $CO_2e.kWh^{-1}$	Grams (g) of carbon dioxide equivalent (CO_2e) per kilowatt-hour (kWh) of electricity generated
Haul road	The track along the onshore cable route used by construction traffic to access different sections of the onshore cable route.
Horizontal directional drill (HDD)	Trenchless technique to bring the offshore cables ashore at the landfall. The technique will also be used for installation of the onshore export cables at sensitive areas of the onshore cable route.
Jointing bay	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The location where the offshore cables come ashore.
Link boxes	Underground chambers or above ground cabinets next to the onshore export cables housing low voltage electrical earthing links.
Offshore cable corridor	The corridor of seabed from array area to the landfall within which the offshore export cables will be located.

Offshore export cables	The cables which bring electricity from the offshore substation platform(s) to the landfall, as well as auxiliary cables.
Offshore project area	The overall area of the array area and the offshore cable corridor.
Offshore substation platform(s)	Fixed structure(s) located within the array area, containing HVAC electrical equipment to aggregate the power from the wind turbine generators and increase the voltage to a more suitable level for export to shore via offshore export cables.
Offshore converter platform	Should an offshore connection to an HVDC interconnector cable be selected, an offshore converter platform would be required/ This is a fixed structure located within the array area, containing HVAC and HVDC electrical equipment to aggregate the power from the wind turbine generators, increase the voltage to a more suitable level for export and convert the HVAC power generated by the wind turbine generators into HVDC power for export to shore via a third party HVDC interconnector cable.
Onshore cable corridor(s)	Onshore corridor(s) considered at PEIR within which the onshore cable route, as assessed at ES, is located.
Onshore cable route	Onshore route within which the onshore export cables and associated infrastructure would be located.
Onshore export cables	The cables which take the electricity from landfall to the onshore substation. These comprise High Voltage Alternative Current (HVAC) cables and auxiliary cables, buried underground.
Onshore project area	The boundary within which all onshore infrastructure required for the Project will be located (i.e. landfall; onshore cable route, accesses, construction compounds; onshore substation and cables to the national grid substation)
Onshore substation	A compound containing electrical equipment required to transform and stabilise electricity generated by the Project so that it can be connected to the national grid.
Onshore substation works area	Area within which all temporary and permanent works associated within the onshore substation are located, including onshore substation, construction compound, access, landscaping, drainage and earthworks.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the wind turbine generator foundations and offshore substation platform (OSP) or / and offshore converter platform (OCP) foundations as a result of the flow of water.
Temporary construction compound	Area set aside to facilitate construction of the onshore cable route. Will be located adjacent to the onshore cable route, with access to the highway where required.
The Applicant	North Falls Offshore Wind Farm Limited (NFOW).
The Project or ‘North Falls’	North Falls Offshore Wind Farm, including all onshore and offshore infrastructure.
Transition joint bay	Underground structures that house the joints between the offshore export cables and the onshore export cables
Trenchless crossing compound	Areas within the cable corridor which will house trenchless crossing (e.g. HDD) entry or exit points.

Wind turbine generator (WTG)	Power generating device that is driven by the kinetic energy of the wind

33 Climate Change

33.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the likely significant effects of the North Falls offshore wind farm (hereafter 'North Falls' or 'the Project') on climate change, as well as the potential environmental effects of climate change on the Project. Therefore, the chapter comprises a Greenhouse Gas (GHG) assessment and Climate Change Resilience Assessment (CCRA) to consider the likely significant effects related to climate change during the construction, operation and maintenance (O&M), and decommissioning phases of the Project.

2. The GHG assessment predicts the contribution of the Project to GHG emissions in the UK, and it's 'net effect' compared to a baseline of 'without the Project'. The CCRA considers the Project's adaptive capacity to climate change, defined by the potential or ability to adapt to the effects of climate change, which is based on the resilience of the Project to the projected effects of climate change over its lifespan.

3. This chapter has been written by Royal HaskoningDHV, with the assessment undertaken with specific reference to the relevant legislation and guidance, of which the principal policy documents with respect to Nationally Significant Infrastructure Projects are the National Policy Statements (NPS). Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Effect Assessment (CEA) are presented in Section 33.8.

4. The assessment should be read in conjunction with the following linked chapters (Volume 3.1) and appendices (Volume 3.3):

    - ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10);
    - ES Chapter 15 Shipping and Navigation (Document Reference: 3.1.17);
    - ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23);
    - ES Chapter 22 Land Use and Agriculture (Document Reference: 3.1.24);
    - ES Chapter 27 Traffic and Transport (Document Reference: 3.1.29); and
    - ES Chapter 34 Major Accidents and Disasters (Document Reference: 3.1.36).

5. Additional information to support the GHG assessment presented in this Chapter includes:

    - ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71).

33.2 Consultation

6. Consultation with regard to climate change and the GHG assessment has been undertaken in line with the general process described in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8). The key elements to date have

included scoping, the ongoing technical consultation via the Air Quality, Noise and Vibration and Climate Change Expert Topic Group (ETG), and comments received on the Preliminary Environmental Information Report (PEIR). This feedback received has been considered in preparing the ES.

7. Table 33.1 provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

8. This chapter has been updated following the consultation on the PEIR in order to produce the final assessment. Full details of the consultation process will also be presented in the Consultation Report, submitted as part of the DCO application.

Table 33.1 Consultation responses

Consultee	Date / Document	Comment	Response / where addressed in the ES
Planning Inspectorate	26/08/2021 / Scoping Opinion	The ES should include a description and assessment (where relevant) of the likely significant effects the Proposed Development has on climate (for example having regard to the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development. This may include, for example, alternative measures such as changes in the use of materials or construction and design techniques that will be more resilient to risks from climate change. Please note that further comments are made on climate change in section 6.3 of this Scoping Opinion.	A GHG assessment has been undertaken as part of the PEIR and updated for the ES and is presented in this chapter and within Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). The likely significant effects of the Project on the climate, as assessed through the GHG assessment, are presented in Section 33.6.1. A CCRA has been undertaken for the ES and is presented in this chapter (see Section 33.6.2). The assessment evaluates the Project's adaptive capacity and describes mitigation measures which have been incorporated to ensure that the design is resilient to the projected effects of climate change.
		Table 4.7 Vulnerability of infrastructure to climate change during construction and decommissioning. The Scoping Report states that the vulnerability of the Proposed Development to climate change during the construction phase will not be considered as construction is planned to take place within the next 10 years and climate change impacts are not considered to be likely during that timeframe. The Inspectorate considers that there is potential for climate change impacts to have likely significant effects on the construction phase, for example in respect of increased flood risk that may require mitigation in the planning of construction compounds and temporary drainage strategies. The Scoping Report does not state what the anticipated operational lifetime of the Proposed Development is likely to be; however, the Inspectorate notes that other offshore windfarms have expected lifetimes of approximately 30 years, and on that basis would expect decommissioning to commence in around 2060 at the earliest. The decommissioning phase may be vulnerable to the impacts of climate change, particularly given the timescales involved.	A CCRA has been undertaken for the ES and is presented in this chapter (see Section 33.6.2), which includes a high-level assessment of the vulnerability of infrastructure to climate change during both construction and decommissioning. The assessment evaluates the Project's adaptive capacity and describes mitigation measures which have been incorporated to ensure that the design is resilient to the projected effects of climate change.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		The ES should therefore include an assessment of these matters, albeit it is acknowledged that it may be high level and it may involve cross referencing to other assessments within the ES, eg marine geology, oceanography and physical processes, water resources and flood risk and major accidents and disasters.	
		Para 809 Cumulative effects. The Scoping Report states that a cumulative assessment of greenhouse gas (GHG) emissions with other projects is proposed to be scoped out of the ES as the Proposed Development is responsible for its activities only. The ES should include a description of the likely significant cumulative effects of the Proposed Development with other projects scoped into the assessment, including those in relation to GHG emissions where significant effects are likely to occur. The Inspectorate notes that other cumulative effects, i.e. those relating to vulnerability of the Proposed Development and other projects to climate change will be scoped into the ES as part of relevant aspects chapter including water resources and flood risk, and coastal erosion.	Standard practice for GHG assessments is to only consider the development being assessed, as the 'receptor' for the assessment is the global atmosphere. IEMA guidance (2022) states that *"effects of GHG emissions from specific cumulative projects… in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has emissions for assessment over any other."* Therefore, a cumulative assessment of GHG emissions has not been carried out, in accordance with the approach detailed in IEMA guidance. The CCRA cumulative effects assessment in respect of the Projects vulnerability to climate change is presented in Section 33.8.2, and references other technical assessments (i.e., ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10), ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23)).
		Section 4.4.4 Assessment methodology. The Inspectorate notes that a GHG assessment will be prepared to support the assessment of effects during construction, operation and decommissioning of the Proposed Development. It is unclear from the Scoping Report as to which elements or activities will be specifically included within the GHG assessment, e.g. whether this will road traffic emissions, materials, energy used, any supporting activities or infrastructure, and which gases would be considered, given that there a range of	The GHG assessment has included embodied carbon in materials, vessels, plant and equipment and road traffic during construction and road traffic and vessels during O&M. The elements included in the GHG assessment are detailed further in Section 33.4.1 and in ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). It should be noted that the design of the Project has further developed since PEIR, and any updates to the Project have been

Consultee	Date / Document	Comment	Response / where addressed in the ES
		gases that are considered to be GHGs. This should be explained in the ES and justification should be provided for any exclusions. The Inspectorate notes that paragraph 810 refers to the use of UK carbon budgets to frame the GHG assessment in the context of potential transboundary impacts. For avoidance of doubt, the Inspectorate has assumed that this applies to the assessment methodology for GHG emissions scoped into the ES. The Inspectorate notes that the sixth carbon budget as set out in the Carbon Budget Order 2021 is the most recent, but expects that the GHG assessment would be carried out by reference to the carbon budget in place at the time of submission of any DCO, reflecting targets for the relevant construction and operational (design) years. The ES should set out the criteria by which the assessment will determine whether the effects associated with climate change impacts are significant or not significant, and a conclusion on this should be reported in the ES.	reflected in the updated GHG assessment (see Section 33.6.1). In this assessment, the term ‘GHG’ or ‘carbon’ encompasses carbon dioxide (CO_2) and the six other gases referenced in the Kyoto Protocol (methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3)). The results are presented in carbon dioxide equivalent (CO_2e), which recognises that different gases have notably different global warming potentials (GWPs). The effect significance of the Project’s GHG emissions is evaluated for each phase of the Project, in accordance with IEMA (2022) guidance, by comparing the magnitude of emissions with the relevant UK Carbon Budget and comparing 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 a science-based 1.5°C transition towards net zero. The construction phase is compared with the 5th UK Carbon Budget (2028 to 2032), given construction will commence within the next five years and likely occur during this Budget period. For the O&M and decommissioning phases, the relevant UK Carbon Budgets have not all been set or do not apply, as the Project’s operational lifetime extends beyond 2037 (the latest current date the Carbon Budgets extend to) and 2050, the year which the UK commits to achieving net zero. The first give years of the Project’s O&M phase aligns with the 6th Carbon Budget (2033-2037), therefore O&M GHG emissions over this budget period have also been compared for further context.

Consultee	Date / Document	Comment	Response / where addressed in the ES
			The assessment methodology of likely significance climate change effects is presented in Section 33.4.3.1.
London Borough of Waltham Forest	10/08/2021 / Scoping Opinion	The applicants have submitted a EIA Scoping Report which has been reviewed by officers. The report covers a wide breadth of issues proportionate to the status of this application as a NSIP, and include both off-shore physical and geological issues, as well as wider socio-economic and on-shore visual and physical impacts such as air quality and wider climate change. It is not considered that there are any significant issues raised by the scoping report which would directly impact upon LBWF, and therefore no comments are made in relation to the scoping opinion.	Noted.
Essex County Council	09/07/2021 / Expert Topic Group (ETG)	Essex County Council appreciated the consideration of climate change in the Application. No comments were made on the EIA approach to climate change for the Project outlined in the ETG meeting.	The climate change chapter comprises two assessments – a GHG assessment and a CCRA. The methodology for the assessment is detailed in Section 33.4. Additional guidance (IEMA, 2022) has been released since the ETG meeting and has been used in the GHG assessment.
Essex County Council	20/08/2021 / Scoping Opinion	It is noted that updates to the EIA Regs in 2017 state this this important topic requires consideration, within Schedule 4 of the same it states at para 5 that: *A description of the likely significant effects of the development on the environment resulting from, inter alia …. (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change*. It is also backed up by case law which states this is now a consideration for NSIPs.	This chapter presents the GHG assessment for the Project. Any updates to the Project have been reflected in the updated GHG assessment. A CCRA has been undertaken for the ES and is presented in this chapter (see Section 33.6.2).
		It is correct that the development of the magnitude as proposed would be subject to a number of factors in relation to climate change going forward, providing post construction a low carbon energy source to fall in with Government guidance to promote the same. It is also considered necessary that the development itself must show how it can achieve zero carbon during its lifetime from construction to implementation and contribute to net carbon gain.	This chapter provides the GHG assessment, and the GHG payback period is presented in Section 33.6.1.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		Measures to avoid, prevent, mitigate and to seek to offset carbon impact must be ensured, including the adaption to its effects, such as protecting communities from water shortages, flooding and heatwaves.	The likely significant effects of the Project on the climate, as assessed through the GHG assessment, are presented in Section 33.6.1. This assessment concludes that the Project will enable the provision of renewable energy to the UK electricity grid and contribute positively to both the UK's progress in meeting its net zero targets, and to the climate system. Therefore, the overall significance of effect for the whole lifecycle of the Project is considered to be beneficial and as such no mitigation measures are required.
		The Essex Climate Action Commission was set up and a series of Special Interest Groups (SIG) advise the Council about tackling climate change. The commission has over 30 members over a wide range of senior professionals, local councillors, academics, business's, people and 2 members of the Young Essex Assembly. The commission will run for 2 years initially and make recommendations about how we can improve the environment and the economy of Essex. The findings of the commission will not be published until Q3 2020 but the applicant should have knowledge of this initiative, their values and objectives and the implications for the future aspirations of the development.	Noted. The '*Net Zero: Making Essex Carbon Neutral*' (Essex Climate Action Commission, 2021) report has been reviewed and taken into consideration in this chapter (Section 33.4.1.3).
		Mitigation against the climate change impacts of the development will be brought through a range of issues that will need to be considered in the EIA, including, but not limited to transportation (electric vehicles and charging points, use of public transport, car sharing, sustainable low carbon traffic modes etc) the built environment, green infrastructure (planting, Sustainable Urban Drainage, greenhouse gas emissions, air quality etc).	This chapter presents the GHG assessment for the Project. Project-level GHG mitigation is being incorporated into the design development process wherever it is practicable to do so. NFOW has sought to reduce Project GHG emissions during the construction and operation phases. The process of reducing GHG emissions from the Project itself is guided by the hierarchy summarised in Table 33.4 and discussed in Section 33.4.4.1.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		The submitted ES should include a description and assessment (where relevant) of the likely significant effects the Proposed Development has on climate (for example having regard to the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project during its construction phase, to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development. This may include, for example, alternative measures such as changes in the use of materials or construction and design techniques that will be more resilient to risks from climate change.	This chapter presents the GHG assessment and CCRA for the Project. Any updates to the Project have been reflected in the updated GHG assessment. A summary of climate change resilience measures which are embedded into the Project design can be found in Section 33.3.3.
		It is noted and recognised in part 4.4 of the submission that the applicants propose to include climate change as an important topic in their eventual EA. This is hugely welcomed and will be to the benefit of the scheme and its final consideration. The information and initiatives within this chapter are significant, the joint council's look forward to discussion this topic further with the applicants in the forthcoming schedule of stakeholder engagement.	Noted. The Climate Change topic was included as part of the Traffic and Transport, Air Quality, Climate Change, Noise and Vibration Expert Topic Group meeting in July 2021 (see below) and joint North Falls and Five Estuaries Offshore Wind Farms ('Five Estuaries') 'Onshore Noise & Vibration, Air Quality and Climate Change ETG in October 2023.
Tendring District Council	14/07/2023 / Consultation Response Letter	The proximity of the development and associated construction activity to homes genuinely runs the risk of undermining public support for off-shore wind and other means of generating clean, renewable energy. This could be damaging to the government's ambitions around zero carbon and the fight against climate change which is of imperative importance to all residents and future generations.	Noted. The potential impacts on sensitive receptors (i.e., neighbouring properties and homes) during construction are assessed throughout the technical chapters of the Environmental Statement and have been minimised insofar as possible. This is detailed further in the relevant technical chapters (all in Volume 3.1), e.g.ES Chapter 20 Onshore Air Quality (Document Reference: 3.1.22), ES Chapter 26 Noise and Vibration (Document Reference: 3.1.28), ES Chapter 27 Traffic and Transport (Document Reference: 3.1.29), ES Chapter 28 Human Health (Document Reference: 3.1.30), etc.
Essex County Council	14/07/2023 / Consultation Response	Climate Focus Area (CFA). The proposed development is situated within the Essex Climate Action Commission's (ECAC) recommended Climate Focus Area (CFA), which is formed of the Blackwater and Colne River catchment areas (please see Figure 1 on the	Noted. This Project will enable to provision of renewable energy to the UK electricity grid and contribute positively to the UK's progress in meeting its net zero targets, as

Consultee	Date / Document	Comment	Response / where addressed in the ES
	Letter, Appendix One	following page for further details). The objective of this recommendation is for the CFA to *"accelerate [climate] action and provide exemplars, for learning and innovation: adopting Sustainable Land stewardship practices: 100% by 2030 and Natural Green Infrastructure: 30% by 2030"* (ECAC, 2021). Among the objectives of the CFA are to achieve net zero carbon, biodiversity net gain, improve soil health and air quality, reduce flooding and urban heat island effect, and enhance amenity, liveability and wellbeing of Essex communities. It will achieve this by wholesale landscape change in rural areas and urban areas and it will look to developments to contribute to these targets.	well as furthering the objectives of the CFA to achieve net zero carbon.
		Energy & Low Carbon ECC welcomes the support the Government's Energy Security Strategy gives for offshore wind expansion and goal of 50 GW of offshore wind production by 2030. The Essex Sector Development Strategy advocates offshore wind through recognising clean energy as a key growth area for Essex with a key role for offshore wind in that as part of the outcomes being delivered from the strategy. The ECAC report also recognises the need to embrace large-scale renewable energy installations, such as solar and wind farms. And the recommendations also include: Essex to produce enough renewable energy within the county to meet its own needs by 2040. All large-scale renewable developments to have an element of community ownership from 2021.	Noted. The Applicant welcomes the advocation of offshore wind and embracement of large-scale renewable energy installations in the ECAC report. Further details on the energy generation by the Project are described in ES Chapter 2 Need for the Project (Document Reference: 3.1.4), and details of the Project's ownership structure can be found in the Funding Statement (Document Reference: 6.4).
		We would welcome details on how Green House Gas (GHG) emissions of associated infrastructure i.e. the substation, and throughout the lifetime of the development will be minimised including embodied and operational carbon. Whilst the overall project is likely to be considered net zero due to the net positive impact of the generation of renewable energy- it is also important that emissions reduction measures are sought at each stage of the Project. The aim should be for a net zero development at all stages/ within each element of infrastructure of the Project and reliance on the positive impact of renewable energy production should not be relied upon to mitigate those. The potential impact on not just the UK to meet its climate GHG reduction commitments and wind energy targets, but the impact on Essex and	The Project will be seeking to minimise, where practicable, GHG emissions during construction, operation and decommissioning (including embodied carbon) through the use of best available techniques (i.e., materials, technologies and methodologies). The extent of the Project design has been reduced since PEIR stage, with the number of export cables reducing from 4 to 2, onshore substation footprint reducing from 8 ha to 6 ha, number of wind turbine generators (WTGs) reducing from 72 to a maximum of 57 and maximum

Consultee	Date / Document	Comment	Response / where addressed in the ES
		the various commitments by ECC and its boroughs/districts should also be considered within the PEIR and future assessments/reports.	turbine height reducing by 20m. Plans will seek to further minimise GHG emissions through efficient design, e.g. offshore vessel and onshore traffic management plans. A summary of mitigation measures recommended to reduce GHG emissions throughout the lifetime of the Project is provided in Sections 33.3.3 and 33.6.1.
		Additionally, BEIS analysis has identified the incredible need for energy storage, in a decarbonised net zero energy system. This is due to the intermittent nature of renewable energy technologies such as offshore wind. Hence it is asked for confirmation as to the plans for the NF project also include battery storage or more innovative solutions such as green hydrogen production.	The Project will not include battery storage, as this has been discounted as an option. The Project will not directly generate hydrogen; however, it is anticipated that the electricity generated could end up in the electrolysis supply chain.
		Climate Change ECC notes the submission of details pursuant to climate change in Chapter 33 of the PEIR. ECC notes the acknowledgement that the submission at 33.1.5 that: *"The design of the Project is currently being developed and adaptive capacity to climate change (defined as 'the potential or ability of a system to adapt to the effects or impacts of climate change') is being incorporated into the design. At this stage of the design, there is insufficient information to undertake an assessment to determine the vulnerability and resilience of the Project to climate change. This will be considered further at the assessment stage for the Environmental Statement (ES)."* ECC looks forward to the receipt of the as promised details at DCO submission. It is noted that the current proposals make reference to The Essex Climate Action Commission, which was set up to advise Essex County Council with respect to tackling climate change. The Commission published its 'Net Zero: Making Essex Carbon Neutral' report in July 2021 (Tendring District Council, 2021), which encourages large-scale renewable energy installations such as wind farms as proposed by this NSIP to be embraced in Essex. The Commission also advises that residents and businesses should be supplied with 100% renewable energy, and to	A CCRA has been undertaken for the ES and is presented in this chapter (see Section 33.6.2). The assessment evaluates the Project's adaptive capacity and describes mitigation measures which have been incorporated to ensure that the design is resilient to the projected effects of climate change. Noted. The '*Net Zero: Making Essex Carbon Neutral*' (Essex Climate Action Commission, 2021) report has been reviewed and taken into consideration in this chapter (Section 33.4.1.3). ES Chapter 2 Need for the Project (Document Reference: 3.1.4) provides details of the renewable electricity anticipated to be generated by the Project.

