RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Preliminary Environmental Information Report

Chapter 30 – Climate Change

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Glossary

Term	Definition
Array Areas	The DBS East and DBS West offshore array areas, where the wind turbines and array cables will be located. The array areas do not include the offshore export cable corridor.
'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.
Inter-Platform Cables	Cables linking offshore platforms.
Landfall	The point on the coastline at which the offshore export cables are brought onshore, connecting to the onshore export cables at the Transition Joint Bay.
Offshore Converter Platforms (OCPs)	Offshore Converter Platforms (OCPs) will be required for the HVDC option. The OCPs are fixed structures located within the array area that collect the AC power generated by the wind turbines and convert the power to DC, before transmission through the offshore export cables to the Project's onshore grid connection points.
Offshore Substation Platforms (OSPs)	Offshore Substation Platforms (OSPs) will be required for the HVAC option. These are fixed structures located within the array areas that contain electrical equipment to aggregate the power from the wind turbines, followed by conversion into a more suitable voltage for transmission through the offshore export cables to the Project's onshore grid connection points.
Onshore Export Cable Corridor	This is the area which includes cable trenches, haul roads, spoil storage areas, and limits of deviation for micro-siting. For assessment purposes, the cable corridor does not include the onshore substations, Transition Joint Bays or temporary access routes; but includes construction compounds (purely for the cable route).

Term	Definition
Onshore Export Cables	Onshore export cables take the electricity from the Transition Joint Bay to the onshore substations.
Onshore Substations	A compound containing electrical equipment required to transform and stabilise electricity generated by the Projects so that it can be connected to the electricity transmission network. There will be one onshore substation for each Project.
The Applicant	RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited as the owners of DBS West and DBS East respectively are the named undertakers that will have the benefit of the Development Consent Order. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited.
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Climate Change Committee
CH_4	Methane
COP	Conference of Parties
CO_2	Carbon dioxide
CO_2e	Carbon dioxide-equivalent
DBS	Dogger Bank South
DESNZ	Department for Energy Security and Net Zero
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
HVAC	High-Voltage Alternating Current
HVDC	High-Voltage Direct Current
ICE	Inventory of Carbon and Energy
IEMA	Institute of Environmental Management & Assessment
JUV	Jack-up installation vessels
LCA	Life Cycle Analysis

Term	Definition
LULUCF	Land Use, Land Use Change and Forestry
N_2O	Nitrous Oxide
NF_3	Nitrogen Tifluoride
NPS	National Policy Statements
NRMM	Non-Road Mobile Machinery
NSIP	Nationally Significant Infrastructure Projects
OCP	Offshore Converter Platforms
OSP	Offshore Substation Platforms
PEIR	Preliminary Environmental Information Report
PFCs	Perfluorocarbons
SF_6	Sulphur Hexafluoride
SOV	Service Operations Vessel
UNFCCC	United Nations Framework Convention on Climate Change

30 Climate Change

30.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the likely significant effects of the Projects on climate change and comprises a Greenhouse Gas (GHG) assessment. The chapter provides an overview of the existing environment for the proposed Onshore and Offshore Development Area, followed by an assessment of likely significant effects for the construction, operation, and decommissioning phases of the Projects. 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'* (IEMA, 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 **Chapter 6 EIA Methodology**. The GHG assessment quantified the GHG savings as a result of implementation of the Projects, accounting for emissions released during its lifecycle. This information is then used to determine the net effect of the provision of renewable energy to the UK electricity grid, and how the Projects contribute to the UK's decarbonisation targets.

2. The assessment should be read in conjunction with the following linked chapters:

- **Chapter 24 Traffic and Transport**; and
- **Chapter 26 Air Quality.**

3. Additional information to support the GHG assessment include:

- **Appendix 30.1 Greenhouse Gas Assessment Methodology**

4. The design of the Projects 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*") (Parry *et al.* 2007) is being incorporated. At this stage of the design, there is insufficient information to undertake an assessment to determine the vulnerability and resilience of the Projects to climate change. This will be considered within the Environmental Statement (ES).

30.2 Consultation

5. Consultation with regard to climate change and the GHG assessment has been undertaken in line with the general process described in **Chapter 6 EIA Methodology**. The key element of consultation to date has been scoping. The feedback received has been considered in preparing the PEIR. **Table 30-1** provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

6. This chapter will be updated following consultation on PEIR in order to produce the final assessment that will be submitted with the Development Consent Order (DCO) application. Full details of the consultation process will also be presented in the Consultation Report alongside the DCO application.

Table 30-1 Consultation Responses

Comment	Project Response
Planning Inspectorate - Scoping Responses 02/09/2022	
Cumulative impacts - emissions Paragraph 1026 outlines the global approach to assessment of Greenhouse Gas (GHG) emissions, seeking to scope out an assessment with other projects. in line with IEMA guidance. The Inspectorate is in agreement with this approach provided that overall emissions are considered. It is noted from Paragraph 1030 that cumulative effects related to climate resilience of the Proposed Development is to be assessed in each relevant ES chapter (e.g., flood risk and hydrology).	Standard practice for GHG assessments is to only consider the developments or projects themselves, as the 'receptor' for the assessment is the global atmosphere. This position is supported by the IEMA guidance (IEMA, 2022) which states: *"effects of GHG emissions from specific cumulative projects therefore 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 for over any other."* and the Planning Inspectorate's agreement with this approach is noted. The GHG assessment has considered emissions from all stages of the Projects, including construction, operation and decommissioning. Therefore, a cumulative assessment of GHG emission for the Projects has not been carried out.

Comment	Project Response
Vulnerability of infrastructure to climate change (construction and decommissioning) The Scoping Report seeks to scope this matter out on the basis that the construction phase is anticipated to take place within the next 10 years and so effects are considered unlikely. The Inspectorate does not understand this rationale given that evidence exists that infrastructure in the UK is already being affected by the effects of climate change. There is an absence of detailed information in the Scoping Report about the sensitivity and risks associated of the receiving environment, and the phasing and timescales of construction. In the absence of this information the Inspectorate cannot agree to scope this matter out of the ES. The ES should provide an assessment of the vulnerability of infrastructure to climate change during construction and decommissioning, where likely significant effects could occur.	The approach to scope out undertaking a resilience assessment during construction of the Projects derives from the view that climate is distinct from weather. Infrastructure in the UK is being affected by the effects of climate change, but the climate is unlikely to change significantly enough from present day conditions within the time period for when construction of the Projects will begin (i.e. less than 10 years). Current construction practices will account for hazardous weather, but as stated the climate (being a 30 year average of the weather), is unlikely to change before construction is complete. At this stage of the EIA process a vulnerability assessment of the Projects cannot be carried out, however, once all the relevant work to inform the ES is completed, the assessment will be carried out and detailed in the ES.
Characterisation of existing emissions and baseline Paragraph 1014 indicates that the emissions within the East Riding of Yorkshire are likely to be dominated by industrial and commercial sources, however, does not reference any other sources such as transport emissions. The Inspectorate considers that any baseline information should consider all sources of emissions where data is available. The general and brief characterisation of the climate of the east coast of England in Paragraphs 1018-1019 is noted. The ES should contain a detailed characterisation of the receiving environment in so far as it is relevant to	This chapter presents the GHG assessment undertaken as part of PEIR. As the study area now includes the UK grid network, there is a wider focus rather than considering emissions within regional administrative boundary. The approach to determining the baseline environment (or 'Do Nothing' scenario) now considers the generation of electricity from gas, as this is the most common form of fossil fuel production in the UK, as detailed in Section 30.5. GHG's released from electricity generated by gas generation