Consultee	Date / Document	Comment	Response / where addressed in the ES
		see Essex produce enough renewable energy within the county to meet its own needs by 2040.	
Essex County Council, Tendring District Council	01/10/2023 North Falls and Five Estuaries Air Quality, Noise and Vibration and Climate Change ETG Meeting	No comments or objections were raised on the discussion of updates to the Project(s) since PEIR or the Applicant's response to Section 42 responses (as detailed in the rows above) (including guidance to be used for the assessments).	Noted.
Associated British Ports	22 April 2024 Targeted Consultation	The additional Offshore Wind Generating capability of up to 504MW that North Falls will add to UK Renewable generating capacity is to be welcomed and will contribute to the UK Government ambition for 50GW by 2030. Current capacity is of the order of 14GW across the UK of which 5GW is already installed in the southern North Sea offshore East Anglia. There is a further 10GW of capacity either consented, or in the planning & consenting process in the East of England region, of which North Falls represents a significant additional contribution to future supply of clean, green energy both for the East of England region and for the UK overall. The East of England is at the vanguard of clean and renewable energy generation for the UK and as Associated British Ports we fully support the North Falls development, and this Targeted Consultation.	Noted, the Applicant welcomes Associated British Ports support for the Project.

33.3 Scope

9. Potential impacts upon climate change have been "Scoped in" are shown in Table 33.2. As discussed further in Sections 33.4.3.1.2 and 33.4.4.1, the carbon storage / sequestration and a cumulative effects GHG assessment have been scoped out of the assessment.

Table 33.2 Summary of impacts scoped in relating to climate change

Potential Impact	Justification
GHG Assessment – assessment of the impact of the Project (during construction, O&M and decommissioning) on the global atmosphere receptor	Quantification of the Project's GHG emissions Quantification of GHG Savings or 'Carbon' as a result of the Project as a whole.
CCRA – assessment of the direct impacts of climate change during the construction, O&M and decommissioning phases of the Project	Assessment of the vulnerability of the Project to climate change.

33.3.1 Study area

10. North Falls is an extension project to the existing Greater Gabbard offshore wind farm. The North Falls array area is located in the southern North Sea and covers a total area of 95 km^2. The Project will make landfall between Clacton-on-Sea and Frinton-on-Sea, Essex. The onshore project area is located entirely in the Tendring District of Essex. The location of the Project infrastructure is shown in ES Figures 5.1 and 5.2 (Document Reference: 3.2.3) of ES Chapter 5 Project Description (Document Reference: 3.1.7).

33.3.1.1 GHG Assessment

11. The GHG assessment considers emissions associated with the Project which contributes to its total GHG footprint. Emissions which are released or avoided due to the Project have the same effect on atmospheric GHG concentrations and the net effect on climate change regardless of where they occur, therefore the study area of the GHG assessment is not geographically defined.

12. The scope of the assessment is limited to quantifying direct and indirect GHG emissions arising from the Project, including processes inherent in its construction (which includes raw material extraction, manufacturing, transport and installation), O&M, end of life and eventual decommissioning. Key emission sources associated with the Project are defined by a list of GHG-emitting activities provided in Table 33.9. GHG emissions are quantified for each phase of the Project and combined to present total emissions over the whole lifecycle.

33.3.1.2 CCRA

13. The scope of the CCRA is focused on evaluating the vulnerability and resilience of receptors associated with the Project to the effects of climate change. Therefore, the study area for the CCRA is spatially bounded and defined by the Project DCO boundary, and includes the onshore project area and offshore project area, the location of which is shown in ES Figures 5.1 and 5.2 (Document Reference: 3.2.3) of ES Chapter 5 Project Description (Document Reference: 3.1.7). The temporal scope of the CCRA includes the construction, O&M and decommissioning phases of the Project.

33.3.2 Realistic worst case scenario

14. The final design of the Project will be confirmed through detailed engineering design studies that will be undertaken post-consent and prior to the construction phase. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst case scenarios have been defined in terms of the likely significant effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for Nationally Significant Infrastructure Projects (NSIPs), as set out in Planning Inspectorate Advice Note Nine (2018). The Rochdale Envelope for a project outlines the realistic worst case scenario for each individual impact, so that it can be safely assumed that all other scenarios within the design envelope will have less impact. Further details are provided in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

15. The realistic worst case scenarios for the likely significant effects scoped into the EIA for the GHG assessment and CCRA are summarised in Table 33.3. The GHG assessment quantifies the emissions saved as a result of implementation of the Project, accounting for emissions released from activities during construction, O&M and decommissioning. Therefore, the realistic worst case scenario is based upon activities predicted to release the highest emissions quantity and are based on the Project parameters described in ES Chapter 5 Project Description (Document Reference: 3.1.7), which provides further details regarding specific activities and their durations. The CCRA assesses the impacts of climate change on the Project, therefore the largest footprint/area of land disturbance and/or works associated with an option is considered to the realistic worst case scenario.

16. As detailed in ES Chapter 5 Project Description (Document Reference: 3.1.7), at this stage of the Project's development, some optionality is required in order to future-proof the DCO. One area of optionality is in relation to the national grid connection point, which is discussed further in ES Chapter 1 Introduction (Document Reference: 3.1.3) and ES Chapter 5 Project Description (Document Reference: 3.1.7). The following grid connection options are therefore included in the Project design envelope:

- Option 1: Onshore electrical connection at a national grid connection point within the Tendring peninsula of Essex, with a project alone onshore cable route and onshore substation infrastructure;
- Option 2: Onshore electrical connection at a national grid connection point within the Tendring peninsula of Essex, sharing an onshore cable route and onshore duct installation (but with separate onshore export cables) and co-locating separate project onshore substation infrastructure with Five Estuaries; or
- Option 3: Offshore electrical connection, supplied by a third party.

17. Grid connection Option 2 was identified as being the worst case scenario of these options, due to, for example, a greater number of plant/equipment, vehicles and greater quantities of construction materials being required, as well as the largest footprint of the three grid connections, and therefore has been assessed in this chapter as the realistic worst case scenario for both the GHG assessment and CCRA.

18. Under Option 2, the Project’s onshore infrastructure comprises the following elements:

- Landfall, where the offshore export cables are brought ashore;
- Onshore cable route, which includes space for temporary works for the installation of cable ducts and buried onshore export cables, including areas for temporary construction compounds (TCCs), construction and O&M accesses (including Bentley Road improvement works);
- Onshore substation, proposed to be located west of Little Bromley;
- Onshore substation works area, which includes land required for temporary construction, export cables, means of access, drainage, landscaping and environmental mitigation for the onshore substation;
- The search area for the East Anglia Connection Node (EACN) (the Project’s national grid connection point), within which will be located the Project’s national grid substation connection works.

19. Collectively, the footprint of the Project’s onshore infrastructure is referred to herein as the ‘onshore project area’, and is shown on ES Figure 5.2 (Document Reference: 3.2.3). The Project’s onshore infrastructure outlined above is proposed to be located entirely within the Tendring peninsula of Essex.

Table 33.3 Realistic worst case scenario: effects arising from development of North Falls alone – Option 2 (Installation of ducts for a second project)

Element of the Project infrastructure	Parameter	Notes
Construction		
Impact 1: GHG emissions during construction Impact 2: Impact of climate change on the Project	Indicative construction programme: • 2027 to 2031 (onshore and offshore infrastructure) Onshore: • Bentley Road improvement works: 6-9 months • Landfall: 13 months (of which HDD = 6 months) • Onshore cable route: 18-27 months, with a 57 month gap in between i.e. 111 months start to finish [same for onshore substation] • Onshore substation: 21-27 months • Major HDD (each location) = 8 months (of which HDD = 4 months) • Minor HDD crossings = 2 months • Major HDD crossings to include 24 hour / 7 days working where required • Number of TJBs = 4 • TJB dimensions = 4 x 15m Offshore: • Offshore substation installation and commissioning: 12 months • Offshore export cable installation: 3 months • Foundation installation: 6 months • Array cable installation: 6 months • Turbine installation: 6 months • Full system commissioning: 9 months	Maximum duration of construction related activities.
	Offshore: • Installation of up to 57 wind turbine generators (WTGs) • Up to two offshore electrical platforms (offshore substations platforms (OSP) / offshore converter platform (OCP))	Maximum amount of construction materials required. Maximum footprint of disturbance and activities within the onshore project area.

Element of the Project infrastructure	Parameter	Notes
	• WTG and offshore substation foundation types have yet to be determined, so the options with maximum construction material (i.e. jacket) and scour protection (i.e. gravity based monopile structure) quantities are used in ES GHG emission calculations • Offshore export cables: o Indicative offshore cable corridor length: 57 km (Options 1 and 2) o Maximum total indicative offshore export cable length: 125.4 km (based on 2 cables) • Array and platform interconnector cables: o Maximum potential length of array cables and platform interconnector cable: 190 km	
	Onshore: Landfall: • Up to 3 horizontal directional drilling (HDD) locations • HDD temporary works area = 75 x 150 m • Max HDD depth 20 Onshore cable route: • Length of onshore cables = Up to 24 km, 2 cable circuits (Up to 48 km in total) • Installation of up to 4 trenches and ducts (2 for the Project and 2 for Five Estuaries). Cable trench dimensions = 3.75 – 1.2 x 2 m (tapered top to bottom) • Jointing bays = Maximum of 192 (approximately every 500 m) buried below ground. Joint bay dimensions = 15 x 4 m • Indicative cable route width = 72 m (open cut trenching), 90 m (trenchless crossings), 130 m (complex trenchless crossings) • Temporary construction compound dimensions = 150 x 150 m (main) to 100 x 100 m (satellite) • Haul road width = 6 m wide road, 10 m wide total including verges, drainage and passing places. Haul road spacing at passing places = approximately every 500 m • Bentley Road improvement works: o widening of the A120-Bentley Road bellmouth; o four sections of widening to Bentley Road; o the relocation of utility poles; and	Maximum amount of construction materials required. Maximum footprint of disturbance and activities within the onshore project area.

Element of the Project infrastructure	Parameter	Notes
	○ the removal or cutting back of hedgerows/trees in addition of completion of a temporary non-motorised user route. Onshore substation: • One onshore substation (AIS design: 280 x 210 m) • Number of buildings: 6 • Indicative construction compound footprint: 250 x 150 m • Onshore substation O&M haul road – 7 months duration National grid substation connection works: • All enabling worth / platform constructed by National Grid. • Equipment may include: ○ cable sealing ends, surge arrestors, earth switch, disconnectors, circuit breakers, current transformers, voltage transformers, busbars.	
	Quantities of the main and most GHG-intensive materials are included in the assessment. Furthermore, precautionary assumptions are adopted for quantities of known materials (i.e., using the maximum quantity). It is assumed that all material used for the Project's construction would require raw material extraction, e.g., virgin metals, to present a conservative assessment. However, it is likely that materials that will be used in construction will have a higher recycled content, and thus a lower embodied carbon content than what has been assumed for the assessment. The specific nature and composition of some materials, such as the type of steel to be used, are unknown at the time of assessment, which may affect the embodied carbon content contained within the material: • Where Project-specific information on the material composition of cables for the Project could not be supplied, assumptions are made based on the cable diameter and the breakdown of cable composition typically used on other offshore wind projects. • If there is variation in terms of the emissions intensity of the emission factors used to calculate emissions across different compositions of the same material, the 'General' option within the Inventory of Carbon and Energy (ICE) database (Jones & Hammond, 2019) is chosen. If a 'General' option is not available, a median value is assumed.	
	Vessels required: • Scour layer vessels, gravity base foundation vessels, jack-up installation vessels (JUVs), support vessels, transport vessels (i.e. heavy transport vessels (HTVs)), transition piece and WTG installation vessels (i.e., heavy lift vessels (HLVs)), WTG installation vessels, OSP/OCP installation vessels, crew transfer vessels (CTVs), cable laying vessels (e.g. anchor handling vessels, main laying vessel, burial and jointing vessels, and support vessels, e.g., service operation vessels (SOVs), tugs, multicats, etc.	Indicative vessel and helicopter quantities, trips and types included in the GHG assessment.

Element of the Project infrastructure	Parameter	Notes
	• Further details are provided in Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). Helicopter movements included during construction phase: • Maximum of 100 return trips.	
	Onshore plant and equipment requirements: • ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71) details the anticipated plant and equipment required for the Project	Anticipated onshore plant and equipment requirements and hours present during construction included in the GHG assessment.
Operation		
Impact 1: GHG emissions during O&M	Indicative operational life = 30 years Assumed O&M activities of up to 57 WTGs and 2 offshore electrical platforms Indicative capacity: 850 MW	This results in a higher amount of GHG emissions released during O&M.
	Vessels required: • JUVs, SOVs, CTVs, lift vessels, cable maintenance vessels, and auxiliary vessels (e.g., survey vessels (including ornithological, marine mammal, geophysical and geotechnical) • Total of 1,222 maximum vessel round trips assumed per year. Helicopter movements included during O&M phase: • Maximum of 100 return trips.	Indicative vessel and helicopter trips included in the GHG assessment.
	<u>GHG savings or carbon offset by the Project</u> Assumed electricity supplied by the Project would be generated from gas, as this is the most common form of new plant in terms of fossil fuel combustion (see Section 33.5.1.1 for further details). Embodied carbon from spare parts used during repair and replacement events assumed to be 3.7% of construction and operational emissions based on literature sources (see Section 33.4.3).	To help determine the GHG savings as a result of the Project from emissions avoided due to the provision of renewable energy to the UK grid.
Impact 2: Impact of climate change on the Project	Onshore substation • Indicative area of AIS substation: 280 x 210 m Timeframes • Earliest operational start date: 2031	Climate projection data is available for various emission scenarios. RCP8.5 is commonly used to represent worst-case climate change outcomes.

Element of the Project infrastructure	Parameter	Notes
	• Indicative operational duration: 30 years • Consideration of high emissions scenario (RCP8.5) for future climate baseline.	
Decommissioning		
No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable route, 400kV cable route and onshore substation. It is also recognised that legislation and industry good practice change over time. It is likely that the onshore project infrastructure, including the cables, would be removed, reused, or recycled wherever possible and the transition bays and cable ducts left in place. It is likely that offshore project area infrastructure would be removed above the seabed and reused or recycled where practicable. Cables, cable protection and scour protection would likely be left in situ. The detail and scope of decommissioning works would be determined by relevant legislation and guidance at the time of decommissioning and would be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase. The contribution from decommissioning has been scaled based on the total GHG contribution, as detailed in Section 33.4.3.1.2.		

33.3.3 Summary of mitigation embedded in the design

33.3.3.1 GHG assessment

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

21. In response to these principles, the need for the Project in relation to achieving net zero targets by 2050 for the UK and decarbonisation of the energy sector is well established and set out within ES Chapter 2 Need for the Project (Document Reference: 3.1.4). Furthermore, project level GHG mitigation is being incorporated into the design development process wherever it is practicable to do so. Considering the primary purpose of the Project is to generate low carbon renewable energy, the process of reducing GHG emissions from the Project itself is guided by the hierarchy summarised in Table 33.4.

Table 33.4 GHG mitigation hierarchy specific to North Falls

	Hierarchy	Principle	Project Response
	Do not build (Eliminate)	Evaluate the basic need for the proposed project and explore alternative approaches to achieve the desired outcome(s).	The purpose and rationale for the Project is to mitigate against climate change by replacing existing high-carbon energy generation within the UK electricity mix. Therefore, not building could have the effect of perpetuating and exacerbating climate change.
	Build less (Reduce)	Realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required.	Offshore wind farms by their design are efficient in their use of materials. Minimising the use of steel and other materials is a key design feature of the approach to project design. An example of reductions in the extent of new construction required, is with the option to share an onshore cable route with Five Estuaries and co-locating of separate project onshore substation infrastructure (as discussed further within ES Chapter 5 Project Description (Document Reference: 3.1.7)). This option reduces the requirement to construct a second onshore cable route, therefore disturbing a smaller area of land and requiring less construction materials.
	Build clever (Substitute)	Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the Project, and at end-of-life.	The Project will utilise, as appropriate, the latest, most efficient and effective technologies and methodologies. Construction of offshore components of wind farms is by its nature expensive and relies on the use of highly specialised, efficient vessels and equipment with a dedicated and highly

	Hierarchy	Principle	Project Response
			trained workforce. The Project will utilise, as appropriate, new available proven technology.
	Construct efficiently (Compensate)	Use techniques (e.g. during construction and operation) that reduce resource consumption and associated GHG emissions over the life cycle of the Project.	As detailed above, the Project will utilise where appropriate, new available proven technology and the construction of offshore components of wind farms is, by nature, expensive and relies on the use of highly specialised, efficient vessels and equipment. Plans, such as the offshore Vessel and onshore Traffic Management Plans, will seek to further minimise the GHG emissions through efficient design and organisation.

33.3.3.2 CCRA

22. In accordance with the Applicant's technical requirements and specifications which are built upon industry good practice engineering codes and standards in the offshore wind sector, the Project will be designed to be resilient to hazards arising from current extreme weather events and climatic conditions, and have adaptive capacity to future climate change impacts where appropriate. Offshore structures are resilient to flooding and water ingress, and have been designed to withstand severe storm conditions, including potential changes in conditions as a result of future climate change. The onshore elements are also inherently robust to future climatic changes such as flooding and heatwaves.

23. Climate change resilience measures which are embedded into the Project design include:

- Based on standard industry practice and occupational health and safety regulations and standards, construction management plans, such as the Code of Construction Practice (CoCP) and Project Environmental Management Plan (PEMP), will include risk assessments and health and safety protocols, which will be prepared prior to the commencement of construction works. Outline versions of these plans accompany the DCO application (Document References: 7.13 and 7.6).
- These management plans will account for exposure of site workers and construction plant to extreme weather events and ensure appropriate preparation and response measures are in place to minimise their impacts. These measures would include, but are not limited to, the following:
    - Scheduling construction activities based on seasonality and timely weather forecasts;
    - Monitoring of on-site weather conditions and severe weather alert services;
    - Incorporating a severe weather protocol into construction management plans and assigning clear responsibilities in the event of an emergency; and
    - Requiring contractors to include additional provisions in their management plans based on weather conditions at the time of works

such as additional rest breaks during heatwaves, securing stored equipment and material during high wind events and specifying de-icing equipment during cold spells.

- The WTGs and fixed substructures have been designed with sufficient safety margins to account for extreme weather events such as storm surges and high winds. The substructures, turbines and inter-array cables have been designed using metocean hindcast data as the basis for all loadcases. Hindcast models synthesise long-term time series of wind, waves and current data and are correlated with satellite observations and real-time measurements. Based on the models, wind, wave and current parameters for 10-year, 50-year and 100-year extreme weather events were extrapolated and accounted for in the Project design.
- The turbine controller monitors the operational health of the turbines and adjusts the pitch and orientation based on the site conditions. At wind speeds above the design operational load limit, the turbines will shut down and remain in idle configuration to prevent structural damage during gusts or sustained high winds. Normal operations will resume once the wind speed returns below the cut-out speed.
- Regular inspections and maintenance of offshore infrastructure will be carried out over the Project's operational lifetime to identify and remediate any damage and maintain good working conditions. Similar to construction works, prior to the commencement of O&M activities, risk assessments and health and safety protocols will be prepared, which will include the identification of suitable windows for works based on timely weather forecasts and the monitoring of weather conditions on-site. The Project's O&M personnel will monitor emerging climate change data and observed climate change impacts, such as extreme weather incidents on-site, and develop appropriate risk management measures on a rolling basis.
- The flood risk assessment undertaken for the Project assesses flood risk at the onshore substation and has incorporated allowances for climate change in the drainage design. See ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) and associated Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29) for further details.
- Prior to the commencement of decommissioning activities, as part of health and safety protocols, a review of recent climate hazards and up-to-date climate projection data will be undertaken to develop suitable mitigation and management measures, which will be secured in management plans for this stage of works.