Comment	Project Response
the assessment of significant environmental effects, with cross references to related aspect chapters (e.g., the proposed assessment of flood risk) where appropriate.	sources instead of the Projects (over the design life) is derived using the BEIS 2022 Digest of UK Energy Statistics (DUKES) (BEIS, 2022b) A Climate Change Resilience assessment will be undertaken at the ES stage, which will include a detailed characterisation of the existing and projected climate in the Study Area.
Project vulnerability to climate change Paragraph 1029 identifies the potential for the increase in coastal erosion to affect project infrastructure. The ES should detail how the design of the scheme has considered this in relation to location of infrastructure and protective measures, in particular in relation to the identified area of rapid erosion at the Holderness Coast (and the potential impacts on the cable landfall point and onshore substations / cable route). Where this assessment identifies design changes to be required, these should also be assessed in the relevant aspect chapter.	See **Chapter 8 Marine Physical Process** for details on coastal erosion with consideration for the Projects. The vulnerability and resilience of the Projects to coastal erosion will be considered further within a Climate Change Resilience assessment presented in the ES. In addition, any relevant design changes to the Projects will be identified in the Climate Change Resilience assessment presented in the ES.
Approach to assessment The Inspectorate notes the references in the Scoping report to professional guidance (i.e., 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (Institute of Environmental Management and Assessment, IEMA 2022)) and the assessment being 'informed' by 'Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (IEMA 2020). The ES should set out the methodologies used to explain any departure from the proposed approach where professional judgement has been applied, as this is presented in limited detail within the Scoping Report. Outputs from other assessments should be clearly explained where these have been applied.	The GHG assessment has been carried out in accordance with the IEMA guidance (IEMA, 2022), and the assessment methodology is provided in section 30.4.3 and Appendix 30.1.
Environment Agency – Scoping Responses 08/12/2021	

Comment	Project Response
The Environment Agency will be interested to see further details relating to how the project can minimise its emissions. There may be opportunity to work together on shared ambitions. Please contact us to discuss this in more detail. The National Flood and Coastal Erosion Risk Management Strategy (https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2) sets out the Environment agency's vision and objectives.	This chapter presents the climate change and GHG assessment for the Projects, including embodied emissions in materials, and the release of GHGs from marine vessels, road vehicles, helicopters and onshore construction plant and equipment. Further details of measures to reduce the release of GHGs associated with the Projects through design are provided in section 30.3.3. The Environment Agency's position of setting itself a goal to become a net zero organisation by 2030, whilst being more resilient to flooding and coastal change, as outlined in the National Flood Coastal Erosion Risk Management Strategy is acknowledged. During ongoing consultation, where appropriate, the Environment Agency may be contacted to discuss where emissions have been reduced within the design of the Projects, and where there may be potential for collaboration, particularly with respect to the resilience of the Projects to flood and coastal erosion.
Natural England – Scoping Responses 08/12/2021	
The England Biodiversity Strategy published by Defra establishes principles for the consideration of biodiversity and the effects of climate change. The ES should reflect these principles and identify how the development's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained. The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF Para 174), which should be demonstrated through the ES.	See **Chapter 18 Terrestrial Ecology and Ornithology** for details of the Biodiversity Net Gain strategy.

30.3 Scope

30.3.1 Study Area

7. The Projects' array areas are located more than 100km offshore on the Dogger Bank in the southern North Sea. The total developable area for each Project array covers approximately 500km^2. The offshore development area of the Projects will consist of up to 200 wind turbines, offshore platforms, inter-platform cables, array cables and offshore export cables to connect the array areas with the landfall. The Projects will make landfall on the East Riding of Yorkshire coastline near Skipsea. The onshore aspects of the Projects includes the buried onshore export cables from the landfall and the onshore substations.

8. The GHG assessment determines the change in GHG emissions as a result of the implementation of the Projects, which acknowledges the replacement of electricity from fossil fuel sources with renewable offshore wind.

9. The scope of the assessment encompasses the quantification of GHG emissions from both the onshore and offshore elements of the Projects, and includes material extraction and manufacturing, transport and installation, operation and maintenance and end of life and decommissioning. A schematic diagram of the Projects' system boundary is provided in **Plate 30-1**; where emissions from activities within the pale green box are included within the assessment. The Study Area for the GHG assessment is defined both geographically, as the Onshore and Offshore Development Areas, and by the processes that create the offshore wind farms (i.e. construction), and their operation and maintenance, and decommissioning. The Study area also included the UK wide electricity grid, where the beneficial effect of the provision of renewable energy can be quantified.

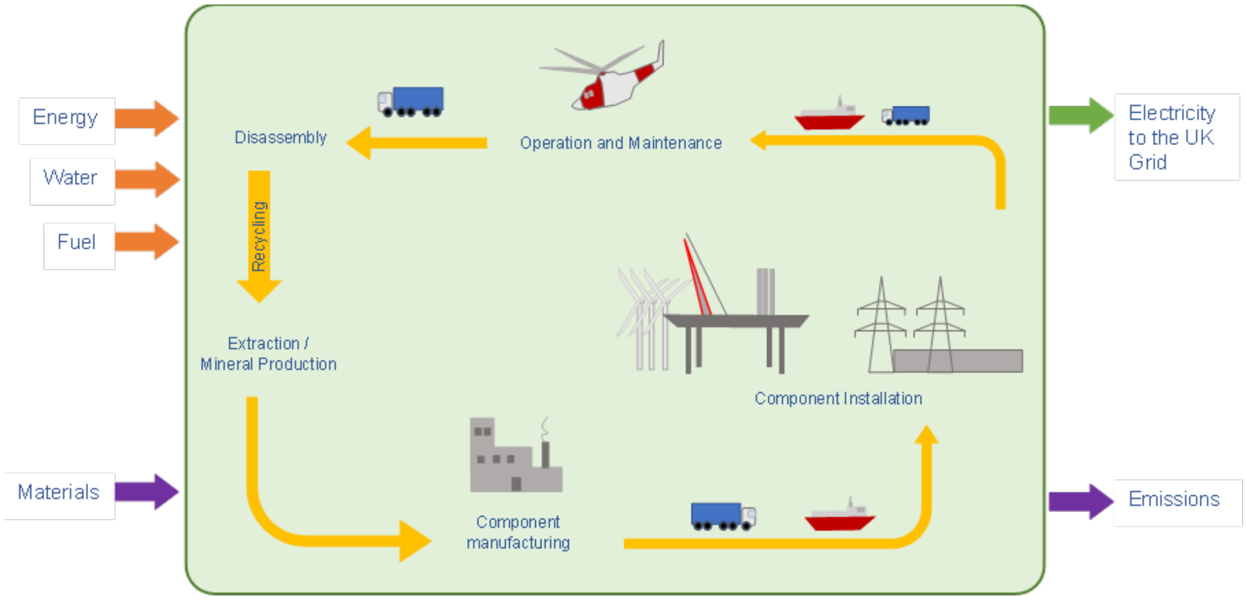

Plate 30-1 System Boundary for the Projects' GHG Assessment

30.3.2 Realistic Worst Case Scenario

10. The realistic worst case design parameters for likely significant effects scoped into the EIA for the GHG assessment are summarised in **Table 30-2**. These are based on the Projects parameters described in **Chapter 5 Project Description**, which provides further details regarding specific activities and their durations.

30.3.2.1 Construction Scenarios

11. The following principles set out the framework for how the Projects may be constructed (relating to both onshore and offshore works):
    - DBS East and DBS West may be constructed at the same time, or at different times;
    - If built concurrently, both Projects could be constructed in five years;
    - If built non-concurrently, either Project could be built first;
    - If built non-concurrently, each Project would require a five year period of construction;
    - If built non-concurrently, it is anticipated that there would be up to a two year lag between the start of construction for the first project and the start of construction for the second project; and
    - Assuming a maximum construction period per Project of five years, and taking the above into account, the maximum construction period over which the construction of both Projects could take place is seven years.
12. All possible construction scenarios allow for the flexibility to build out the Projects using a phased approach. This will allow the Projects to adapt to the National Grid Electricity Transmission's development plans for onshore grid connection points. Under a phased approach the maximum timescales for individual elements of construction have been assessed.
13. In order to determine which construction scenario presents the realistic worst case for each receptor and impact, the assessment considers both maximum duration effects and maximum peak effects, in addition to each Project being developed in isolation, drawing out any differences between each of the two Projects.
14. The three construction scenarios are therefore:
    - Build DBS East or build DBS West in isolation;
    - Build DBS East and DBS West concurrently – reflecting the maximum peak effects; and
    - Build the Projects sequentially with a lag of up to two years – reflecting the maximum duration of effects.

30.3.2.2 Operation Scenarios

15. Operation scenarios are described in detail in **Chapter 5 Project Description**. The assessment considers the following scenarios:

- Only DBS East in operation;
- Only DBS West in operation; and
- The two Projects operating concurrently, with or without a lag of two years between each Project commencing operation.

16. If the Projects are built out using a phased approach, there would also be a phased approach to starting the operational stage. The worst case scenario for the operational phase for the Projects have been assessed. See section 5.1.1 of **Chapter 5 Project Description** for further information on phasing scenarios for the Projects.