33.4 Assessment methodology

33.4.1 Policy, Legislation and Guidance

33.4.1.1 International Agreements

33.4.1.1.1 United National Framework Convention on Climate Change (UNFCCC)

24. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty addressing climate change which entered into force on 21st March 1994. Its main objective is 'to stabilize greenhouse gas

concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system'. In its early years, it facilitated intergovernmental climate change negotiations and now provides technical expertise. Its supreme decision-making body, the Conference of the Parties (COP), meets annually to discuss and assess progress in addressing climate change.

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

26. Subsequently, the meetings of COP 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).

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

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

28. At COP22, held in November 2016, the UK ratified the Paris Agreement to enable the UK to "*help to accelerate global action on climate change and deliver on our commitments to create a safer, more prosperous future*" (Department for Business, Energy and Industrial Strategy (BEIS), 2016). At the COP24 meeting, held in Katowice, Poland in December 2018, a set of rules for the Paris climate process were agreed upon.

29. COP26 was held in 2021 in Glasgow, and for the first time, nations have been called upon to 'phase down' unabated coal power and inefficient subsidies for fossil fuels (UNFCCC, 2022). The main headlines of COP26 were:

- The signing of the Glasgow Climate Pact, which is a series of decisions and resolutions that build on the Paris Agreement setting out what needs to be done to tackle climate change, but does not specify what each country must do and is not legally binding

30. Agreeing on the Paris Rulebook, which gives the guidelines on how the Paris Agreement is delivered. Agreements in the finalised Rulebook include an enhanced transparency framework for the reporting of emissions, common timeframes for emissions reduction targets and mechanisms and standards for international carbon markets (UK Parliament, 2022). The most recent COP (COP28) was held in Dubai in November/December 2023. Some of the most significant outcomes of COP28 include a consensus being reached on the need for a global transition away from fossil fuels (however this does not amount to a commitment to phase them out completely), the conclusion of the first Global Stocktake, the Food and Agriculture Organization roadmap to 1.5 °C, in addition to the Global Renewables and Energy Efficiency Pledge, the latter of which is a commitment to triple the worlds renewable energy generation capacity by 2030.

33.4.1.1.2 Nationally Determined Contribution (NDC)

31. In line with Article 4 of the Paris Agreement, the UK communicated its Nationally Determined Contribution (NDC) to the UNFCCC in December 2020, committing the UK to reducing economy-wide GHG emissions by at least 68% by 2030, compared to 1990 levels. At COP26, Parties resolved to pursue efforts to limit global temperature increase to 1.5^{o}C, recognising this would require rapid, deep and sustained reductions in GHG emissions and accelerated action, and also agreed in paragraph 29 of the Glasgow Climate Pact to *“revisit and strengthen the 2030 targets in their NDCs as necessary to align with the Paris Agreement temperature goal by the end of 2022, taking into account national circumstances"*. The UK has strengthened its NDC in several ways and submitted its updated Adaptation Communication to the UNFCC in October 2021.

33.4.1.1.3 The Climate Change Act 2008

32. The Climate Change Act 2008 provides a framework for the UK to meet its long-term goals of reducing GHG emissions to ‘net zero’ (i.e. at least a 100% reduction relative to 1990 levels) by 2050 (“climate mitigation”). This target was introduced by the Climate Change Act 2008 (2050 Target Amendment) Order 2019, which amended the previous 2050 GHG target of an 80% reduction compared to 1990 levels. The Climate Change Act 2008 also established a system of Carbon Budgets, introduced to drive progress towards this target.

33. The Climate Change Act 2008 implements the UK’s commitments to reduce GHG emissions based on its obligation under the UNFCCC. The UK’s target for reducing GHG emissions are in line with the global goals established by the UNFCCC as detailed in Section 3.2.2.1 of ES Chapter 3 Policy and Legislative Context (Document Reference: 3.1.5). As a signatory of the Paris Agreement, the UK is required to submit plans to reduce their emissions (along with other climate actions) every five years, starting in 2020.

34. 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. The six Carbon Budgets that have been placed into legislation and will run up to 2037

are identified in Table 33.5, which demonstrates the phased reduction in future permissible GHG emissions. 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 33.5 The Six UK Carbon Budgets

Budget	Carbon Budget Level (Mt CO_2e)	Reduction below 1990 level	
		UK Targets	Achieved by the UK
1st Carbon Budget (2008 to 2012)	3,018	26%	30%
2nd Carbon Budget (2013 to 2017)	2,782	32%	38%
3rd Carbon Budget (2018 to 2022)	2,544	38%	44%
4th Carbon Budget (2023 to 2027)	1,950	52%	-
5th Carbon Budget (2028 to 2032)	1,725	58%	-
6th Carbon Budget (2033 to 2037)*	965	77%	-
7th Carbon Budget (2038 to 2042)*	To be set in 2025		
Net Zero Target		At least 100% by 2050	
*The 6th Carbon Budget, and subsequent budgets, include international aviation and shipping			

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

36. In December 2020, the UK set a 6th Carbon Budget, recommending a reduction in UK GHG emissions of 78% by 2035, relative to a 1990 baseline (a 63% reduction from 2019) (CCC, 2020). This target, which has already been enshrined in UK law, has been set in line with the UK commitments in relation to the Paris Agreement and with the goal of achieving a target of reaching net zero GHG emissions by 2050.

37. As part of the 6th Carbon Budget, the role of the offshore wind sector and the construction industry are both the focus of action to contribute to meeting these targets. ES Chapter 2 Need for the Project (Document Reference: 3.1.4) provides further details on the need for the Project in contributing to meeting these targets.

38. The CCC publishes annual progress reports on the UK's progress against GHG emissions reduction targets to 2050. The most recently published report 'Progress in reducing emissions: 2023 Report to Parliament' (CCC, 2023) identifies that UK GHG emissions (including the UK's share of international aviation and shipping) increase by 0.8% in 2022 compared to 2021, but remain 9% below pre-pandemic (2019) levels. UK electricity supply emissions rose by 10% between 2020 and 2021, and then slightly reduced (by 1%) between 2021 and 2022. This report also outlined the key challenges in achieving net zero targets, including highlighting the need for further policy progress to ensure the Government's commitment to electricity generation being 95% low-carbon by

2030 and on the path to full decarbonisation by 2035. The report also acknowledges that renewable energy generation continued to grow in 2022, with a further 2.7 GW of offshore wind deployed, but below the rate required to meet the Government's targets of 50 GW by offshore wind by 2030. The report outlines that an average annual deployment rate of 4.5 GW is required to deliver the target 50 GW of offshore wind by 2030.

33.4.1.1.4 Climate Change Risk Assessment 2022

39. In compliance with the requirement in the Climate Change Act 2008 to undertake a Climate Change Risk Assessment every five years, 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.

33.4.1.1.5 National Adaptation Programme

40. The third NAP (Defra, 2023) sets the actions that the UK Government will undertake to adapt to the challenges of climate change in the UK as identified in the Climate Change Risk Assessment. The NAP forms part of the five-yearly cycle of requirements detailed in the Climate Change Act 2008. The NAP details the range of climate risks which may affect infrastructure, the natural environment, health, communities and the built environment, business and industry and international affairs. The third NAP covers key actions for 2023 to 2028 and includes the UK's fourth Strategy for Climate Adaptation Reporting.

33.4.1.2 National Policy Statements

41. The assessment of potential impacts upon climate change has been made with specific reference to the relevant legislation and guidance, of which the principal policy documents with respect to the Nationally Significant Infrastructure Projects (NSIPS) are the National Policy Statements (NPS). Those relevant to the Project are:

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

42. Reference to the particular requirement's location within the NPS and to where within this chapter or wider ES it has been addressed has been provided in Table 33.6.

Table 33.6 NPS Assessment Requirements

NPS requirement	NPS reference	ES reference
Overarching NPS for Energy (EN-1)		
3.3 The need for new nationally significant energy infrastructure projects 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. 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. 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. Applications for offshore wind above 100MW or solar above 50MW in England, or 350MW for either in Wales, will continue to be defined as NSIPs, requiring consent from the Secretary of State (see EN-3).	Paragraph 3.3.3 Paragraphs 3.3.20, 3.3.21 and 3.3.24	The purpose of the Project is to contribute to climate change mitigation by replacing existing high-carbon energy generation, with a renewable form of energy, which will improve energy security and help the UK meet its net zero commitments.
4.10 Climate Change Adaptation and Resilience *Applicant assessment* 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. 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. 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. 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	Paragraphs 4.10.8 to 4.10.13	The projected impacts of climate change over the operational lifetime of the Project have been considered as part of the CCRA, which is presented in Section 33.6.2. The CCRA presents the projected impacts of climate change across a range of scenarios and considers the direct impacts of climate change on the Project, as provided in Section 33.5.2 and Section 33.6.2 respectively. The high emissions scenario (RCP 8.5) for

NPS requirement	NPS reference	ES reference
climate change scenario. These results should be considered alongside relevant research which is based on the climate change projections. 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. *Secretary of State decision making* 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.		future climate baseline has been considered in the assessment. Climate change resilience mitigation measures have been considered as part of the assessment and outlined in Section 33.3.3. The latest UK Climate Projections have been used in the assessment, see Section 33.5.2.2. Further information on the assessment of flood risk for the Project is provided in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) and ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29) which has been prepared in accordance with the methodology and guidance set out in the Environment Agency Flood Risk Assessments: Climate Change Allowance (2016) guidance.
5.3 Greenhouse Gas Emissions *Applicant assessment* 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.	Paragraph 5.3.4	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

NPS requirement	NPS reference	ES reference
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.		from these phases. The assessment approach is outlined in Section 33.4.3.1 and ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71) and the assessment is presented in Section 33.6.1. The Project will seek to minimise, where practicable, GHG emissions during each phase through the use of best available techniques and efficient design/management (i.e., through offshore vessel and onshore traffic management plans). A summary of mitigation measures recommend to reduce GHG emissions through the lifetime of the Project is provided in Sections 33.3.3 and 33.6.1. Once operational, the Project will have a carbon benefit after 2.5 years (as discussed in Section 33.6.1.4).
5.3 Greenhouse Gas Emissions *Mitigation* 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. 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.	Paragraphs 5.3.5 to 5.3.7	Mitigation measures to curb GHG emissions have also been considered as part of the assessment and embedded into the design as outlined in Sections 33.3.3.1 and 33.6.1, these include the minimising of emissions associated with the

NPS requirement	NPS reference	ES reference
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.		Project, through industry good practice measures in the OCoCP, and a sustainable approach to securing materials, etc. It is anticipated that the requirement for a GHG Reduction Strategy under EN-1 is primarily aimed at other energy generation forms. This chapter clearly demonstrates the benefit of provision of renewable energy to the grid, through the provision of the Project.
5.3 Greenhouse Gas Emissions *Secretary of State decision making* 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. The Secretary of State should be content that the applicant has taken all reasonable steps to reduce the GHG emissions of the construction and decommissioning stage of the development. The Secretary of State should 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.	Paragraphs 5.3.8 to 5.3.10	The GHG assessment and any recommended mitigation measures are presented in Section 33.6.1.
NPS for Renewable Energy Infrastructure (EN-3)		
2.4 Climate change adaptation and resilience Part 2 of EN-1 covers the Government’s energy and climate change strategy, including policies for mitigating climate change. 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.	Paragraphs 2.4.1 to 2.4.3, and 2.4.8	A CCRA has been undertaken, which is presented in Section 33.6.2, and discusses the resilience of the Project (including land-side infrastructure) to climate-change

NPS requirement	NPS reference	ES reference
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. *Offshore wind* 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.		induced weather phenomena as well as storms.

33.4.1.3 Other Legislation, Policy and Guidance

33.4.1.3.1 Legislative Background

43. The requirement to consider climate and GHG emissions has resulted from the 2014 amendment to the EIA Directive (2014/52/EU) and the Infrastructure Planning (EIA) Regulations 2017 (the 'EIA Regulations'). This includes the requirement to include an estimate of expected emissions and the impact of a Project on climate, including consideration of the nature and magnitude of the release of GHGs during project activities.

33.4.1.3.2 National Planning Policy Framework (NPPF)

44. The National Planning Policy Framework (NPPF) was first published on 27 March 2012 and most recently updated on 19 December 2023 (Department for Levelling Up, Housing & Communities, 2023). While the NPSs are the predominant planning policy for NSIPs like this Project, the NPPF provides further context to England's planning policy approach and can be generally considered alongside the NPS.

45. The revised NPPF advises that the planning system should support the transition to a low-carbon future. The NPPF states in paragraph 159 that:

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

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

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

33.4.1.3.3 Local Policies

46. The Essex Climate Action Commission was set up to advise Essex County Council on how to tackle climate change. This included devising a roadmap to guide Essex to net zero emissions by 2050. The 'Net Zero: Making Essex Carbon Neutral report' sets out a comprehensive plan to:

- Reduce the county's emissions to net zero by 2050, in line with UK statutory commitments; and,
- Improve Essex's resilience to future climate impacts such as flooding and heatwaves (Essex Climate Action Commission, 2021).

33.4.1.4 Guidance

33.4.1.4.1 GHG Assessment

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

48. The 2022 IEMA guidance presents guidelines for undertaking GHG assessments and distinguishing different levels of significance. The guidance does not update the IEMA's position that all emissions contribute to climate

change, however, it now provides relative significance descriptions to assist assessments specifically in the EIA context (detailed further in Section 33.4.3.1.3).

49. The updated 'PAS 2080: Carbon Management in Buildings and Infrastructure' (2023) published by the British Standards Institution provides requirements for the management of whole life carbon in built environment projects in alignment with transitioning to a net zero carbon economy by 2050. Industry good practice measures have been reviewed and identified as part of the GHG assessment to enable further carbon reduction on the Project, including a process of managing GHG emissions over the project lifecycle.

33.4.1.4.2 CCRA

50. IEMA has also published 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation' (2020), which provides a framework for the consideration of climate change resilience and adaptation in the EIA process. The guidance advises that future climate conditions within the study area should be identified and assessed with consideration of how adaptation and resilience measures have been built into the design of a development.

33.4.2 Data Information and Sources

33.4.2.1 Site Specific Survey

51. No site-specific surveys are undertaken for this Chapter.

33.4.2.2 Other available sources: desktop study

52. The sources of information presented in Table 33.7 were consulted to inform the GHG assessment and CCRA.

Table 33.7 Data sources used to inform the GHG assessment and CCRA

Data set	Source	Spatial coverage	Year	Summary
GHG Assessment				
Conversion factors for reporting of GHG emissions	DESNZ, 2023c	UK	2023	Emission factors for use in the GHG assessment, for fuel consumption.
Digest of UK Energy Statistics	DESNZ, 2023d	UK	2023	Up-to-date energy statistics for the UK, including the estimated carbon intensity of current grid-supplied electricity.
Treasury Green Book supplementary appraisal guidance on valuing energy use and GHG emissions supporting data tables	DESNZ, 2023e	UK	2023	Grid-average emission factors for the UK grid and future projections.
Life Cycle GHG Emissions of Utility Scale Wind Power	Dolan and Heath, 2012	N/A	2012	Benchmarking of results from the GHG assessment.
Inventory of Carbon and Energy (ICE)	Jones & Hammond, 2019	International	2019	Emission factors for embodied carbon in materials used in construction.

Data set	Source	Spatial coverage	Year	Summary
Life Cycle Costs and Carbon Emissions of Offshore Wind Power	Thompson & Harrison, 2015	UK (plus some international considerations)	2015	Provides benchmark for results from the GHG assessment and likely contribution of decommissioning activities (as a proportion of total Project GHG emissions).
CCRA				
IPCC Sixth Assessment Report	IPCC	Global	Various	Current state of knowledge on climate science and possible future emission scenarios.
Marine Climate Change Impacts Partnership (MCCIP) Reports	Various (e.g., Horsburgh et al., 2020; Masselink et al., 2020; Wolf et al., 2020)	UK	Various	A collection of evidence reviews and summary reports on climate change effects in the marine environment.
Met Office UK Climate Averages, Regional Climate Summaries	Met Office, 2023	UK	Various	Historical climate observations and current climate conditions for the UK. Note: The Met Office data is based on observations over land recorded by onshore climate stations.
Met Office UK Climate Projections (UKCP) Database	Met Office, 2018	UK	2018	Climate change projection data. IEMA (2020) guidance recommends the use of these in climate change resilience assessments, however they are most applicable to coastal and onshore areas.
Offshore Wind Climate Adaptation and Resiliency Study	Weisenfeld et al., 2021	USA (but applicable elsewhere)	2021	Review of key relevant climate factors to the offshore wind sector and opportunities for offshore wind resilience.

33.4.3 Impact Assessment Methodology

53. ES Chapter 6 EIA Methodology (Document Reference: 3.1.8) explains the general impact assessment methodology applied to the Project. The climate change chapter comprised two separate assessments: a GHG assessment and a CCRA.

54. The GHG assessment is undertaken in accordance with Institute of Environmental Management and Assessment (IEMA) guidance *'Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance'* (2022). This guidance document provides a topic-specific methodology for the assessment of GHGs and determining the significance of emissions generated by a project, and therefore the assessment methodology differs from that presented in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

55. The CCRA is undertaken in accordance with IEMA's '*Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation*' (2020). This guidance document provides a methodology for identifying relevant current and future climate baseline conditions and assessing a project's vulnerability and resilience to the effects of climate change. As the CCRA considers climate change impacts on the Project, as opposed to vice versa, its assessment methodology is also topic-specific and differs from that presented in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

56. The methodologies for both assessments are detailed in this Section 33.4.3.1 and Section 33.4.3.2 respectively.

33.4.3.1 GHG Assessment Methodology

57. The purpose of the GHG assessment, which has been undertaken in accordance with IEMA (2022) guidance, is to consider the likely significant effects of the Project on climate change via the GHG emissions created and avoided by project activities during the construction, O&M, and decommissioning phases. Emissions and their effect significance are presented separately per project phase. This chapter provides a GHG assessment for the Project considering the worst case scenario, as detailed in Section 33.3.2.

58. ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71) details the GHG assessment methodology, including further context on the climate change benefits of offshore wind and GHG sources for offshore wind farms. As discussed in this section and in ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71), there are inherent uncertainties associated with carrying out GHG footprint assessments for offshore wind energy projects, although the approach to determine emissions from individual source groups is well-defined. The assumptions and limitations of the GHG footprint assessment are detailed in Section 33.4.6.

33.4.3.1.1 GHG Assessment Approach

59. GHG emissions arising from the construction, O&M and decommissioning phases of the Project are assessed within a defined 'project boundary' as outlined in Section 33.3.1.1. GHG emissions are quantified using a standard calculation-based methodology, which involves multiplying activity data gathered for the Project with the relevant emission factors. Where full details of activity data are not available, industry benchmarks and assumptions using professional judgement are utilised where information gaps exist.

60. To account for differences in project activities, GHG emissions are firstly calculated for each phase of the Project. In addition to evaluating each phase of the Project, in line with EIA industry good practice, an overall significance is also determined by considering the Project's life cycle emissions. The whole life cycle emissions total is contextualised with a high level comparison to emissions avoided from the displacement of electricity, which would have otherwise been generated from other forms of generation, i.e., emissions from a 'do nothing' or 'without Project' scenario (see Section 33.5.1.1).

61. The overall effect significance considers all emissions released by the wind farm in its entirety and therefore the net contribution to climate change, in line with IEMA (2022) guidance.

62. The additional parameters also calculated to contextualise the outcomes of the assessment, in particular to with respect to the benefits of supplying renewable energy to the UK electricity grid are described in Table 33.8.

Table 33.8 Additional parameters for the GHG assessment

Parameter name	Phase	Description
Comparison to UK Carbon Budget	Construction O&M	Construction, and O&M emissions are calculated as a percentage of the UK Carbon Budget to which the phase of the Project corresponds.
Avoided emissions	O&M	GHG savings from the provision of renewable energy, or the avoidance of emissions from displacing electricity which would have otherwise been generated using natural gas. The DESNZ's GHG emission factor (DESNZ, 2023d) for the electricity generated by natural gas only considers operational emissions and therefore does not account for other lifecycle carbon impacts. To enable a like-for-like comparison, the Project's construction and decommissioning emissions are excluded from this calculation.
GHG intensity	O&M Whole life-cycle	The amount of GHGs released per unit of electricity generated, typically expressed as grams (g) of CO_2e per kWh. The CCC's GHG intensities (CCC, 2013) of various forms of electricity generation are based on lifecycle emissions.
GHG payback period	Whole life-cycle	The time it would take for electricity generated by the Project to offset its whole life emissions by displacing an equivalent amount of grid electricity generated using natural gas.