17. The operations lifetime of each Project is expected to be 30 years.

30.3.2.3 Worst Case Scenario for GHG Assessment

18. The principal aim of the GHG assessment is to determine the emission savings associated with the implementation of the Projects. The potential for emission savings is greatest in the concurrent scenario, where both Projects are developed, providing the largest renewable energy capacity.

19. In addition, the worst case scenario for GHG emissions is assessed on the assumption that the information provided for the Projects are reflective of the ‘sequential construction scenario, as this reflects the maximum activity requirements for emission sources such as marine vessels, construction plant and equipment and road vehicles.

20. The in isolation scenario will have less release of GHG emissions associated with activities during construction, operation and decommissioning. However, as the renewable generation capacity under these scenarios is less, there is less potential for emission savings.

21. In terms of the release of emissions associated with activities during construction, operation, and decommissioning, the sequential scenario is considered to be worst case. This is because there are more activities being undertaken during construction which will release GHG emissions. The worst case design parameters for the sequential scenario which is likely to release the greatest quantity of GHG emissions are detailed in **Table 30-2**.

Table 30-2 Realistic Worst Case Design Parameters for the Sequential Scenario

	Parameter (DBS East and DBS West sequentially)	Notes
Construction		
GHG emission during construction	Indicative construction programme: • Seven years offshore construction campaign • Wind turbine installation – approximately 54 months • Foundation installation – approximately 36 months • Offshore substation platform installation – approximately 48 months; and • Array and export cable installation – 54 months • Onshore export cable – 57 months • Onshore substation construction – 6 years	n/a
	Infrastructure: Installation of up to: • 200 x wind turbines on suction bucket jacket foundations • 11 x offshore platforms on gravity based foundations • 6 x offshore export cables - 1,028 km of total cable length • 650 km of array cables	Maximum quantities of construction materials required. Suction bucket jacket foundations are the worst case for

	Parameter (DBS East and DBS West sequentially)	Notes

	• 385 km of inter-platform cables
	• 9,559,950 m^3 scour protection for the wind turbines foundations
	• 1,079,800 m^3 scour protection for offshore platforms foundation
	• 2,450,483 m^3 of rock berm protection for unburied offshore export cables
	• 401,050 m^3 of rock berm crossing protection for offshore export cables
	• 1,055,211 m^3 of rock berm protection for unburied inter-platform cables
	• 133,400 m^3 of rock berm crossing protection for inter-platform cables
	• 569,800 m^3 of rock berm protection for unburied array cables
	• 57,000 m^3 of rock berm crossing protection for array cables 2 x onshore substa-tions
	• 2 x onshore substations
	• 5 cable circuits; comprising a total of 14 cables
	  ○ 4 x AC circuits (3 x power cables per circuit) = 12 cables
	  ○ 1 x DC circuit (2 x power cables) = 2 cables
	• 6 x transition joint bays
	• No. of compounds (est.):
	  ○ Main compounds – 4
		wind turbines based on the foundation footprint and scour protection requirements compared with other foundation options. The offshore platforms worst case foundation is gravity based foundations due the quantities of scour protection required.

	Parameter (DBS East and DBS West sequentially)	Notes
	◦ Minor compounds – 30 ◦ HDD compounds – 140 ◦ Substation compound – 2 • 343 x link boxes (est.)	
	Vessel movements - 11,489 maximum return trips for construction activity vessels	Indicative vessels associated with construction are included in the GHG assessment. The different types of vessel associated with each activity is detailed in **Appendix 30.1.**
	Helicopter movements – 730 maximum helicopter return trips per year per project	n/a

	Parameter (DBS East and DBS West sequentially)	Notes
Operation and Maintenance		

GHG emissions during operation and maintenance	• Operational life - 32 years, up to 200 wind turbines
	• Operational and maintenance vessels annual return trips
	    o Jack-Up vessels – 16 trips
	    o Service Operations vessels (SOV) – 104 trips
	    o Accommodation vessels – 104 trips
	    o CTV – 104 trips
	    o Lift vessels – 16 trips
	    o Cable maintenance vessels – 1 trip
	    o Auxiliary vessel – 128 trips
	• Annual helicopter return trips during operational and maintenance
	    o General operations – 20 trips
	    o Turbine transfers – 12 trips
	• Spare parts (information derived from literature)	

Decommissioning		
The contribution from decommissioning has been scaled based on the total GHG contribution, as detailed in section 30.4.		

30.3.3 Mitigation Embedded in the Design

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

23. In response to these principles, the need for the Projects in relation to achieving net zero targets by 2050 for the UK and decarbonisation of the energy sector is well established and set out within **Chapter 2 Need for the Project.** Furthermore, project-level GHG mitigation is being incorporated into the design development process for the Projects wherever it is practicable to do so. Taking into account that the primary purpose of the Projects is to generate low carbon renewable energy, the process of reducing GHG emissions from the Projects is guided by the hierarchy summarised in **Table 30-3**.

24. RWE has a circularity framework which has three core circular principles, namely:

- Reducing consumption & increase inflow of circular materials
- Enhancing material (re)use and lifetime as well as
- Minimising end-of-life treatment.

25. In addition, RWE has integrated sustainability guidelines and continuously develops its approaches and processes to ensure a resource-conserving and future-oriented energy supply under the condition of economic efficiency.

Table 30-3 IEMA GHG Guidance (IEMA, 2022) – Mitigation Hierarchy Specific to the Projects

	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 Projects is to tackle climate change by replacing existing high carbon energy generation. Therefore, a 'do not build' scenario 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 is a key design feature of the approach to Projects' design and procurement.
	Build clever (Substitute)	Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the project, and at end-of-life.	The Projects will use the latest, most efficient and effective turbines, offshore substation and / or converter platforms, and onshore components such as the onshore substations.

	Hierarchy	Principle	Project Response
	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.	Offshore construction is by its nature expensive and relies on the use of highly specialised, efficient vessels and equipment with a dedicated and highly trained workforce. Similarly, onshore construction requires the use of specialised plant and equipment, vehicles with a dedicated and skilled workforce. In addition, the Projects will be seeking to maximise the efficiency of the use of vessels and road vehicles, not only to minimise emissions but also to save on fuel costs. Opportunities to construct and operate efficiently to minimise resource consumption and reduce GHG emissions from activities associated with the Projects will be considered as the design progresses.

30.4 Assessment Methodology

30.4.1 Policy, Legislation and Guidance

30.4.1.1 International Agreements

26. The international agreements relevant for climate change and renewable energy are detailed in section 3.3.1 of **Chapter 3 Policy and Legislative Context**. This highlights the United Nations Framework Convention on Climate Change (UNFCCC), the implementation of measures under the UNFCCC such as the Kyoto Protocol, the Paris Agreement and the UK's climate goals. Section 3.3.1 of **Chapter 3 Policy and Legislative Context** also presents the European Union (EU) Renewable Energy Directive. Following the UK's withdrawal from the EU the UK remains committed to reducing GHG emissions, however, there are uncertainties as to the extent to which EU legislation already transposed into English and Welsh law will be retained going forward.

30.4.1.2 National Policy Statements

27. The specific assessment requirements for climate change are set out within the current and draft versions of the Overarching National Policy Statement (NPS) for Energy (EN-1) and NPS for Renewable Energy Infrastructure (EN-3) and summarised in **Table 30-4**.

28. Reference to the particular requirements location with the current and draft NPS and to where it has been addressed in this chapter or wider PEIR has also been provided in **Table 30-4**. Minor wording changes within the draft version which do not materially influence the NPS requirements have not been reflected.

29. Following the consultation in 2021 on the draft energy NPS, a new consultation opened on the 30 March 2023 on revised drafts of the energy NPSs, including EN1, EN3 and EN5. Due to the timing of this consultation, and finalisation of this PEIR we have been unable to review and take these revised draft NPS into account within these documents. However, these will be reviewed and incorporated into the final ES where relevant.

Table 30-4 NPS Assessment Requirements

NPS Requirement	NPS Reference	PEIR Section Reference
EN-1 NPS for Energy		
An increase in renewable electricity is essential to enable to UK to meet its commitments under the EU Renewable Energy Directive. It will also help improve our energy security by reducing our dependence on imported fossil fuels, decrease greenhouse gas emissions and provide economic opportunities.	Paragraph 3.3.11	The purpose of the Projects 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.
New energy infrastructure will typically be a long-term investment and will need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure. The ES should set out how the proposal will take account of the projected impacts of climate change. While not required by the EIS Directive, this information will be needed by the IPC. The IPC should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections available at the time the ES was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure.	Paragraphs 4.8.5 and 4.8.6	The impacts of climate change on the Projects will be considered in a climate change resilience assessment at the ES stage.