33.4.3.1.2 Emission Calculations

63. GHG emission sources arising from the Project are categorised into five main source groups, as detailed in Table 33.9.

64. The approach to quantifying GHG emissions for each of the source groups detailed in Table 33.9 are provided in ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). The total operational life of the Project in anticipated to be 30 years.

Table 33.9 Emission Source Groups Considered in the Assessment

Source Name	Phase*	Onshore or Offshore	Definition	Project Sources
Embodied carbon in materials	Construction O&M	Onshore and offshore	Embodied emissions within materials, comprising GHGs released throughout the supply chain. This includes the extraction of raw materials, transport, manufacturing, assembly and their end-of-life profile.	Embodied emissions are quantified, where practicable, for the main construction materials to be used for the Project. Most of the materials used for the Project will be recycled at decommissioning. The requirement for spare (or replacement) parts during operation is not known at this stage, therefore the likely magnitude contribution of emissions in relation to the overall footprint of the Project is obtained from existing literature.
Marine vessels	Construction O&M	Offshore	Emissions released as exhaust gases from the combustion of fossil fuels by marine vessels.	Emissions associated with the movement of marine vessels for the Project are calculated. Emissions include vessels used during construction activities such as the installation of wind turbines, foundations and cables and for the transport of material supplies from the manufacturing site to the wind farm site and vessels used during O&M activities such as cable repairs and crew transfer.
Helicopters	Construction O&M	Offshore	Emissions released as exhaust gases from the combustion of fossil fuels by helicopters.	Emissions associated with the movement of helicopters from an onshore base during construction and O&M are calculated.
Road vehicles	Construction O&M	Onshore	Emissions released as exhaust gases from the combustion of fossil fuels by road vehicles.	Emissions associated with the movement of heavy goods vehicles (HGVs) and staff travel during construction and O&M are calculated.
Plant and equipment	Construction	Onshore	Emissions are released as exhaust gases from the combustion of fossil fuels by non-road mobile machinery (NRMM).	Emissions from the use of NRMM during construction of the Project are calculated. This included the landfall, trenchless crossings, cable installation and onshore substation works.
Waste disposal	Construction	Onshore*	Emissions are released during the disposal of waste.	Emissions from the disposal of waste generated during construction of the Project are calculated. This includes waste generated during onshore construction works, i.e. during the construction at landfall, along the onshore cable route, onshore substation and Bentley Road improvement works**.

Source Name	Phase*	Onshore or Offshore	Definition	Project Sources
*GHG emissions from decommissioning phase activities have been estimated at 1.2% of the Project's lifecycle GHG emissions, using an industry benchmark obtained from literature (Thomson & Harrison, 2015) and therefore sources contributing to decommissioning emissions are not specified in this table. See ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71) for further details. **Due to the design maturity that will take place post consent, information on all waste generated during the construction of the Project are not available at the time of the assessment. Therefore, the assessment considered the main known waste types for construction of onshore infrastructure only, as this level of detail is not currently known for offshore infrastructure.				

65. Details on the activities that will take place during the construction, O&M and decommissioning phases are not fully known at this stage, therefore some assumptions have been made in order to quantify GHG emissions, as detailed in Section 33.4.6. These assumptions are based on indicative data from similar projects provided by the Applicant's design team or professional judgement.

66. Details surrounding decommissioning activities are not available at this stage in the Project, as the decommissioning policy of the Project is not yet known, therefore a detailed GHG assessment cannot be performed at his stage. It is also recognised that legislation and industry good practice change over time and the detail and scope of decommissioning works would be determined by relevant legislation and guidance at the time of decommissioning and would be agreed with the regulator. Therefore, emissions from decommissioning are derived from previous studies (Thomson & Harrison, 2015), which qualified them to be approximately 1.2% of an offshore wind farm's carbon footprint, see ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71) for further details.

67. The approach to quantifying GHG emissions for each of the source groups detailed in Table 33.9 are provided in ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). The total operational life of the Project in anticipated to be 30 years.

Carbon Storage and Sequestration

68. As stated in ES Chapter 22 Land Use and Agriculture (Document Reference: 3.1.24), soils hold a large reserve of organic carbon, which may be lost because of land use change and changes as a result of human activity (including climate change), resulting in the release of GHG emissions. The ability for natural environment to take up and store significant amount of carbon in soils, sediment and vegetation can support in tackling the climate crisis (Natural England, 2021).

69. As detailed in ES Chapter 23 Onshore Ecology (Document Reference: 3.1.25), the onshore project area is mainly arable fields, interspersed with field margin drains, rivers and areas of scattered and dense scrub. Other small areas of habitat present which are considered to be of a higher ecological value include semi-improved grassland, marshy grassland, woodland (broadleaved and mixed semi-natural and plantation) and woodland scrub successional habitats. Habitats with high levels of carbon stores (like peatland) are not located within the onshore project area.

70. There will be temporary loss of land, soil degradation and loss of soil to erosion, during the construction phase due to the footprint of the onshore cable route and temporary construction compounds. However, the Project will reinstate most of the land to its pre-construction condition, therefore affected land will regain its ability to store and sequester carbon. The onshore cables will be buried to an indicative depth of 1.6 m and the natural environment reinstated after the onshore construction phase of the Project. Permanent land take will occur because of onshore substation, associated flood attenuation and landscaping during the operational phase of the Project and through the Bentley Road improvement works.

71. The Project's Outline Landscape and Ecological Management Strategy (Document Reference: 7.14) outlines landscaping and environmental mitigation including reinstating of habitats, tree planting and habitat creation to mitigate the loss of habitat due to construction of permanent above ground infrastructure. Therefore, it is considered that any permanent change to the land use affecting the natural environment's ability to store and sequester carbon will be negligible and a quantitative assessment of the GHG emissions from land use change has not been undertaken in this assessment.

33.4.3.1.3 Definitions of Sensitivity, Value and Magnitude

72. The GHG assessment is undertaken in accordance with a topic-specific assessment methodology and approach to determining the significance of effect as provided within IEMA guidance (2022) and set out in the following sections.

Sensitivity

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

Magnitude

74. 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, the Project's construction, O&M, and decommissioning emissions have been calculated as part of the assessment, both by Project phase and combined over the whole lifecycle.

75. 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.

Significance of Effect

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

77. 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 up to 2037 and net zero commitments, and states "*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*".

78. The updated IEMA guidance provides significance descriptions to assist assessments, specifically in the EIA context. Section VI of the updated IEMA

guidance (IEMA, 2022) describes five distinct levels of significance which are not solely based on whether project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a science-based 1.5°C aligned transition towards net zero. These are presented below in Table 33.10.

Table 33.10 Significance of Effect Criteria (IEMA, 2022)

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

79. The effect significance of the Project's GHG emissions is firstly evaluated for each phase of the Project. As discussed in Section 33.6.1.4.1, the overall effect of significance then considers 'whole lifecycle' emissions and the net contribution to climate change. For the construction phase, significance is determined by comparing the magnitude of emissions with the 5th UK Carbon Budget (2028 to 2032) 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 a science-based 1.5°C transition towards net zero.

80. For the O&M and decommissioning phases, the relevant UK Carbon Budgets have not all been set or do not apply, as the Project's operational lifetime extends beyond 2037 (the latest current date 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. The first five years of the Project's O&M phase aligns with the 6th Carbon Budget (2033-2037). Emissions over this budget period have also been compared for further context.

81. In addition to evaluating each phase of the Project, an overall significance is also determined by considering the Project's life cycle emissions. The whole life

cycle emissions total is contextualised with a high level comparison to emissions avoided from the displacement of electricity, which would have otherwise been generated from other forms of generation. The overall effect significance considers all emissions released by the wind farm in its entirety and therefore the net contribution to climate change.

82. Likely significant effects identified within the assessment as major / moderate adverse or beneficial are deemed to be significant in EIA terms within this chapter. Whilst only one level of significance criteria is provided where there is a net reduction in emissions, further context with respect to the level of emissions avoided compared to the baseline scenarios is provided in Section 33.6.1.

33.4.3.2 CCRA Methodology

83. An assessment of the resilience and vulnerability of the Project to the projected effects of climate change has been undertaken. The assessment identifies the likelihood of climate hazards occurring within the study area, and the consequences of the impact will be highlighted.

84. The construction phase is anticipated to be up to 5 years, commencing as early as 2027. As the construction phase of the Project is likely to be completed within the next 10 years, the degree of climatic change over this period, as distinct from standard weather fluctuations, is not likely to result in significant changes from present day conditions (see Section 33.5.2.1), when compared to O&M timeframe where the change of climate related hazard is more likely. Therefore, a high level assessment is undertaken for the construction phase in the CCRA.

33.4.3.2.1 CCRA Approach

85. The methodology for the assessment is informed by IEMA guidance, Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (IEMA, 2020). The methodology varies from the general EIA approach presented in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

86. A four-step methodology has been adopted for the CCRA in line with industry good practice for assessments of climate resilience. The initial stages of the assessment aim to identify the climate hazards to which the Project could be vulnerable to during its operational lifetime. If deemed necessary, a more detailed risk assessment is then undertaken on climate hazards which are considered to be material to the Project, which assess the level of risk associated with the hazards posed to the Project based on projected changes in climate change variables. A step-by-step approach to the CCRA is provided below.

87. For the purpose of the CCRA, the following key terms are adopted:

- 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 variable, which has potential to do harm to receptors such as increased precipitation or storms.
- Climate change impact: an impact from a climate hazard which affects the ability of the receptor to maintain its functions or purpose.

Step 1: Identifying Receptors, Climate Variables and Hazards

88. The first step of the CCRA is to identify the receptors associated with the Project which may potentially be impacted by climate hazards. The identified receptors associated with the Project include those known to have already experienced climate change impacts (e.g., receptors in known flood zones) and unknown receptors which are likely, but yet to be impacted, based on available data and literature.

89. Key climate hazards relevant to the study area are identified based on 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.

90. Climate projection data was obtained from the UKCP database, which was used to identify trends in climate variables and describe potential climate hazards within the study area. Data was retrieved for two RCPs (RCP4.5 and RCP8.5) which represent different possible climate futures based on different GHG concentration trajectories. For each RCP, data is presented for the 10th, 50th (median) and 90th percentile to provide a reasonable outlook on the future climate baseline in accordance with the requirements of the NPS. The climate projection data are provided in Section 33.5.2.2.

91. Climate projection data has also been supplemented with other literature sources and future baseline trends and relevant impact assessments discussed in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10) and ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23).

Step 2: Climate Vulnerability Assessment

92. The second step consists of a qualitative vulnerability assessment of the Project to key climate hazards, informed by professional judgement and supporting literature. Vulnerability is defined as the degree of response to a change in the environment and based on the capacity to accommodate or recover from change and considered to be a function of:

- Sensitivity: the potential to be affected by change.
- Exposure: exposure, both spatially and temporally, to climate hazards.

93. Both the sensitivity and the exposure of the Project and its associated infrastructure to climate hazards are considered to determine vulnerability. This approach attributes either a high, medium or low vulnerability rating to each climate hazard identified based on the interrelationships between sensitivity and exposure. The matrix used for the vulnerability assessment is set out in Table 33.11.

Table 33.11 CCRA: Sensitivity-Exposure Matrix for Determining Climate Vulnerability

Sensitivity	Exposure		
	Low	Medium	High
Low	Low vulnerability	Low vulnerability	Low vulnerability
Moderate	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

94. Climate change impacts upon the Project only arise when receptors have a level of sensitivity and/or exposure, and are therefore vulnerable to climate hazards. The nature of any climate change impacts are also described alongside the vulnerability assessment to specify how the Project and its receptors are likely to experience the climate hazard and the outcomes.

95. For those hazards categorised as medium or high, the risk of climate change to the Project, and consequently to its operations, is then determined through Steps 3 and 4 of the CCRA process. Hazards with low vulnerability are screened out from further assessment due to low potential for likely significant effects. This is in line with risk assessment approach proposed by the European Commission in its guidance note whereby only potentially significant risks from climate change are taken forward for detailed analysis (EC, 2021).

Step 3: Climate Risk Assessment

96. The magnitude of the climate change impact, or the climate risk, is then qualitatively evaluated based on its likelihood and consequence, which are defined as follows:

- Likelihood: the probability or frequency of the climate change impact occurring during the operational lifetime of the Project.
- Consequence: the degree of harm of the climate change impact based on factors such as its spatial extent, duration, complexity or the number of receptors affected.

97. This approach attributes either an extreme, high, medium or low risk rating based on the interrelationships between likelihood and consequence. The matrix used for the risk assessment is set out in Table 33.12.

Table 33.12 Likelihood-Consequence Matrix for Determining Climate Risk

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Very unlikely	Low risk	Low risk	Low risk	Medium risk	Medium risk
Unlikely	Low risk	Low risk	Medium risk	Medium risk	High risk
Moderate	Low risk	Low risk	Medium risk	High risk	Extreme risk
Likely	Low risk	Medium risk	Medium risk	High risk	Extreme risk
Almost certain	Low risk	Medium risk	High risk	Extreme risk	Extreme risk

98. For climate risks identified as medium, high or extreme, additional mitigation measures would be required based on professional judgement, and the residual risk is reassessed.

Step 4: Resilience Rating

99. For climate risks identified as 'medium', 'high' or 'extreme' in the likelihood/consequence matrix in Step 3 (see Table 33.12), secondary mitigation measures are identified. With the proposed secondary mitigation measures taken into consideration, a resilience rating is identified as one of the following:

- High – strong degree of climate resilience. Remedial action or adaptation may be required but it is not a priority.
- Moderate – a moderate degree of climate resilience. Remedial actions or adaptation is recommended to improve climate resilience, although sufficient resilience is considered to be present.
- Low – a low level of climate resilience. Remedial action or adaptation is required as a priority.

33.4.3.2.2 Significance of effect

100. The significance of the CCRA is determined through consideration of the residual risk (identified in Step 3) and resilience rating (identified in Step 4) for each climate change impact assessed. Table 33.13 presents the matrix used to identify the overall significance of the CCRA. This risk-resilience matrix is obtained from industry good practice for risk assessment procedures with respect to climate resilience.

Table 33.13 CCRA Significance Criteria

Risk Rating	Resilience Rating		
	High	Moderate	Low
Low	Not significant	Not significant	Not significant
Medium	Not significant	Not significant	Significant
High	Not significant	Significant	Significant
Extreme	Significant	Significant	Significant

33.4.4 Cumulative Effects Assessment (CEA) Methodology

33.4.4.1 GHG Assessment

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

33.4.4.2 CCRA

102. The CEA for a CCRA considers the potential for other projects or plans to act collectively to exacerbate a project's climate vulnerability and risk. Likewise, there is also potential for a project to influence the climate change resilience of other projects or plans.

103. Due to the location of the wind farm site (i.e. offshore infrastructure), it is highly unlikely for the offshore elements of the Project to affect or be affected by neighbouring developments with respect to climate change resilience. Therefore, a CEA is not undertaken for the CCRA of the Project's offshore infrastructure. There are other developments in close proximity to the onshore project area, therefore the potential for cumulative impacts, which is considered in Section in Section 33.8.2.

33.4.5 Transboundary Effects Assessment Methodology

33.4.5.1 GHG Assessment

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

33.4.5.2 CCRA

105. It is not relevant to assess transboundary effects relating to climate change resilience, since the assessment focusses on the effects of climate change on the Project itself. Therefore, a transboundary effect assessment is not undertaken for the CCRA.

33.4.6 Assumptions and Limitations

33.4.6.1 GHG Assessment

106. A number of assumptions are made in the GHG assessment, as set out in Table 33.14. Further details of the methodology adopted to quantify GHG emissions from the Project are presented in ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71). Where there are uncertainties regarding input data or information used in the assessment, a conservative approach has been adopted to provide a robust assessment.

Table 33.14 Assumptions and Limitations for the GHG assessment

Assumption or limitation	Discussions
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 assessment to provide a precautionary assessment. Many sectors are anticipated to decarbonise over the next 30 years, and during O&M and decommissioning, it is likely that the emissions intensity of manufacturing wind farm components and the movement of marine vessels will be less than the present day. Therefore, emissions associated with the O&M and decommissioning phases of the Project are likely to be a significant overestimation.
Quantities for all materials to be used during construction are not available at the time of the assessment	Quantities of the main and most GHG intensive materials are included in the assessment, and where information specific to the Project is not available, indicative quantities from other offshore wind farm projects have been utilised. Furthermore, precautionary assumptions are adopted for quantities of known materials (i.e., using the maximum quantity).
The recycled content of construction materials is unknown	As an example, it has been assumed that all steel used on the Project is virgin steel to provide a conservative assessment. It is possible that materials that will be used in construction such as steel will have some recycled content, and thus a lower embodied carbon content than has been assumed in this assessment.
The specific nature and composition of some materials, such as the type of concrete or steel to be used, is unknown which may affect the embodied carbon within a material.	If there is variation across different compositions of the same material, the 'General' option within the ICE database has been chosen, if available, or the median value if not.

Assumption or limitation	Discussions
Disposal route of waste generated by the Project	The specific waste disposal route for construction waste has not been decided, therefore, worst-case assumptions are adopted with respect to the disposal method, e.g. open- or closed-loop recycling, combustion, composing, landfill, anaerobic digestion, of each waste type.
Energy displaced by the Project would otherwise be produced by natural gas	The approach for energy displaced by the Project, advocated by RenewableUK (2024), is used to determine emissions for the 'Do Nothing' scenario in which the Project is not developed based on DESNZ emission factor for natural gas (DESNZ, 2023d). The fuel mix in the UK may change in the future, but it is considered a valid approach for determining avoided emissions as a result of renewable energy projects.
LCA	Although robust and fit for the purposes of an EIA, this assessment should not be taken to be a comprehensive, detailed LCA of the Project, the reason being that it is not possible to fully define the supply chain for the Project and undertake the relevant detailed assessments at this stage in the Project. Therefore, assumptions and simplifications to the methodology are made in certain areas and a precautionary approach has been adopted for the assessment to allow for this.

33.4.6.2 CCRA

107. A number of assumptions are made in the CCRA, as set out in Table 33.15.

Table 33.15 Assumptions and Limitations for the CCRA

Assumption or limitation	Discussions
Climate change projections	A key assumption of the climate projection data from the UKCP is that the model is strongly dependent on 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 this chapter present a range of outcomes in terms of climate projection data. However, the UKCP user 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 projections, 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 as such in the chapter. 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 projections are provided by grid cells in the UKCP 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 is important to note that the majority of climate observation and projection data is for onshore areas, with less information available for marine areas.

33.5 Existing environment

108. This section describes the existing environment in relation to climate change associated with the North Falls study area.

33.5.1 GHG Assessment

33.5.1.1 Baseline 'Do Nothing' Scenario

109. To help determine the significance of effects and contextualise the outcomes of the GHG assessment, consideration of a baseline or 'Do Nothing' scenario is required, which assumes that the Project is not constructed.

110. UK electricity is currently generated from a number of different energy sources, including gas, nuclear, onshore and offshore wind, coal, bioenergy, solar and hydroelectric. However, it is recognised that the growth of renewable energy is key to the UK's Energy Strategy and net zero targets, coupled with a transition away from electricity generated from fossil fuels.

111. The 'Do Nothing' scenario is established from the assumption that electricity from the Project displaces generation from 'natural gas' sources, as this is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2022). This approach is advocated for offshore wind farms by RenewableUK (2023) and is considered to account for the UK's transition from fossil fuel-based generation sources to renewables.

112. An alternative approach would be to use the future electricity emission factors of the UK grid, for which projections are available from DESNZ (2023d). However, these projections will account for renewable energy projects such as North Falls becoming operational and decarbonising the UK electricity grid. Therefore, the use of the future projection of the UK grid is not considered to be reasonable approach when determining a 'Do Nothing' or without project baseline scenario.

33.5.1.1.1 Energy produced by the Project

113. The estimated quantity of electricity produced by the Project is quantified in accordance with the approach advocated for offshore wind farms by RenewableUK (2024), where the anticipated installed capacity (850 MW) is multiplied by the hours in the year (8,760) and by an appropriate average load or capacity factor. The capacity factor for the Project is anticipated to be 61.5%. The capacity factor is in alignment with BEIS Round 5 Allocation Framework (DESNZ, 2023) which provides predicted capacity factors for new build offshore wind farms.

114. The anticipated energy produced by the Project is:

- Approximately: 4,579,290 MWh/year
- Approximately: 137,378,700 MWh over the 30 year lifetime of the Project

33.5.1.1.2 GHG Emissions from 'Do Nothing' Scenario

115. GHG emissions produced from the generation of electricity of an equivalent gas power station to the Project in the 'Do Nothing' scenario is presented in Table 33.16. This has been quantified by multiplying the anticipated energy generated by the Project by the estimated CO_2 emissions from gas supplied electricity (371 tonnes $CO_2.GWh^{-1}$) (DESNZ, 2023d). It is noted that this emission factor is in

units of CO_2, rather than CO_2e, however, CO_2 is likely to form the main contribution to total GHG emissions from electricity generation using natural gas. Therefore, this factor would be higher, were other GHGs to be included, which provides a conservative approach for the assessment.

Table 33.16 Do nothing scenario baseline GHG emissions

Timeframe	Anticipated energy produced by project	GHG emissions from electricity generated from gas (tonnes CO_2)
Per year	4,579 GWh per year	1,698,917
Duration of project (30 years)	137,379 GWh over 30 years of project	50,967,498

33.5.2 CCRA

116. Sections 33.5.2.1 and 33.5.2.2 below discuss the current and future baseline climate. Specific receptors (i.e. what part of the Projects) with the potential to be affected by climate change and assessed in the CCRA are identified as part of 'Step 1: Identifying receptors, climate variables and hazards' of the CCRA presented in Section 33.6.2.

33.5.2.1 Current Baseline Climate

117. The Project's offshore infrastructure is located in the southern North Sea, approximately 42 km from the East Anglia coast. The onshore Project area comprises of landfall, located between Frinton-On-Sea and Clacton-On-Sea, an onshore cable route, running from landfall in a general north-west direction to the onshore substation, and an onshore substation, located east of the village of Ardleigh and west of Little Bromley, works to connect to the National Grid, and in addition to some road improvement works on Bentley Road.

118. Existing climate data was obtained from the Met Office's 'UK Climate Averages' (The Met Office, 2023), which summarise various climate variables over 30-year time slices based on historical observations recorded by climate stations. The nearest onshore climate station to the Project is Wattisham (52.123, 0.961), which is located approximately 22 km north of the onshore project area at its closest location (i.e. the onshore substation). The most recent time slice available for climate data is for the period of 1991 to 2020. This data is supplemented with a review of the Met Office's 'Regional Climate Summaries', which presents the climate characteristics of 11 different regions in the UK using observations over the 1981 to 2010 period (not yet updated to the more recent 1991 to 2020 time period).

119. Across the UK, annual average temperatures over the most recent decade (2009 to 2018) have been on average 0.3°C warmer than the 1981-2010 average and 0.9°C warmer than the 1961-1990 average. All the top ten warmest years for the UK, in the series from 1884, have occurred since 2002. The most recent decade (2009-2018) has been on average 1% wetter than 1981-2010 and 5% wetter than 1961-1990 for the UK overall, both in the summer and winter months. Mean sea level around the UK has risen about 17 cm since the start of the 20th century (The Met Office, 2022).

120. Current climate conditions for Wattisham, England (South), England and the UK are provided in Table 33.17. Southern England is the closest to continental Europe and as such can be subject to continental weather influences, resulting

in cold spells in winter and hot, humid weather in summer. The area is also furthest from the paths of most Atlantic depressions, with their associated cloud, wind and rain, so the climate is relatively quiescent (The Met Office, 2016).

121. Rainfall is generally well-distributed throughout the year in Southern England, but with a higher concentration in the autumn and winter seasons. Southern England is susceptible to both summer thunderstorms with periods of intense rainfall, as well as severe dry periods with below average rainfall. As one of the more sheltered parts of the UK as a result of its distance from the Atlantic, Southern England experiences the strongest winds from December to February. Temperature patterns display a seasonal variation; January is the coldest month and July the warmest. Coastal areas are generally milder than inland during winter, but cooler during late spring and summer as a result of sea breezes (The Met Office, 2016).

Table 33.17 Existing onshore local, regional and national climate for the 1991 to 2020 period (The Met Office, 2023)

Climate Variable	Units	Annual Average			
		Wattisham	England South	England	UK
Maximum temperature (average over 12 months)	°C	14.2	14.4	13.8	12.8
Minimum temperature (average over 12 months)	°C	6.44	6.42	6.12	5.53
Days of air frost	Days	41.9	41.9	45.1	53.4
Rainfall	mm	623	808	870	1,163
Days of rainfall ≥ 1mm	Days	117	129	135	159
Mean wind speed at 10m	Knots	9.14	8.04	8.33	9.27

122. Table 33.17 displays the influence of the maritime setting of the Project. Annual average maximum and minimum temperature at Wattisham is warmer compared to the UK averages. There are fewer days of air frost compared to regional and national averages. Wattisham also experiences a noticeably drier climate compared to the regional and national average, with ~42 less days of rainfall greater than 1 mm compared to the UK average. Mean wind speed (at 10 m) is greater than the England South and England average, but slightly lower than the UK average.

33.5.2.2 Future Baseline Climate

123. Climate change projections are used to identify future changes to climate variables within the study area. It is anticipated that the Project will have an operational lifespan of 30 years, starting as early as 2031. For the O&M phase of the CCRA, time slices presenting 30-year averages, depending on data availability, are considered to be suitable for the assessment. As such, climate forecasts and impacts to the baseline conditions arising from the operation of the Project have been based on a 30-year lifespan.

124. The Met Office's UKCP database provides probabilistic climate change projections for the UK at a spatial resolution of 25 km 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.

125. The UCKP database uses RCP which align with the emission scenarios used in the IPCC's Fifth Assessment Report. The likelihood of individual RCPs occurring is dependent on current and future GHG emissions and the implementation of mitigation strategies. For this CCRA, data was obtained for RCP4.5 and RCP8.5, which are described further in Table 33.18. For each RCP, where relevant and available, three probabilities are considered, 10% (unlikely), 50% (median) and 90% (projections unlikely to be less than).

Table 33.18 Summary of the RCP emission scenarios considered in the CCRA

RCP	Scenario Description	Scenario description	Increase in global mean surface temperature (°C) by 2081-2100
4.5	Intermediate scenario	GHG emissions peak around 2040 and then start to decline	2.4 (1.7 – 3.2)
8.5 (worst case)	Very high GHG emission scenario	Increasing global GHG emissions throughout the 21st century	4.3 (3.2 – 5.4)

126. Future climate projections are modelled projections and are strongly dependent on future global GHG emissions, and uncertainties associated with these are detailed in Table 33.15. In some cases, projections to the year 2100 (or later) are presented, as this is the only data available for some climate variables.

33.5.2.2.1 Land-based Meteorological Projections – Temperature, Precipitation and Wind Projections (UKCP)

127. By the end of this century, all areas in the UK are projected to be warmer, with more warming expected in the summer than in the winter (The Met Office, 2022). 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 (The Met Office, 2019a).

128. For precipitation, the probabilistic projections provide low (10% probability) to high (90% probability) changes across the UK. Across the UK as a whole, the climate modelling shows that 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 significant increases in hourly precipitation extremes (The Met Office, 2022).

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

130. Changes in temperature and rainfall are modelled with a high level of confidence, other climate parameters considered in this assessment such as wind speed have more uncertainty.

131. There has been some debate in recent years as to whether storm events will increase in frequency and/or intensity in the UK due to climate change, which

could cause operational disruption and damage to coastal infrastructure and flooding. Although the future of storm surges remains uncertain, with no evidence to suggest any variation in frequency or intensity, a change in the severity of future storm surges cannot be ruled out (Palmer et al., 2018).

132. Data was retrieved from the UKCP database for the 25 km land-based grid squares representing the Project study area (612500, 212500 (portion of offshore export cable near landfall, landfall and approximately first half of the onshore cable route from landfall) and 612500, 237500 (onshore substation and approximately second half of the onshore cable route near the onshore substation)) for mean, maximum and minimum air temperature and precipitation rate anomalies. As caveated previously, the majority of UKCP probabilistic projections are land-based and thus do not provide direct coverage of the offshore area in which the Project's offshore infrastructure is located.

133. Annual, winter and summer averages for temperature and precipitation variables are presented for the 30-year operational time slice (2030 to 2059) compared to a baseline period of 1981 to 2010, as shown in Table 33.19. These parameters are also presented for the decommissioning time slice (2060s) in Table 33.20.

134. In both time slices and across both RCP4.5 and RCP8.5, climate projections for two 25 km land-based grid squares covering the onshore project area indicate a trend of increasing annual mean, maximum and minimum air temperature.

135. During the 30 year operational period, under RCP8.5 the mean air temperature rise will range between 0.74°C to 2.26°C, whilst the RCP4.5 scenario suggests a slightly lower mean air temperature increase, ranging from 0.48°C to 1.8°C. Annual precipitation values are predicted to be relatively similar under both scenarios, with changes to precipitation rates appearing to more variable between probabilities than for other indicators, ranging from -8.28% to +4.69% over the 30 year operational period. Similarly, precipitation rates under RCP4.5 also appear to vary between probabilities, from -7.63% to 4.3%.

136. During the 2060s (i.e., approximate decommissioning period), under RCP8.5 the mean air temperature rise will range between 1.34°C to 3.64°C, whilst the RCP4.5 scenario suggests a slightly lower mean air temperature increase, ranging from 0.77°C to 2.56°C. Annual precipitation values are predicted to be relatively similar under both scenarios, with changes to precipitation rates appearing to more variable between probabilities than for other indicators, ranging from -11.89% to +6.18% during the 2060s period. Similarly, precipitation rates under RCP4.5 also appear to vary between probabilities, from -10.06% to +4.69%.

Table 33.19 Projected annual, winter and summer average temperature and precipitation rate anomalies under RCP4.5 and RCP8.5 within the study area in O&M (relative to the 1981 to 2010 baseline) at the 10th, 50th and 90th percentile (The Met Office, 2018)

Indicator		Unit	Climate projection scenarios							
			RCP4.5 2030 to 2059 (2040s)				RCP8.5 2030 to 2059 (2040s)			
			10th	50th	90th	Trend*	10th	50th	90th	Trend*
25 km land-based grid square: 612500, 212500 (offshore export cable near landfall, landfall and approximately first half of onshore cable route from landfall)										
Air temperature	Mean annual	°C	+0.49	+1.11	+1.8	↑	+0.75	+1.49	+2.26	↑
	Maximum annual	°C	+0.5	+1.19	+1.94	↑	+0.77	+1.59	+2.44	↑
	Minimum annual	°C	+0.41	+1.05	+1.77	↑	+0.64	+1.41	+2.24	↑
	Mean summer	°C	+0.47	+1.38	+2.33	↑	+0.79	+1.86	+2.94	↑
	Mean winter	°C	+0.17	+1.04	+1.94	↑	+0.4	+1.33	+2.34	↑
Precipitation rate	Annual	%	-7.5	-1.62	+4.30	↑↓	-8.07	-1.67	+4.69	↑↓
	Summer	%	-32.93	-11.22	+10.53	↑↓	-38.35	-13.94	+10.29	↑↓
	Winter	%	-4.34	+6.34	+18.1	↑↓	-3.84	+8.19	+21.62	↑↓
25 km land-based grid square: 612500, 237500 (onshore substation and approximately second half of onshore cable route near the onshore substation)										
Air temperature	Mean annual	°C	+0.48	+1.10	+1.78	↑	+0.74	+1.47	+2.24	↑
	Maximum annual	°C	+0.50	+1.18	+1.93	↑	+0.76	+1.58	+2.42	↑
	Minimum annual	°C	+0.41	+1.03	+1.75	↑	+0.63	+1.39	+2.21	↑
	Mean summer	°C	+0.45	+1.35	+2.29	↑	+0.76	+1.82	+2.88	↑
	Mean winter	°C	+0.17	+1.04	+1.94	↑	+0.39	+1.33	+2.33	↑
Precipitation rate	Annual	%	-7.63	-1.68	+4.30	↑↓	-8.28	-1.75	+4.68	↑↓

Indicator		Unit	Climate projection scenarios							
			RCP4.5 2030 to 2059 (2040s)				RCP8.5 2030 to 2059 (2040s)			
			10th	50th	90th	Trend*	10th	50th	90th	Trend*
	Summer	%	-32.48	-10.66	+11.23	↑↓	-37.91	-13.38	+11.53	↑↓
	Winter	%	-4.40	+5.59	+16.74	↑↓	-3.89	+7.38	+20.0	↑↓
*Trend is for indicative purposes only.										

Table 33.20 Projected annual, winter and summer average temperature and precipitation rate anomalies under RCP4.5 and RCP8.5 within the study area in decommissioning (relative to the 1981 to 2010 baseline) at the 10th, 50th and 90th percentile (The Met Office, 2018)

Indicator		Unit	Climate projection scenarios							
			RCP4.5 2050 to 2079 (2060s)				RCP8.5 2050 to 2079 (2060s)			
			10th	50th	90th	Trend*	10th	50th	90th	Trend*
25 km land-based grid square: 612500, 212500 (offshore export cable near landfall, landfall and approximately first half of onshore cable route from landfall)										
Air temperature	Mean annual	°C	+0.77	+1.61	+2.55	↑	+1.35	+2.47	+3.64	↑
	Maximum annual	°C	+0.77	+1.70	+2.70	↑	+1.36	+2.60	+3.89	↑
	Minimum annual	°C	+0.68	+1.57	+2.59	↑	+1.20	+2.40	+3.69	↑
	Mean summer	°C	+0.86	+2.04	+3.37	↑	+1.51	+3.14	+4.79	↑
	Mean winter	°C	+0.34	+1.44	+2.60	↑	+0.76	+2.13	+3.63	↑
Precipitation rate	Annual	%	-10.12	-2.74	+4.35	↑↓	-11.86	-2.97	+5.76	↑↓
	Summer	%	-39.76	-15.94	+6.52	↑↓	-50.88	-22.57	+6.30	↑↓

Indicator		Unit	Climate projection scenarios							
			RCP4.5 2050 to 2079 (2060s)				RCP8.5 2050 to 2079 (2060s)			
			10th	50th	90th	Trend*	10th	50th	90th	Trend*
	Winter	%	-5.16	+8.96	+24.44	↑↓	-4.19	+13.2	+33.34	↑↓
25 km land-based grid square: 612500, 237500 (onshore substation and approximately second half of onshore cable route near the onshore substation)										
Air temperature	Mean annual	°C	+0.76	+1.59	+2.52	↑	+1.33	+2.44	+3.60	↑
	Maximum annual	°C	+0.76	+1.69	+2.68	↑	+1.35	+2.58	+3.87	↑
	Minimum annual	°C	+0.67	+1.54	+2.55	↑	+1.18	+2.36	+3.64	↑
	Mean summer	°C	+0.83	+1.99	+3.29	↑	+1.47	+3.06	+4.69	↑
	Mean winter	°C	+0.33	+1.43	+2.59	↑	+0.75	+2.12	+3.62	↑
Precipitation rate	Annual	%	-10.06	-2.53	+4.69	↑↓	-11.89	-2.75	+6.17	↑↓
	Summer	%	-38.85	-15.20	+7.09	↑↓	-49.91	-21.59	+7.54	↑↓
	Winter	%	-4.58	+8.76	+23.29	↑↓	-3.51	+12.8	+31.66	↑↓
*Trend is for indicative purposes only.										

33.5.2.2.2 Marine Projections

Sea Temperature

137. In addition to an increase in air temperatures, climate change is also likely to affect sea surface and near-bottom temperatures, which in addition to 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 in Plate 33.1. Across all regions in the last 40 years, the southern North Sea has experienced the strongest surface warming trend of 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 (Cornes et al., 2023).

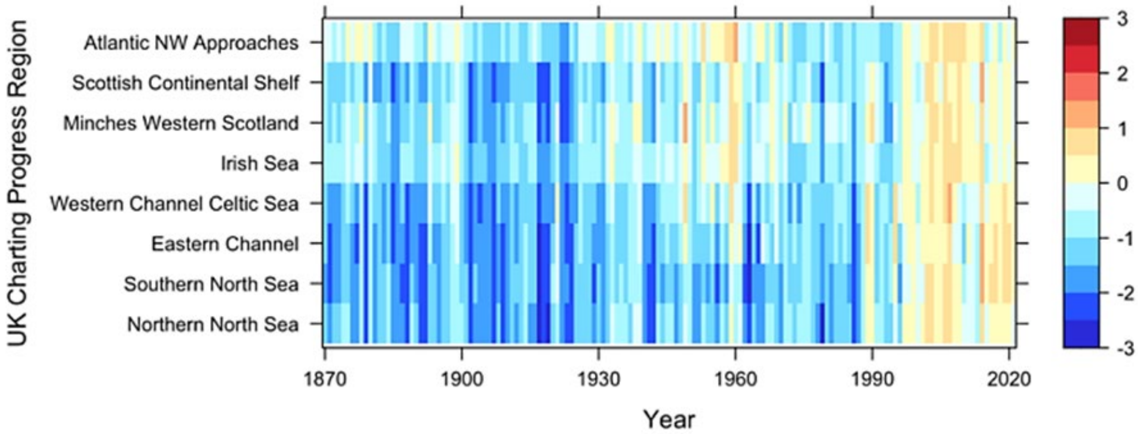

Plate 33.1 Observed changes in sea temperatures around the UK. Anomalies are calculated relative to the period 1991-2020 and are normalised (sourced from Cornes et al., 2023)

138. 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).

139. It is predicted that under RCP8.5, the average annual mean sea surface temperature change at the southern North Sea from 2079 to 2098 could be 3.72°C (± 1.03°C) compared to a 2000 to 2019 baseline, while projections for near-bottom temperature change sit around 3.65°C (± 1.01°C) (Cornes et al., 2023).

Sea-level Rise and Storm Surge

140. 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 (The Met Office, 2022).

141. Although the majority of UKCP probabilistic projections are over land, and thus do not provide direct coverage of the offshore area in which the Project is located, marine projections for sea level rise around the UK are available. Sea level anomalies data were retrieved from the UKCP database for the grid square covering where the export cable corridor reaches landfall (51.83°N, 1.25°E).

142. To provide projections of sea level rise from 2007 to 2100 under RCP4.5 and RCP8.5, sea level anomalies data were retrieved from the UKCP database for the grid square covering where the export cable corridor reaches landfall (51.83°, 1.25°). Plot graphs of sea level rise averages for the two RCP scenarios are displayed in Plate 33.2. Under RCP4.5, average sea level rise by 2050 is predicted to be between 0.19 m and 0.36 m (5th and 95th percentile respectively). Under RCP8.5, this projection increases slightly to a sea level rise of between 0.22 m and 0.4 m (5th and 95th percentile respectively) (The Met Office, 2018).

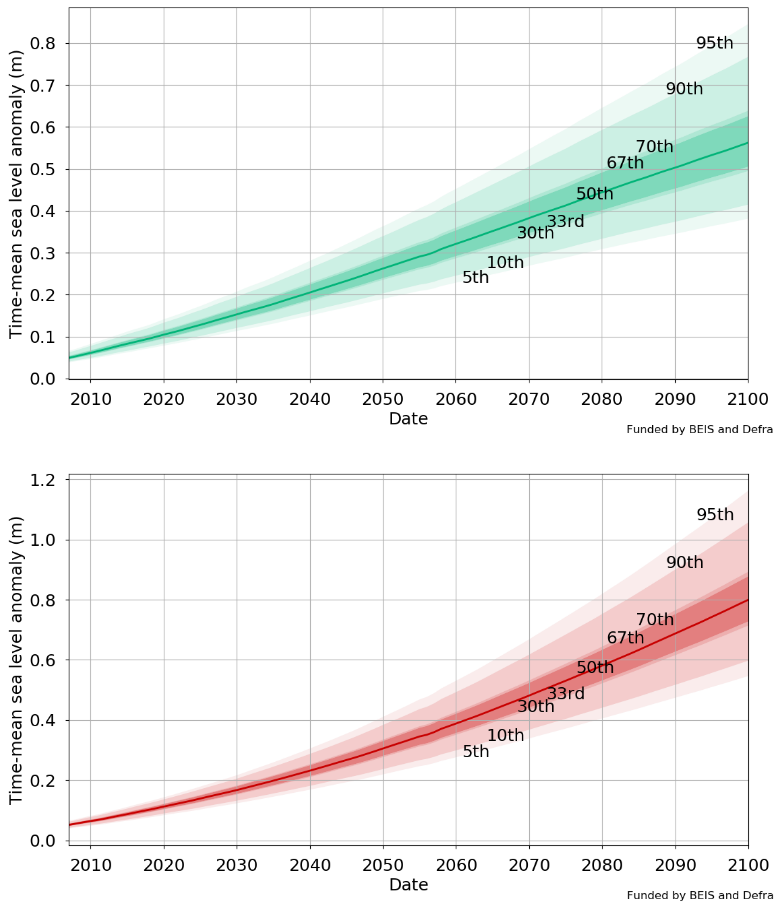

Plate 33.2 Time mean sea level anomaly (m) for years 2007 up to and including 2100, for Project coastal grid square (51.83°N, 1.25°E), using baseline 1981-2000, and scenarios RCP4.5 (green) and RCP8.5 (red), showing the 5th to 95th percentiles (Met Office, 2018)

143. 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 currently regional rates of sea level rise around the UK are between 1 mm to 2 mm per annum, and rates in the south of the UK are higher than some parts of Scotland when vertical land movement (glacial isostatic adjustment since the last ice age) is also taken into consideration (Horsburgh et al., 2020).

144. Horsburgh et al. (2020) concluded that there is no observational evidence for long-term trends in either storminess across the UK or resultant storm surges, and storm surge stimulations for the 21st century suggest a best estimate of no significant changes to storm surges. Wolf et al. (2020) summary on future projections on storms and waves concluded that future projections in waters surrounding the UK are sensitive to climate model projections for the North Atlantic storm track, which contains considerable uncertainty. In the near future, natural variability dominates any climate-related trends in storms and waves, and towards the end of the 21st century, there is some consensus that mean significant wave height is decreasing while most extreme wave height is increasing (Palmer et al., 2018).

145. Sea level rise, in addition to other factors such as storms, anthropogenic disturbance and reduced sediment supply, will also result in greater coastal erosion. 17% of the UK coastline is undergoing erosion and it is approximated that 28% of the 3,700 km England and Wales coastline is experiencing erosion greater than 10 cm per year (Masselink et al., 2020). The future baseline for coastal erosion in the offshore Project study area is discussed in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10).

33.6 Assessment of Effects

33.6.1 Impact 1: GHG Assessment

146. This section presents the GHG assessment which considers the construction, O&M and decommissioning phases of the Project individually, and then combined over the whole lifecycle. The carbon benefits of the Project are also determined.

147. As discussed in Section 33.4.3.1.3, the receptor for the GHG assessment is the global atmosphere, which is defined as high sensitivity. The magnitude of impact is not defined in EIA terms but represented by the magnitude of GHG emissions released or saved as a result of Project activities.

148. As noted in Table 33.3 and ES Appendix 33.1 Greenhouse Gas Assessment Methodology (Document Reference: 3.3.71), conservative assumptions are adopted for the assessment with respect to the activity data and emission factors used, such as assuming the most GHG-intensive construction materials and the worst-case distance for vessel round trips. In addition, wider decarbonisation trends are not considered within the assessment, as the utilised emission factors are representative of present-day conditions. Specifically, the manufacturing of products and the movement of marine vessels are likely to be less GHG intensive over the Project's timeframe, as the UK electricity grid decarbonises, and organisations adopt emission reduction

measures in line with their sectoral decarbonisation trajectories. Therefore, the calculated GHG emissions are likely to present an overestimate of actual emissions, particularly during the O&M and decommissioning phases.

33.6.1.1 Likely significant effects during construction

149. GHG emissions calculated for each source group in the construction phase are shown in Table 33.21.

Table 33.21 Construction GHG emissions from the Project

Source	Project location	GHG emissions (tonnes CO_2e)	% of total construction GHG emissions
Embodied emissions in materials	Offshore	2,119,879	80.1%
	Onshore	43,851	1.7%
Marine vessels	Offshore	428,662	16.2%
Helicopters	Offshore	103	0.0%
Plant and equipment	Onshore	43,195	1.6%
Road traffic vehicles	Onshore	4,129	0.2%
Waste disposal	Onshore	7,489	0.3%
Total (over entire construction phase)	**Onshore**	**98,665**	3.7%
	Offshore	**2,548,644**	96.3%
	Onshore and Offshore	**2,647,309**	

150. Emissions during the construction phase are estimated to be 2.65 million tonnes CO_2e. Embodied carbon in materials is expected to be the largest source of emissions to during construction, contributing approximately 82% of overall the total during this phase. The majority of embodied carbon is from offshore components, and in particular from the use of steel and aggregate/stone/rock, due to the large quantities required to construct the infrastructure components and/or their high embodied carbon content. These materials account for 34% and 54% of total embodied carbon emissions respectively.

33.6.1.1.1 Comparison to UK Carbon Budgets

151. The Project's construction phase falls under the 5th Carbon Budget period (2028 to 2032). Estimated construction emissions would constitute around 0.15% of the 5th Carbon Budget, which forms a relatively small proportion, and GHG emissions during construction would occur over a short duration as a single occurrence.

152. It should be noted that some of construction GHG emissions predicted in Table 33.21 are likely to occur outside the territorial boundary of the UK, given the international nature of supply chains. Therefore, these emissions would take place outside the scope of the UK's national Carbon Budget, policy and governance. However, considering that GHG emissions affect the climate system 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 assessment.

33.6.1.1.2 Significance of effect

153. Based on their negligible contribution to the 5th Carbon Budget, construction emissions arising from the Project are unlikely to affect the UK's ability to meet

future Carbon Budgets and progress towards achieving a science-based net zero transition. Construction methods are expected to comply with applicable existing and emerging policy requirements and good practice design standards for offshore wind farms. Therefore, the Project's construction emissions are considered to have a minor adverse effect on climate change, which is not significant in EIA terms. Moreover, it should be noted that construction emissions would be released once to enable the development of the Project and the provision of renewable energy to decarbonise the UK electricity grid in the long run, as detailed in Section 33.6.1.2.1.

154. There are opportunities for further reductions in construction phase emissions, which can be captured through the implementation of a standard carbon management process. The 'PAS 2080' guidance document (2023) provides requirements to demonstrate leadership and establish effective governance mechanisms for reducing whole life carbon in built environment projects. The following management measures are recommended to the Project as industry good practice for further consideration but are not required as additional mitigation:

- Optimise the efficiency of construction activities to reduce fuel and material consumption and promote resource efficiency, e.g., inclusion of delivery and transport coordination requirements in the Vessel Management Plan, and adoption of waste hierarchy in construction management plans.
- Explore opportunities to reduce embodied carbon and other construction emissions by developing carbon-focused procurement criteria and incentive mechanisms for material suppliers and project partners, such as low carbon and recycled materials, circular construction methods and performance benchmarking.
- Review and include PAS 2080's key principles and requirements with respect to carbon management in the relevant project documents, such as:
  - Establish and communicate carbon management goals, roles and responsibilities, requirements and procedures to parties involved in the delivery of the Project.
  - Practise the GHG mitigation hierarchy over the Project's lifetime (see Section 33.3.3.1).
  - Promote collaboration and information sharing across the Project's value chain to encourage whole life carbon reductions and continual improvement.
  - Provide training and raise awareness among the project team and partners on key carbon emission sources and low carbon solutions.

155. These measures will be secured in the OCoCP which accompanies the DCO application (Document Reference 7.13).

33.6.1.2 Likely significant effects during operation and maintenance

156. GHG emissions calculated for each source group in the O&M phase are shown in Table 33.22 by source group.

Table 33.22 Operation and maintenance GHG emissions from the Project

Source	Project location	GHG emissions (tonnes CO2e)	% of O&M GHG emissions
Marine vessels	Offshore	1,335,557	89.7%
Helicopters	Offshore	103	0.0%
Road traffic vehicles	Onshore	10.4	0.0%
Spare parts	Onshore and offshore	153,034	10.3%*
Total (over 30-year operational lifetime)	**Onshore and offshore**	**1,488,704**	
Annual total (average per year O&M)	**Onshore and offshore**	**49,623**	
*Calculated as 3.7% of total construction and O&M emissions			

157. Total O&M emissions are estimated to be 1.5 million tonnes CO_2e over the 30-year operational lifetime, and on average, approximately 49,600 tonnes CO_2e per year. Marine vessels emissions constitute the majority of O&M emissions, accounting for approximately 90% of the total. As noted in Section 33.4.6, the approach to calculating emissions from marine vessels is considered to be conservative, as it assumes there would be no decarbonisation in the shipping industry over the temporal scope of the assessment. Therefore, the figures presented in Table 33.22 are likely to be an overestimation.

33.6.1.2.1 Operational GHG Intensity and Emission Savings

158. 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 Project is determined to be 10.8 g CO_2e per kWh. As discussed in Section 33.5.1.1.1, this figure assumes an installed windfarm capacity of 850 MW and a capacity factor of 61.5%.

159. Electricity generated by the Project 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 mix, leading to avoided GHG emissions and thus savings over its operational lifetime. Table 33.23 presents the quantity of emissions which would have been produced under the 'Do Nothing' scenario in the Project's absence, which assumes that the electricity would otherwise be generated from natural gas. These figures are used to determine the emissions saved with the Project in operation, accounting for the O&M emissions detailed in Table 33.22.

Table 33.23 Electricity generation and GHG intensity for the Project

Project	Project's total O&M GHG emissions (tonnes CO_2e)	GHG emissions from 'Do Nothing' Scenario (tonnes CO_2)	GHG emissions saved (tonnes CO_2e)
North Falls	1,488,704	50,967,498	49,478,793

160. Adopting the assumptions specified above, the Project would result in a saving of approximately 49.5 million tonnes CO_2e over the 30 year O&M phase. The Project would therefore support the UK's transition to a low to zero-carbon energy generation mix.

33.6.1.2.2 Comparison to UK Carbon Budgets

161. The first five years (2031-2035) of the Project's O&M phase broadly falls under the 6th Carbon Budget period (2033 to 2037). O&M emissions that would be released from activities associated with the Project over this period would constitute around 0.03% of the 6th Carbon Budget. Although O&M GHG emissions would occur continuously over the Project's operational lifetime, the magnitude of emissions would be negligible in comparison to the Carbon Budget.

162. In addition, when considering the emissions saved by the Project from the provision of renewable energy to the grid, the Project would result in an avoidance of emissions when compared to the 'Do Nothing' scenario considered in Table 33.23.

33.6.1.2.3 Significance of effect

163. The Project will contribute to the UK meeting the projected increase in electricity demand over the years due to population and economic growth (BEIS, 2022), as well as the supply of renewable energy to decarbonise the power sector and support emission reductions in other economic sectors. Given the low GHG intensity of electricity generation, and emission savings associated with the Project's operations, the significance of effect of the Project on GHG emissions during the O&M phase is considered to be beneficial, which is significant in EIA terms. Any O&M emissions released by the Project over its lifetime would be negligible and offset by the emissions it avoids.

33.6.1.3 Likely significant effects during decommissioning

164. The decommissioning strategy for the Project is not known at this stage, and therefore a detailed quantification of project-specific decommissioning emission sources has not been undertaken. However, these emission sources are likely to include marine vessel emissions from the disassembly of offshore infrastructure and transport to its end of life destination and emissions from waste processing, recycling and disposal.

165. Using an industry benchmark obtained from the literature (Thomson & Harrison, 2015), the Project's decommissioning emissions are estimated to be 50,236 tonnes CO_2e, which accounts for 1.2% of the Project's lifecycle GHG emissions.

166. It is anticipated that a large proportion of wind farm components would be recycled, repurposed or incinerated for energy recovery at the end of life stage, as opposed to being sent to landfill, with current estimates for wind turbines recyclability ranging from 85 to 90% (Schmid *et al.*, 2020). There are also alternatives to decommissioning of offshore wind farms with potentially lower GHG footprint which could be explored as part of determining the preferred decommissioning strategy for the Project (Spyroudi *et al.*, 2021). Furthermore, emission calculations for other decommissioning activities for the Project are likely to be an overestimate, as they would not account for high levels of decarbonisation which will be achieved in the future. For example, as 2050 is the UK's target net zero year, new end of life strategies are likely to become commercially available which are likely to result in less emissions than equivalent activities undertaken in the present day.

33.6.1.3.1 Significance of effect

167. Decommissioning would result in a single occurrence of GHG emissions, and is an inherent process in the lifecycle of offshore wind projects. However, as the UK economy is likely to decarbonise over the lifespan of the Project, emission estimates based on present day activities are likely to result in an overestimation. Therefore, the Project's decommissioning emissions are considered to have a negligible effect on climate change, which is not significant in EIA terms. Similar to construction, decommissioning activities are expected to comply with applicable policy requirements and good practice design standards for offshore windfarms at the time of its occurrence. Carbon management measures as specified by PAS 2080 discussed Section 33.6.1.1.2 are also applicable to decommissioning activities.

33.6.1.4 Whole Lifecycle GHG emissions

168. The Project's GHG emissions over its whole lifecycle are presented in Table 33.24. The total GHG emissions resulting from the construction, O&M and decommissioning of the Project are estimated to be 4.19 million tonnes CO_2e. Construction emissions contributed the largest proportion of lifecycle emissions, accounting for 63% of the total.

Table 33.24 Whole lifecycle GHG emissions from the Project

Phase	GHG emissions (tonnes CO2e)	Percentage of whole lifecycle GHG emissions
Construction	2,647,309	63.2%
O&M	1,488,704	35.6%
Decommissioning	50,236	1.2%
Total	**4,186,249**	

169. When considering a temporal profile of Project's lifecycle emissions, construction emissions represent the highest peak over the maximum five year construction period (2027-2031), while O&M emissions account for a lower magnitude of continuous emissions over the 30-year lifetime of the Project.

170. To contextualise the carbon benefits of the wind farm in its entirety, an overall GHG intensity and payback period are calculated using the whole lifecycle GHG emission from the Project, the anticipated lifetime electricity output of the Project and the avoided emissions from the displacement of electricity which would have otherwise been generated using natural gas. Using this approach, the GHG payback of the Project is 2.5 years from the time when the Project becomes fully operational, as set out in Table 33.25.

Table 33.25 Whole lifecycle GHG 'payback' period

Parameter	Value	Unit
Energy produced by Project	4,579	GWh/year
CO_2* intensity of electricity generated by natural gas	371	tonnes CO_2/GWh
Annual CO_2* from gas-generated electricity (i.e. saved per year)	1,698,917	tonnes
Total CO_2e released by the Project (total: construction + 30 year O&M + decommissioning)	4,186,249	tonnes

Parameter	Value	Unit
Time taken for Project-generated CO_2e to be paid back	**2.46**	**years**
Total CO_2* from gas-generated electricity (i.e. over 30-year O&M period)	50,967,498	tonnes
Total GHG emissions saved	**46,781,248**	**tonnes**
*As detailed in Section 33.5.1.1.2, it is noted that the electricity supplied by gas emission factor is in units of CO_2 rather than CO_2e, however CO_2 is likely to form the main contribution to generation of electricity from gas and the factor is likely higher, were other GHGs to be included.		

171. The whole lifecycle GHG intensity of the Project (including construction, O&M and decommissioning GHG emissions) is estimated to be 30.5 gCO_2e per kWh. Total GHG emissions saved as a result of the Project are approximately 46.8 million tonnes CO_2e over the 30-year operational phase. This saving is likely to be even greater, as the comparative 'Do Nothing' scenario carbon intensity (i.e., 371 tonnes CO_2/GWh) is only from electricity generation (i.e., O&M) and are unlikely to include the construction (and demolition) emissions of power station infrastructure, and a more accurate comparison would be using the O&M GHG intensity for the Project quantified in Section 33.6.1.2.1 (i.e., 10.8 g CO_2e per kWh).

172. This indicates that emissions associated with the whole lifecycle of the Project are far exceeded by the avoided emissions which they enable, and any GHG emissions released would be fully offset within their operational lifetime. In addition, the overall GHG intensity of the Project compares favourably with other forms of fossil fuel electricity generation based on their predicted lifecycle GHG intensities (CCC, 2013):

- Unabated Combined Cycle Gas Turbine: 380 to 500 g CO_2e per kWh
- Gas with Carbon Capture Storage: 90 to 245 g CO_2e per kWh
- Coal with Carbon Capture Storage: 80 to 310 g CO_2e per kWh

33.6.1.4.1 Overall significance of effect

173. As discussed previously, a number of conservative assumptions are used in the GHG assessment, and, therefore, the whole lifecycle emissions total presented in Table 33.24 are likely an overestimation. Given the Project will enable the provision of renewable energy to the UK electricity grid and contribute positively to the UK's progress in meeting its net zero targets and the climate system, the overall significance of effect for the whole lifecycle of the Project is considered to be beneficial, which is significant in EIA terms.

33.6.2 Impact 2: CCRA

174. During operation, it is expected that there will be no further requirement for land to be disturbed or excavated, except in the event that onshore cables require repair or maintenance or the onshore substation access works needing to be reinstated. However, these activities would not extend beyond the construction footprint assessed above, and for the former would be relatively rare and localised in occurrence. For the latter, the haul road required to access the onshore substation, required in the unlikely event of transformer failure, would potentially be in place for up to 7 months, but its location would be over land already disturbed during construction. As such, direct and indirect physical

impacts on climate change receptors during operation have been scoped out of further assessment, as impacts would have already occurred during the construction phase.

33.6.2.1 Likely significant effects during construction

175. The likely significant effects of climate change upon the Project during construction are assessed below.

33.6.2.1.1 Step 1: Identifying receptors, climate variables and hazards

176. As discussed in Section 33.4.3.2, as the construction phase of the Project is likely to be completed within the next ten years, the degree of climatic change over this period, as distinct from standard weather fluctuations, is not likely to result in significant changes from present day conditions (as presented in Section 33.5.2.1). Therefore, a high level assessment has been undertaken for the construction phase.

177. The only climate hazards with potential to pose climate change impacts upon receptors associated with the Project during construction are extreme weather events in the short term, as chronic hazards that involve gradual change to climate averages and extremes would occur over the medium to long term (i.e. the O&M phase). Construction site workers, onshore and offshore project infrastructure (including temporary construction compounds and trenchless crossings) and construction equipment/vessels/vehicles associated with the Project have been identified as the receptors which may be vulnerable to the effects of climate change during the construction phase. The potential climate hazards with potential to affect these receptors are identified as:

- Flooding,
- Heatwaves, and
- Storm events (high winds and flooding), including marine storm surges.

178. The vulnerability and by extension the resilience of the Projects' receptors to these climate parameters are considered in Step 2 of the CCRA below.

33.6.2.1.2 Step 2: Climate vulnerability assessment

Flooding

179. There is a potential that flooding could cause damage to onshore infrastructure, including temporary construction compounds. Increased flooding risk during the construction phase is considered in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) and within the Flood Risk Assessment presented in ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29). ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29) states that prior to commencement of the construction works, detailed drainage surveys and ground investigations will be undertaken to support the development of the detailed drainage design for all elements of the onshore infrastructure. The construction drainage infrastructure will be developed and agreed with the appropriate regulators, where relevant, and implemented to minimise water within the working areas, ensure ongoing drainage of surrounding land and that there is no increase in surface water flood risk. ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29) considers the appropriate climate change allowances and concludes that

mitigation measures to mitigate the risk of flooding over the Project's lifetime can be achieved.

180. A local specialist drainage contractor will be appointed to undertake surveys to locate drains, and create drawings pre- and post-construction, to ensure appropriate reinstatement. Construction drainage will include provisions to minimise flood risk within the working area and ensure ongoing drainage of surrounding land. Flood risk mitigation measures are detailed in ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.1.29) which concludes that the potential for temporary increase in flood risk during construction will be mitigated through the use of appropriate management measures, which are discussed further in ES Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29).

181. The receptors outlined in Step 1 (see Section 33.6.2.1.1) are considered to have a medium exposure to flooding and the sensitivity is assumed to be low if suitable mitigation measures are implemented. Based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to flooding.

Heatwaves

182. There is a potential for heatwaves to cause harm to both onshore and offshore construction site workers and damage to the onshore infrastructure during construction, specifically the onshore cable route and onshore substation. The application of an OCoCP and OPEMP during the construction phase will prioritise workers' safety by considering the impact of extreme weather events, including heatwaves. These plans will include mitigation measures such as monitoring on-site weather conditions, incorporating a severe weather protocol, and scheduling activities based on information from weather forecasts. Construction site workers will be required to include provisions specific to prevailing weather conditions, such as additional rest breaks during heatwaves. By implementing these measures, construction sites can minimise the risks associated with heatwaves to the construction workers and impact on construction activities.

183. Due to the short duration of the construction phase and the application of industry good practice measures, receptors that could be sensitive to heatwaves are considered to have low exposure during the construction phase and a low sensitivity to such climatic changes. Based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to heatwaves.

Storm Events

184. As highlighted in Section 33.5.2.2.2, there is uncertainty as to the degree that climate change would lead to more extreme weather events, but recent evidence suggest this is becoming more prominent, which could cause disruption, flooding and damage during the construction phase of the Project. There is a potential for storm events to cause harm to both onshore and offshore construction site workers and damage to Project infrastructure.

185. While there is likely to be a minor change in the likelihood or severity of storm events during the construction phase, mitigation measures based on industry good practice in the construction sector will be incorporated into construction

management plans, such as the CoCP (an outline version of which is submitted with DCO application (Document Reference: 7.13), to minimise the likelihood of climate change impacts.

186. The extreme weather receptors for the construction phase of the Project are considered to have a medium exposure and low sensitivity to such storm events (given the industry good practice mitigation measures currently in place) due to climate change. Based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to storm events.

33.6.2.1.3 Significance of effect

187. Given that the Project is considered to have low vulnerability to all climate hazards identified, further assessment of climate change impacts and associated risks (Steps 3 and 4 of CCRA) has not been undertaken.

188. On this basis, there is a low likelihood of climate change impacts adversely affecting the Project during its construction phase, and any effects of climate change on the Project are considered to be not significant in EIA terms.

33.6.2.2 Likely significant effects during O&M

189. The likely significant effects of climate change to the Project during O&M are assessed. This section provides a summary of changes to climate variables and the associated climate hazards which are anticipated to interact with the Project over its operational lifespan.

33.6.2.2.1 Step 1: Identifying receptors, climate variables and hazards

190. As discussed in Section 33.5.2, observed and projected changes to the climate baseline in the study area indicate that the key climate variables which could be affected by climate change are temperature, precipitation, wind speed, coastal erosion, sea temperature and extreme weather events.

191. The Project may be exposed to a range of climate hazards, defined as extreme weather events and chronic (longer term) climatic changes with the potential to harm human, environmental or infrastructure receptors (IEMA, 2020). Exposure to potential climate hazards may lead to climate change impacts to the Project, such as physical damages to infrastructure components or adverse working conditions during O&M activities.

192. The Project receptors, climate variables and hazards taken forward into Step 2 of the CCRA are detailed in Table 33.26.

Table 33.26 Project receptors, climate variable and hazard identified for the CCRA (O&M phase)

Climate variable	Potential climate hazards	Receptors affected
Temperature	High temperatures (including heatwaves): the climate projection data in Table 33.19 shows that annual mean, maximum and minimum temperatures in the onshore Project area are predicted to rise, with an increase in annual air temperature of between 0.49 and 1.8 ºC (10th to 90th percentile). This may result in more periods of heatwaves or high temperatures. As detailed in Section 33.5.2.2.2, climate change is also likely to increase the air and sea surface temperatures in the southern North Sea region, where offshore Project infrastructure will be located.	Built offshore (e.g., WTGs, OSP/OCPs, foundations and cables) and onshore (e.g., onshore cable route and onshore substation) infrastructure. The identified receptors associated with the Project are not considered to be vulnerable to sea temperature rise.
	Snow and Ice: the climate projection data in Table 33.19 shows that minimum air temperatures are predicted to increase, meaning potential impacts associated with snow and ice conditions are likely to decrease.	None identified, as snow and ice conditions are likely to be less frequent due to milder winders, impacts to receptors are not considered to be likely.
Precipitation	Increased precipitation and surface water flooding: the climate projection data in Table 33.19 shows that annual precipitation levels in the onshore study area are variable, with the 10th percentile predicting decreases in precipitation levels while the 90th percentile predicts increases in precipitation levels, annually and also during both the winter and summer seasons. The predicted increase in precipitation levels in the study area during the winter season ranges from 16.7% to 21.6% (depending on RCP and 25 km grid square) compared to a 1981-2010 baseline, which could lead to more frequent surface water flooding events during the season.	Built onshore infrastructure (e.g., onshore substation).
Wind speed	Average wind speeds: there is uncertainty as to whether climate change would result in a difference to annual average wind speeds. Potential impacts from high wind speeds in extreme weather events are considered in a row below.	None identified.
Sea level rise and sea conditions	Sea level rise and sea conditions: Climate change is likely to increase mean sea level globally due to melting ice sheets and glaciers and the thermal expansion of seawater. Sea levels at landfall are likely to rise under RCP8.5 by between 0.18 to 0.29 m by 2040, 0.24 to 0.38 m by 2050, 0.3 to 0.49 m by 2060 (10th and 90th percentile, respectively), as shown in Plate 33.2 and detailed in the Sea-level Rise and Storm Surge Section. Under RCP4.5, sea levels are likely to rise by between 0.16 to 0.26 m by 2040, 0.2 to 0.34 m by 2050, 0.24 to 0.42 m by 2060 (10th and 90th percentile, respectively). This may affect receptors in coastal areas, such as the landfall. Sea level rise, in addition to other factors such as storms, anthropogenic disturbance and reduced sediment supply, may also result in more erosion of the coast, as discussed in the Section 33.5.2.2.2 and in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10). Other	Built offshore (e.g., WTGs, OSP/OCPs, foundations and cables) and landfall infrastructure. O&M personnel. Vessels, helicopters and/or other equipment used during O&M activities.

Climate variable	Potential climate hazards	Receptors affected
	chronic changes in sea conditions due to climate change include increased mean maximum wave heights, reduced mean wave heights and changes to tidal range and other characteristics (Palmer et al., 2018).	
Extreme weather events	Climate change is likely to increase the frequency and severity of extreme weather events (Seneviratne et al., 2021). Events relevant to the marine climate include stronger gusts or prolonged high wind events, increasing rainfall intensity, marine heat and cold waves, hot and cold spells above sea and storms. Storm events (high winds and flooding), storm surges and tidal flooding: although there is uncertainty as to the degree that climate change will lead to more extreme weather events, recent evidence is that this is becoming more prominent. Potential extreme weather events include storms, where there may be high winds and flooding (as discussed above). These events could therefore result in impacts to above ground infrastructure (such as the onshore substation) and offshore infrastructure. For the marine climate, storm events include turbulent waves, strong undercurrents and storm surges or ocean swelling caused by high wind pushing the sea towards the coast and lower atmospheric pressure during storms (Palmer et al., 2018).	Built onshore (e.g., landfall, onshore substation) and offshore (e.g., offshore substation, WTGs) infrastructure. O&M personnel. Vessels, helicopters and/or other equipment used during O&M activities.

193. The climate hazards with potential to affect receptors associated with the Project are identified as:

- Higher temperatures (including heatwaves);
- Increased precipitation and surface water flooding;
- Sea level rise and conditions, including coastal erosion; and
- Storm events (high winds and flooding), including storm surges.

194. The vulnerability and by extension the resilience of the Project's receptors to these climate parameters are considered in Step 2 of the CCRA.

33.6.2.2.2 Step 2: Climate vulnerability assessment

195. The vulnerability of the Project and its receptors to the climate hazards identified are considered further in Step 2 of the CCRA and outlined in Table 33.27. A description of how the hazard translates into climate change impacts upon the Project is also provided.

196. This Section should be read in conjunction with the major accidents and disasters screening presented in ES Chapter 34 Major Accidents and Disasters (Document Reference: 3.1.36).

Table 33.27 Climate vulnerability assessment

Climate hazard	Potential climate change impact to the Project	Embedded mitigation	Sensitivity	Exposure	Vulnerability	Screened in for detailed climate risk assessment ?*
Higher temperatures, including heatwaves	Onshore: increases in temperatures may lead to the overheating of onshore infrastructure, such as onshore substation equipment (e.g., switchgear, transformers). Offshore: wind energy is directly proportional to air density, which is inversely proportional to air temperature. Long-term increases in air temperature can lead to slight declines in wind energy output by lowering air density.	The Project's onshore and offshore infrastructure has been designed with sufficient safety margins to cope with any increases in air temperature. Infrastructure (i.e. receptors) with longer lifetimes, such as concrete structures, will be resilient to shorter-duration maximum temperatures due to the material and structural qualities. The below ground components of the Project, including the onshore export cable, will be afforded thermal insulation by the ground and are therefore not considered to be sensitive to damage due to high temperatures. The Project's receptors will be constructed using building materials and techniques as per industry standards that provide sufficient thermal protection to mitigate the risks of increased high temperatures. The Project's offshore infrastructure has been designed with sufficient safety margins to account for extreme weather events and are based on information gathered from satellite observations, real-time measurements and metocean hindcast data, which synthesises long-term time series of wind and waves.	Low	Low	Low	No
Increased precipitation and surface water flooding	Onshore: increases in precipitation could lead to surface water flooding affecting onshore infrastructure, such as the onshore substation, which could damage equipment. Onshore cables are not considered to be a receptor of fluvial flooding as they would be located below ground. Offshore: increases in precipitation and moisture could also affect the functionality of the turbine	Appendix 21.3 Flood Risk Assessment (Document Reference: 3.3.29) considers the effects of increased rainfall intensity due to climate change on the Project, see Appendix 21.3 for further details. The onshore substation is to be located within Flood Zone 1, which represents a low risk of flooding from fluvial sources and the onshore substation is not considered to be at risk from any other sources. The outline drainage design also includes	Low	Medium	Low	No

Climate hazard	Potential climate change impact to the Project	Embedded mitigation	Sensitivity	Exposure	Vulnerability	Screened in for detailed climate risk assessment ?*
	blades and increase the risk of blade edge erosion, increasing maintenance costs (Weisenfeld et al., 2021).	mitigation measures to ensure it does not increase surface water flood risk to the Project. Surface water drainage requirements for the onshore substation have taken account of the sustainable drainage system (SuDS) hierarchy to meet the requirements of relevant policy and guidance. The Project's offshore infrastructure has been designed with sufficient safety margins to account for the functionality of the turbine based and increased risk of blade edge erosion, such as measures to maintain the blades if they become eroded.				
Sea level rise and conditions, including coastal erosion	Onshore: at landfall sea level rise and storm surges could lead to coastal erosion affecting the Project's buried cables and landfall infrastructure. Offshore: sea level rise, compounded by storm surges and tidal changes, could affect fixed foundation components by increasing the risk of water damage and saltwater corrosion of non-resistant components. Faster asset deterioration would increase maintenance and replacement costs. Stronger ocean waves and currents would increase loading and reduce the structural integrity of offshore infrastructure, and if design limits are exceeded may result in asset damage or failure (Weisenfeld et al., 2021). Wind turbine and offshore platform foundations, cables and other support structures which are submerged are exposed to a corrosive and harsh environment due to strong waves and currents and the ocean's salinity. Increase in sea temperature beyond an	Cables will be installed at landfall by the use of Horizontal Directional Drilling (HDD), as discussed in ES Chapter 5 Project Description (Document Reference: 3.1.7), and the landfall transition jointing bay would be greater than 350 m from the shoreline behind the golf course/Site of Special Scientific Interest (SSSI) and so set back from any area at risk of erosion. Further information is provided in ES Chapter 8 Marine Geology, Oceanography and Physical Processes (Document Reference: 3.1.10) on the future trends in baseline conditions with regards to coastal erosion. Modern wind farm design consistent with industry good practice engineering codes and standards will be adopted, which will require resilience to extreme weather events at sea and longer term changes to the climate baseline. Design measures could include high wind ride out and climate change allowance for wind turbine support structures to avoid water damage and saltwater corrosion	Low	Low	Low	No

Climate hazard	Potential climate change impact to the Project	Embedded mitigation	Sensitivity	Exposure	Vulnerability	Screened in for detailed climate risk assessment ?*
	infrastructure's operational temperature range could reduce the structural integrity of infrastructure, resulting increased maintenance and shorter replacement cycles due to fatigue, corrosion damage and faster asset deterioration (Igwemezie et al., 2018).	of non-resistant components and to withstand stronger waves and currents. Real-time monitoring of wind turbine's operational health and site conditions and regular inspections and maintenance of offshore infrastructure will be carried out over the Project's operational lifetime. This will ensure timely identification and remediation of asset degradation and damages and prevent prolonged periods of disruptions to electricity generation.				
Extreme weather events (storm events (high winds and flooding), including storm surges)	Extreme weather events at sea such as storms and surges could damage onshore and offshore infrastructure and increase maintenance and replacement costs. Operational down time during gusts or prolonged high wind events would also disrupt electricity generation, with a risk of lower annual energy output with an increasing frequency of extreme weather events. Moreover, frequent or intense events of turbulent flow of wind may result in loss of low pressure and lift, diminishing wind energy output (Weisenfeld et al., 2021). Extreme weather events could also constrain offshore O&M activities and present health and safety risks to personnel, vessels and other equipment.	The Project has been designed to have an inherent level of resilience to mitigate the risk of storm events to affect receptors associated with the Project. In addition to the embedded mitigation discussed in the rows above, the wind turbines will shut down and remain in idle configuration at wind speeds above the design limit to prevent structural damage. Normal operations will resume once the wind speed returns below the cut-out speed. Management plans prepared prior to the commencement of O&M activities will include weather forecasts, risk assessments and suitable health and safety protocols for extreme weather events to prioritise and safeguard the wellbeing of workers. The Project's offshore infrastructure has been designed with sufficient safety margins to account for extreme weather events and are based on information gathered from satellite observations, real-time measurements and metocean hindcast data, which synthesises long-term time series of wind and waves.	Low	Medium	Low	No
*Step 3: Climate Risk Assessment and Step 4: Resilience Rating						

197. Given that the Project is considered to have low vulnerability to all climate hazards identified, further assessment of climate change impacts and associated risks (Steps 3 and 4 of CCRA) has not been undertaken.

33.6.2.2.3 Significance of effect

198. The CCRA has identified the vulnerability of the Project and its receptors to key climate hazards that are likely to occur within the study area over its operational lifetime. The assessment has determined that, accounting for the Project's embedded mitigation, the vulnerability rating of all hazards identified would be low. Therefore, there is a low likelihood of climate change impacts adversely affecting the Project during its O&M phase, and any effects of climate change on the Project are considered to be not significant in EIA terms.

33.6.2.3 Likely significant effects during decommissioning

199. The decommissioning policy of the Project is not yet known; thus, a detailed CCRA cannot be performed at this stage. Nevertheless, a high level CCRA has been considered below.

200. Decommissioning scenarios are described in ES Chapter 5 Project Description (Document Reference: 3.1.7). Decommissioning arrangements for the offshore and the onshore elements would be confirmed through the approval of a Decommissioning Plan following cessation of commercial operation; however, for the purpose of this high-level assessment, it is assumed that decommissioning of the offshore and onshore elements could be conducted separately, or at the same time.

201. A high-level assessment for the Project is presented based on the high-level decommissioning aims outlined in ES Chapter 5 Project Description (Document Reference: 3.1.7), and assumption that the decommissioning receptors will be equivalent to the construction receptors outlined in Section 33.6.2.1.1. In addition, it was assumed that the decommissioning phase for the Project would be of a similar duration to the construction phase. However, this is likely an overestimation as future development of regulation and methodologies may result in alternative approaches being implemented.

202. It is expected that a detailed CCRA for decommissioning will be performed closer to the decommissioning phase during the preparation of decommissioning plans, and suitable mitigation measures will be adopted to minimise the risks posed to the Project.

33.6.2.3.1 Step 1: Identifying receptors, climate variables and hazards

203. As mentioned above, it is assumed that the decommissioning receptors will be equivalent to the construction receptors outlined in Section 33.6.2.1.1.

33.6.2.3.2 Step 2: Climate vulnerability assessment

Flooding

204. Flooding events associated with the climate change during the decommissioning phase could be associated with sea level rise, tidal flooding, storm events and rain intensity and there is a potential that flooding could cause damage to onshore infrastructure, including temporary compounds used for decommissioning.

205. As detailed in Table 33.20, the projected worst case mean precipitation for the decommissioning phase of the Project shows an increase of 33.35% (90th percentile) in winter for the RCP8.5 compared with the 1981-2010 baseline. Based on the worst case projected rainfall, the future climate change within the decommissioning phase is expected to cause increased rainfall intensity in the onshore project area.

206. As there is no current Decommissioning Plan, detailed mitigation measures are not available. However, it is assumed that the Decommissioning Plan will include the requirement to utilise the industry good practice measures at the time of decommissioning. It is assumed that implementing these measures, will minimise the risks associated with flooding to onshore infrastructure and impact on decommissioning activities.

207. Therefore, the decommissioning phase of the Project is considered to have the medium exposure to flooding compared to the comparable worst case mean precipitation for the decommissioning phase, as per the construction and O&M phases. The sensitivity is assumed to be low if suitable mitigation measures are implemented. As a result, based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to flooding.

208. Given the vulnerability rating of low for the flooding climate hazard and the lack of detailed decommissioning information, an assessment of the predicted effects and associated risks of flooding (Step 3 of the CCRA methodology) was not carried out.

Heatwaves

209. As noted in Section 33.5.2.2, the UK is projected to be warmer across all seasons during the decommissioning period. Under the RCP8.5 (very high emission) scenario, the probabilistic annual mean temperature projections detailed in Table 33.20 are predicted to increase by 1.34 and 3.64°C (10th and 90th percentile respectively) for the onshore project area. Due to the projected future increases in temperature, there is a potential for heatwave or increased temperature to cause harm to decommissioning site workers.

210. As there is no current Decommissioning Plan, detailed mitigation measures are not available. However, it is assumed that the Decommissioning Plan will include the requirement to utilise the industry good practice measures at the time of decommissioning. It is assumed that implementing these measures, will minimise the risks associated with heatwaves to the site workers and impact on decommissioning activities.

211. In addition, the duration of the decommissioning activities is assumed to be equivalent to the construction duration. Therefore, due to the anticipated short duration of decommissioning activities, the Projects are assumed to have a low exposure to and a low sensitivity during the decommissioning phase. The sensitivity is assumed as low if suitable mitigation measures are implemented. As a result, based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to heatwave.

212. Given the vulnerability rating of low for the heatwave climate hazard and the lack of detailed decommissioning information, an assessment of the predicted effects and associated risks of heatwave (Step 3 of the CCRA) was not carried out.

Storm Events

213. As noted in Section 33.5.2.2, there is uncertainty as to the degree that climate change would lead to more extreme weather events, but recent evidence suggest this is becoming more prominent, which could cause disruption, flooding and damage during the decommissioning phase of the Project. There is a potential for storm events to cause harm to both onshore and offshore construction site workers and damage to Project infrastructure. The receptors that could potentially be affected by storm events would be both onshore and offshore construction site workers as well as Project infrastructure.

214. As there is no current Decommissioning Plan, detailed mitigation measures are not available. However, it is assumed that the Decommissioning Plan will include the requirement to utilise the industry good practice measures at the time of decommissioning. It is assumed that implementing these measures, will minimise the risks associated with storm events to the site workers and impact on decommissioning activities.

215. Therefore, the decommissioning phase of the Project is considered to have medium exposure and low sensitivity to storm events. The sensitivity is assumed as low if suitable mitigation measures are implemented. As a result, based on the criteria identified in Table 33.11, the receptors are considered to have low vulnerability to storm events for the Project.

216. Given the vulnerability rating of low for storm events and the lack of detailed decommissioning information, an assessment of the predicted effects and associated risks of storm events (Step 3 of the CCRA) was not carried out.

33.6.2.3.3 Significance of effect

217. A high level assessment of the decommissioning phase was undertaken which considered the same receptors as the construction phase. Based on this, the vulnerability rating of all hazards was deemed to be low. Therefore, it is assumed there is a low likelihood that climate change impacts would adversely affect the Project during the decommissioning phase and impacts are assumed to be not significant in EIA terms.

218. It is recommended that a more detailed assessment of this phase is undertaken prior to decommissioning, where more up to date climate projection data would be available and more information on the decommissioning strategy and policy would be known. This assessment would be undertaken prior to the finalisation of the Decommissioning Plan.

33.7 Potential monitoring requirements

219. There are not anticipated to be any specific monitoring requirements for the Project as a result of the outcomes of the GHG assessment. As noted in Section 33.6.2.2, real-time monitoring of the wind turbine’s operational health and site conditions and regular inspections and maintenance of offshore infrastructure will be carried out over the Project’s operational lifetime.

33.8 Cumulative effects

33.8.1 Impact 1: GHG Assessment

220. As noted in Section 33.4.4.1, the global atmosphere is the only receptor for the GHG assessment (which is of high sensitivity) and IEMA guidance (2022) states that effects of GHG emissions from specific cumulative projects should therefore not be individually assessed, as there is no basis for selecting which projects to assess cumulatively over any other. The impacts considered by the GHG assessment are inherently cumulative, as all developments which emit, avoid or sequester GHG emissions affect global atmospheric concentration irrespective of their location. Thus, no specific cumulative assessment with other projects or plans has been undertaken for the GHG assessment.

33.8.2 Impact 2: CCRA

33.8.2.1 Identification of potential cumulative effects

221. The first step in the CEA process is the identification of which residual effects assessed for North Falls on their own have the potential for a cumulative effect with other plans, projects and activities.

222. As noted in Section 33.4.4.2, the offshore elements of the Project are highly unlikely to affect or be affected by neighbouring developments with respect to climate change resilience. Therefore, the climate change resilience cumulative assessment focused on the onshore elements of the Project only.

223. The only climate variable identified in Section 33.6.2 applicable for consideration for cumulative effects is surface water flooding, due to the potential impacts to land drainage capacity from projects in close proximity to the Project. There is potential for cumulative flooding impacts where projects are directly adjacent to each other, with the same temporal scope.

224. Only likely significant effects assessed in Section 33.6.2 as negligible or above are included in the CEA (i.e. those assessed as ‘no impact’ are not taken forward as there is no potential for them to contribute to a cumulative effect).

33.8.2.2 Other plans, projects and activities

225. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative effects for inclusion in the CEA (described as ‘project screening’). This information is set out in Table 33.28 below, together with a consideration of the relevant details of each, including current status (e.g. under construction, planned construction and/or O&M period), closest distance to North Falls, status of available data and rationale for including or excluding from the assessment.

226. The project screening has been informed by the development of a CEA project list which forms an exhaustive list of plans, projects and activities within the study area relevant to North Falls. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

Table 33.28 Summary of projects considered for the CEA in relation to climate change (project screening)

Project	Status	Development period	Closest distance from the onshore project area	Confidence in data	Included in the CEA (Y/N)	Rationale
National Infrastructure Planning						
Five Estuaries Offshore Wind Farm EN010115	Pre-application	2030 to 2070 (operational period)	Five Estuaries onshore project area directly overlaps with North Falls onshore project area.	High	Yes	The onshore project area for Five Estuaries covers largely the same area as North Falls. There is also a possibility that both projects would be in construction and/or operation for the same time period, therefore, cumulative effects to surface water flooding may occur.
Norwich to Tilbury EN020027	Pre-application	2027 – 2031	Scoping area directly overlaps with North Falls onshore project area.	Low	Yes	The proposed substation area for Norwich to Tilbury is in close proximity to North Falls proposed onshore substation works area; and the proposed new substation operational access road overlaps with the Bentley Road improvement works. Therefore, cumulative effects to surface water flooding may occur.
East Anglia TWO Offshore Windfarm EN010078	Approved (DCO Issued 2022), Correction Order (2022)	Mid 2020s	43km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Bradwell B new nuclear power station EN010111	Pre-application	Predicted 9 – 12 years	21km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Ipswich Rail Chord TR040002	Approved (DCO issued 2012)	Built	17km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Sizewell C Project EN010012	Approved (DCO issued 2022)	2022 – 2034	49km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.

Project	Status	Development period	Closest distance from the onshore project area	Confidence in data	Included in the CEA (Y/N)	Rationale
Nautilus Interconnector EN020023	Pre-application	Information unavailable	44km	Medium	No	Due to the distance from the Project, cumulative effects are not anticipated.
Lake Lothing Third Crossing TR010023	Approved (DCO issued 2020)	Construction over 2 years	76km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Richborough Connection Project EN020017	Approved (DCO issued 2017)	Built	55km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Manston Airport TR02002	Information unavailable	Information unavailable	53km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Kentish Flats Extension EN010036	Approved (DCO issued 2013)	Built	46km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
Sea Link EN020026	Pre-application	Information unavailable	20km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Galloper Offshore Windfarm EN010003	Approved	Built	15km	High	No	Due to the distance from the Project, cumulative effects are not anticipated.
A12 Chelmsford to A120 widening scheme TR010060	Decision	Information unavailable	27km	Medium	No	Due to the distance from the Project, cumulative effects are not anticipated.
Rivenhall IWMF and Energy Centre EN010138	Pre-application	Information unavailable	26km	Medium	No	Due to the distance from the Project, cumulative effects are not anticipated.
Essex County Council						
Elmstead Hall, Elmstead, Colchester, Essex ESS/24/15/TEN	Approved	Information unavailable.	5km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.

Project	Status	Development period	Closest distance from the onshore project area	Confidence in data	Included in the CEA (Y/N)	Rationale
St. George's Infant School and Nursery, Barrington Road, Colchester, Essex, CO2 7RW CC/COL/71/22	Approved	Information unavailable	9km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Wilson Marriage Centre, Barrack Street, Colchester, Essex, CO1 2LR CC/COL/85/22	Approved	Information unavailable	8km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Wivenhoe Quarry Alresford Road, Wivenhoe, Essex, CO7 9JU ESS/80/20/TEN/42/2	Awaiting decision	Information unavailable	7km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Old Heath County Primary School, Old Heath Road, Colchester, Essex, CO2 8DD CC/COL/50/22	Approved	Information unavailable.	8km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Crown Quarry (Wick Farm), Old Ipswich Road, Ardleigh, CO7 7QR ESS/57/04/TEN	Approved	Information unavailable.	5km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Wivenhoe Quarry, Alresford Road Wivenhoe, Essex CO7 9JU ESS/80/20/TEN/42/2	Approved	Information unavailable.	7km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Martell's Quarry, Slough Lane, Ardleigh, Essex, CO7 7RU ESS/42/22/TEN	Out for consultation	Information unavailable	3km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Land at: Elmstead Hall, Elmstead, Colchester, Essex ESS/105/21/TEN	Approved	Information unavailable.	5km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.

Project	Status	Development period	Closest distance from the onshore project area	Confidence in data	Included in the CEA (Y/N)	Rationale
Land at Martells Quarry, Slough Lane, Ardleigh, Essex, CO7 7RU ESS/39/22/TEN	Approved	Information unavailable.	2km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Tendring Education Centre, Jaywick Lane, Clacton on Sea, Essex, CO16 8BE (CC/TEN/40/21/3/1)	Approved	Information unavailable.	6km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Tendring Education Centre, Jaywick Lane, Clacton on Sea, Essex, CO16 8BE (CC/TEN/40/21/4/1)	Approved	Information unavailable.	6km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Crown Quarry (Ardleigh Reservoir Extension), Wick Farm, Old Ipswich Road, Tendring, Colchester, CO7 7QR ESS/57/04/TENLA4	Approved	Information unavailable.	3km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Ardleigh Waste Transfer Station, A120, Ardleigh, Colchester, CO7 7SL ESS/04/17/TEN	Approved	Information unavailable.	3km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Roach Vale, Colchester, CO4 3YN CC/COL/07/22	Approved	Information unavailable.	6km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Boxted Bridge, Boxted, Essex, CO4 5TB CC/COL/106/21	Awaiting decision	Information unavailable	8km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Lufkins Farm, Great Bentley Road, Frating CO7 7HN (ESS/41/15/TEN)	EIA not required. Resolution made/ awaiting legal agreement	Information unavailable.	8km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.

Project	Status	Development period	Closest distance from the onshore project area	Confidence in data	Included in the CEA (Y/N)	Rationale
Tendring District Council						
Land Between the A120 and A133, To The East of Colchester and of Elmstead Market (21/01502/CMTR)	Approved	Operational from 2026	3km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Hamilton Lodge Parsons Hill Great Bromley Colchester Essex CO7 7JB (20/00547/OUT)	Approved – outline	Information unavailable.	2km	N/A	No	Due to the distance from the Project, cumulative effects are not anticipated.
Land adjacent to Lawford Grid Substation Ardleigh Road Little Bromley Essex CO11 2QB (21/02070/FUL)	Approved – full	Information unavailable.	0.5 (from the proposed onshore substation)	N/A	No	Construction and operation of a 50 MW Battery Storage System. As detailed in Table 21.23 of ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23), as the development is small in size with drainage mitigation in place, cumulative effects on water resources and flood risk are not expected. Further details on this rationale are provided in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23).

33.8.2.3 Assessment of cumulative effects

227. Five Estuaries is also in its application phase, having submitted a DCO to the Planning Inspectorate for the project, which was accepted on 22nd April 2024. Although subject to a separate DCO, there is an option (Option 2) for Five Estuaries to share the same landfall location and onshore cable route (including Bentley Road improvement works) as North Falls, with the two projects also having co-located onshore substations within the same onshore substation works area. The two projects also have the same national grid connection point.

228. Five Estuaries Offshore Wind Farm Limited (VEOWL) and NFOW have sought to collaborate and coordinate where practicable, which has led to collaborative design of the projects' onshore infrastructure, and also to sharing of detailed project design information onshore. As a result, a detailed CEA for effects arising from the development of Five Estuaries can be undertaken. The CEA section of this chapter is therefore split into two sections:

- the first describing a detailed CEA covering effects predicted to arise from development of Five Estuaries and North Falls;
- the second, detailing effects predicted to arise from the development of Five Estuaries, North Falls and other projects.

229. The latter section will be based on the project information available for each scheme in the public domain, and by definition is therefore less detailed than the Five Estuaries and North Falls CEA section.

230. Full details on the approach to CEA used within this chapter are set out in ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

33.8.2.3.1 Five Estuaries Offshore Wind Farm

Realistic worst case scenario

231. Using the design information provided by VEOWL and checked/updated against the submission of the Five Estuaries ES, a realistic worst case cumulative scenario has been developed for the purpose of this chapter.

232. This considers three potential cumulative build-out scenarios, as outlined in ES Chapter 5 Project Description (Document Reference: 3.1.7):

- **Scenario 1:** North Falls 'Option 2' build out is progressed, and Five Estuaries Offshore Wind Limited undertakes landfall, onshore substation construction and cable pull which overlaps with North Falls equivalent works. In this scenario, onshore cable route associated works, including temporary construction compounds, accesses and haul road, all remain in place and are used by the second project during its construction.
- **Scenario 2:** North Falls 'Option 1' build out is progressed, and Five Estuaries Offshore Wind Limited undertakes landfall, onshore substation and onshore cable route construction and cable pull, all of which does not overlap with North Falls' equivalent works. There would be a gap of between 1 and 3 years between each Projects' construction. In this scenario, onshore cable route associated works, including temporary construction compounds, accesses and haul road, all remain in place and are used by the second project during its construction.

- **Scenario 3:** North Falls 'Option 1' build out is progressed, and Five Estuaries Offshore Wind Limited undertakes a separate landfall, onshore substation and onshore cable route construction and cable pull with a multi-year (i.e. >3 year) gap between the two construction activities. In this scenario, there is no reuse in onshore temporary works between the two projects, and all onshore cable route associated works are rebuilt and reinstated in full by the second project.

233. Full details on the build out scenarios considered within this assessment are detailed in ES Chapter 5 Project Description (Document Reference: 3.1.7) and ES Chapter 6 EIA Methodology (Document Reference: 3.1.8).

234. The realistic worst case scenario for likely cumulative effects scoped into the EIA for the CCRA is summarised in Table 33.29. This are based on project parameters for Five Estuaries described in ES Chapter 5 Project Description (Document Reference: 3.1.7), which provides further details regarding specific activities and their durations.

Table 33.29 Realistic worst-case scenario of cumulative effects arising from development of North Falls and Five Estuaries Offshore Wind Farm – Scenario 3

Element of the project infrastructure	Parameter	Notes
Construction		
Climate change resilience during construction	**North Falls** • Earliest construction start date: 2027 • Indicative construction duration: 5 years **Five Estuaries** • Earliest construction start date: 2027 • Indicative construction duration: 5 years	Temporal scope of CCRA Multi-year (i.e. >3 year) gap between the two construction activities
Operation		
Climate change resilience during O&M	**North Falls** • Earliest operational start date: 2031 • Indicative operational duration: 30 years **Five Estuaries** • Earliest operational start date: 2031 • Indicative operational duration: 30 years	N/A
Decommissioning		
No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable route, 400kV cable route and onshore substation. It is also recognised that legislation and industry good practice change over time. However, it is likely that the onshore project equipment, including the cable, will be removed, reused, or recycled where practicable and the transition bays and cable ducts being left in place. It is likely that offshore project area infrastructure would be removed above the seabed and reused or recycled where practicable. Cables, cable protection and scour protection would likely be left in situ. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the purposes of a worst case scenario, the impacts will be no greater than those identified for the construction phase.		

During construction

235. ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) presents the cumulative assessment for the Project and Five Estuaries in relation to surface and groundwater flood risk during construction. This concludes that additional impacts on surface and groundwater flows above those concluded for North Falls are not anticipated. Further details on this is provided in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23). Therefore, cumulative effects from both projects is not significant in EIA terms.

During O&M

236. ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) presents the cumulative assessment for the Project and Five Estuaries in relation to surface and groundwater flood risk during the O&M phase. This concludes that additional impacts on surface and groundwater flows at the substation due to the additional Five Estuaries substation are not expected due to the mitigation measures described in the Outline Operational Drainage Strategy (Document Reference: 7.19). Further details on this are provided in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23). Therefore, cumulative effects from both projects is not significant in EIA terms.

During decommissioning

237. No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable route and onshore substation. It is also recognised that legislation and industry good practice change over time. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23), assumes that residual effect during decommissioning would be no worse than for construction (i.e. not significant in EIA terms).

33.8.2.3.2 North Falls, Five Estuaries and other projects

238. Based on the project screening in Table 33.28, in addition to Five Estuaries Offshore Wind Farm, one of the other listed projects will be included in the CEA for further assessment: Norwich to Tilbury.

During construction

239. Table 21.25 of ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) presents the cumulative assessment for North Falls, Five Estuaries and the Norwich to Tilbury project during construction. This concludes that cumulative effects are anticipated to be not significant in EIA terms.

During O&M

240. Table 21.25 of ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23) presents the cumulative assessment for the North Falls, Five Estuaries and the Norwich to Tilbury project. This concludes that cumulative effects are anticipated to be not significant in EIA terms, as surface water runoff from Norwich to Tilbury operational above ground infrastructure would be managed in accordance with the requirements and standards of the relevant

Lead Local Flood Authority, and would adopt suitable sustainable drainage techniques, designed to allow for climate change resilience.

During decommissioning

241. As discussed in Section 33.8.2.3.1, decommissioning strategies have not yet been finalised for North Falls, Five Estuaries or Norwich to Tilbury; however, as discussed in ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23, the cumulative impacts are expected to be the same as those of the initial construction phase (i.e. not significant in EIA terms).

33.9 Transboundary effects

242. As discussed in Section 33.4.5, transboundary effects are not considered to require specific consideration for the GHG assessment or the CCRA.

243. The receptor for the GHG assessment is the global atmosphere, and therefore GHG emissions have an indirect transboundary effect on climate change. Emissions released and avoided by the Project have been assessed in the context of UK Carbon Budgets, which have been set in accordance with international climate agreements. Therefore, the Project's effects on the climate commitments of states are inherently reflected in the GHG assessment.

244. It is not relevant to assess transboundary effects relating to climate change resilience, since the assessment focusses on the effects of climate change on the Project itself.

33.10 Interactions

245. The receptor for the GHG assessment is the global atmosphere. There are no other topics which have direct effects on this receptor, and therefore there are no interactions with this topic.

246. The CCRA focuses on the effects of climate change on the Project, while other topics of the EIA assess the effects of the Project on other receptors. There are potential interactions between the CCRA and other topics that have been considered within the ES. Table 33.30 provides a summary of the principal interactions and signposts to where those issues have been addressed.

Table 33.30 Climate change – CCRA interactions

Impact/receptor		Related chapter (Volume 3.1)	Where addressed in this chapter	Rationale
Construction, O&M and Decommissioning				
Impact 1 GHG emissions		No interactions identified.		
Impact 2 Climate hazards on receptors	Flooding	ES Chapter 21 Water Resources and Flood Risk (Document Reference: 3.1.23)	Section 33.6.2	Potential impacts on the Project as a result of flooding
	Storm events	ES Chapter 34 Major Accidents and Disasters (Document Reference: 3.1.36)	Section 33.6.2	Potential impacts on the Project as a result of storm events

33.11 Inter-relationships

247. The effects identified and assessed in this chapter have the potential to interrelate with each other. The areas of potential inter-relationships between effects are presented in Table 33.31. This provides a screening tool for which effects have the potential to interact. Table 33.32 provides an assessment for each receptor (or receptor group) as related to these impacts.

248. Within Table 33.32, the effects are assessed relative to each development phase (i.e., construction, O&M or decommissioning) to see if (for example) multiple effects could increase the significance of the effect upon a receptor. Following this a lifetime assessment is undertaken which considers the potential for effect to affect receptors across all development phases.

Table 33.31 Inter-relationships between impacts – screening

Potential interactions between impact	Impact 1 GHG emissions	Impact 2 Climate Hazards on receptors
Construction		
Impact 1 GHG emissions	-	No
Impact 2 Climate Hazards on receptors	No	-
Operation		
Impact 1 GHG emissions	-	No
Impact 2 Climate Hazards on receptors	No	-
Decommissioning		
Impact 1 GHG emissions	-	No
Impact 2 Climate Hazards on receptors	No	-

Table 33.32 Inter-relationship between impacts – phase and lifetime assessment

Receptor	Highest Significance Level				
	Constr-uction	O&M	Decomm-issioning	Phase Assessment	Lifetime Assessment
GHG Assessment: Global atmosphere	Minor adverse	Beneficial	Minor adverse	No greater than individually assessed impact. The receptor for the GHG assessment is the global atmosphere. Each GHG released to the atmosphere has the potential to contribute to climate change.	A whole lifecycle GHG assessment was undertaken in Section 33.6.1.4, which highlights that the overall significance of the Projects with respect to GHG emissions would be beneficial, from the provision of renewable electricity to the grid.

Receptor	Highest Significance Level				
	Constr-uction	O&M	Decomm-issioning	Phase Assessment	Lifetime Assessment
				The GHGs released, or saved in each phase of the development are distinct from one another, therefore it is considered that there would either be no interactions between impacts during each of the phases	
CCRA: Receptors identified in CCRA	Not significant	Not significant	Not significant	No greater than individually assessed impact. The CCRA assessment considers the likely significant effects of climate change, through climate hazards, to receptors associated with the Project. It is considered there would be no pathway for interaction to exacerbate the potential impacts associated with climate hazards during or between any of the project phases.	No greater than individually assessed impact. The CCRA predicted that the Project would have a low vulnerability to climate change in each project phase. It is considered that over the project lifetime, these impacts would not combine to increase the significance level of any impacts identified in this assessment.

33.12 Summary

249. A summary of the effects on climate change identified in the assessment are provided in Table 33.33. The GHG assessment calculated the potential for avoided emissions by replacing electricity that would have been generated by fossil fuels (i.e., natural gas). Avoided emissions are estimated to be approximately 46.8 million tonnes CO_2e, resulting in a beneficial effect, which is considered to be significant in EIA terms.

250. A summary of the Projects' vulnerability and resilience to climate change is provided in Table 33.33. The assessment determined that, accounting for embedded mitigation, the vulnerability rating of the Project to identified climate hazards would be low. Therefore, there is a low likelihood of that climate change

impacts to would adversely affect the Projects during the construction and O&M phases, and any effect of climate change upon the Projects would be not significant in EIA terms.

251. A high-level assessment of vulnerability and resilience of the Project during the decommissioning phase was undertaken, where the same receptors and similar assumptions with respect to the implementation of appropriate measures during construction were considered. The assessment predicted a low likelihood of climate change impacts adversely affecting the Project in the decommissioning phase. However, it is recommended that a more detailed assessment of this phase should be undertaken prior to decommissioning, where more up to date climate projection data would be available and more information on the decommissioning policy would be known.

252. The summary of the CEA between North Falls and other projects, including Five Estuaries, is presented also in Table 33.34.

Table 33.33 Summary of potential likely significant effects on climate change

Potential impact	Receptor(s)	Sensitivity/ Vulnerability	Magnitude*	Significance of effect	Additional mitigation measures proposed	Residual effect
Construction phase						
Impact 1: Construction GHG emissions	Global atmosphere	High	N/A**	Minor adverse	N/A	Minor adverse
Impact 2: Impact of climate change on the Project	• Built infrastructure • Construction workers • Vessels, road vehicles and other equipment	Low/Medium	N/A***	Not significant	N/A***	Not significant
O&M phase						
Impact 1: O&M GHG emissions and avoided GHG emissions from the provision of renewable energy	Global atmosphere	High	N/A**	Beneficial	N/A	Beneficial
Impact 2: Impact of climate change on the Project	• Built infrastructure • O&M personnel • Vessels, road vehicles and other equipment	Low/Medium	N/A***	Not significant	N/A***	Not significant
Decommissioning phase**						
Impact 1: Decommissioning GHG emissions	Global atmosphere	Low	N/A**	Negligible	N/A	Negligible
Impact 2: Impact of climate change on the Project	• Built infrastructure • Decommissioning personnel • Vessels, road vehicles and other equipment	Low/Medium	N/A***	Not significant	N/A***	Not significant
Whole project lifecycle phase						

Potential impact	Receptor(s)	Sensitivity/ Vulnerability	Magnitude*	Significance of effect	Additional mitigation measures proposed	Residual effect
Impact 1: Whole project lifecycle GHG emissions and net effect on climate change	Global atmosphere	High	N/A**	Beneficial	N/A	Beneficial
*Risk and Resilience for the CCRA **Not defined as part of the assessment methodology ***Steps 3 and 4 of the CCRA have not been undertaken, as the Project is determined to have low vulnerability to all climate hazards identified. ****A high-level assessment of vulnerability and resilience of the Project during the decommissioning phase was undertaken, where the same receptors and similar assumptions with respect to the implementation of appropriate measures during construction were considered. The assessment predicted a low likelihood of climate change impacts adversely affecting the Project in the decommissioning phase. However, it is recommended that a more detailed assessment of this phase should be undertaken prior to decommissioning, where more up to date climate projection data would be available and more information on the decommissioning policy would be known.						

Table 33.34 Summary of potential cumulative effects on climate change

Potential impact	Cumulative effect	Additional mitigation
Construction, O&M and Decommissioning		
Impact 1: GHG assessment	Cumulative effects in relation to GHGs emissions do not require an assessment.	N/A
Impact 2: Cumulative impact of climate change on the Project	Cumulative effects are not expected.	N/A

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HARNESSING THE POWER OF NORTH SEA WIND

North Falls Offshore Wind Farm Limited

A joint venture company owned equally by SSE Renewables and RWE.

To contact please email contact@northfallsoffshore.com