NPS Requirement	NPS Reference	PEIR Section Reference
EN-3 NPS for Renewable Energy		
Part 2 of EN-1 covers the Government's energy and climate change strategy, including policies for mitigating climate change. Section 4.8 of EN-1 sets out generic considerations that applicants and the IPC should take into account to help ensure that renewable energy infrastructure is resilient to climate change. Offshore [and onshore] wind farms are less likely to be affected by flooding, but applicants should particularly set out how the proposal would be resilient to storms. Section 4.8 of EN-1 advises that the resilience of the project to climate change should be assessed in the Environmental Statement (ES) accompanying an application.	Paragraphs 2.3.1, 2.3.4 and 2.3.5	The impacts of climate change to the Projects will be considered in a climate change resilience assessment at the ES stage.
Draft EN-1 NPS for Energy		
Applicant's Assessment All proposals for energy infrastructure projects should include a carbon assessment as part of their ES (See Section 4.2). This should include. This should include: • A whole life carbon assessment showing construction, operational and decommissioning carbon impacts • An explanation of the steps that have been taken to decrease the climate change impacts at each of those stages • Measurement of embodied carbon impact from the construction stage • How reduction in energy demand and consumption during operation had been prioritised in comparison with other measures • How operational emissions have been reduced as much as possible through application of best available technology for that type of technology	Paragraph 5.3.4	This chapter presents GHG assessment for the Projects. The elements included in the GHG assessment at this stage of the application are outlined in section 30.4.3.1.1, these will be further refined before the ES if further details are available.

NPS Requirement	NPS Reference	PEIR Section Reference
• Calculation of operational energy consumption and associated carbon emission • Whether and how any residual carbon emissions will be (voluntarily) offset or removed using a recog-nised 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 sec-tor level, if sectoral targets are developed.		
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 also give positive weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and decommissioning within the proposed development. However, in light of the vital role energy infrastructure plays in the process of economy wide decarbonisation, the Secretary of State accepts that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure. Operational GHG emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). Given the characteristics of these and other technologies, as noted in Part 3 of this NPS, and the range of non-planning policies aimed at decarbonising electricity generation such as UK ETS (see Sections 2.4 and 2.5 above), government has determined that operational	Paragraphs 5.3.5 to 5.3.7	The GHG assessment has considered emissions during construction, operation and decommissioning of the Projects as presented in section 30.6.1.

NPS Requirement	NPS Reference	PEIR Section Reference
GHG emissions are not reasons to prohibit the consenting of energy projects including those which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR requirements). Any carbon assessment will include an assessment of operational GHG emissions, but the policies set out in Part 2, including the UK ETS, apply to these emissions. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. The Secretary of State does not, therefore need to assess individual applications for planning consent against operational carbon emissions and their contribution to carbon budgets, net zero and our international climate commitments.		
Mitigation A carbon assessment should be used to drive down GHG emissions at every stage of the proposed development and ensure that emissions are minimised as far as possible for the type of technology, taking into account the overall objectives of ensuring our supply of energy always remains secure, reliable and affordable, as we transition to net zero. 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. To be taken into account in Secretary of State decision making steps taken to minimise and offset emissions should be set out in a GHG Reduction Strategy, secured under the development consent order.	Paragraph 5.3.8 to 5.3.10	GHG mitigation is being considered as part of the design of the Projects, further details are provided section 30.3.3. The GHG assessment will be updated at the ES stage and reflect GHG emission mitigation and reduction incorporated in the design stages.

30.4.1.3 Other

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

30.4.1.3.1 Legislative background

31. The requirement to consider climate and GHG emissions arises from the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. 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 construction and operation. The Climate Change Act 2008 established a legally binding target to reduce the UK's GHG emissions by at least 80% in 2050 from 1990 levels, and a system of carbon budgets were introduced in order to drive progress towards this target.

32. Following the 21st Climate Change Conference of the Parties (COP21), the UK signed the Paris Agreement in 2016, a legally binding international treaty on climate change committing all parties to the goal of limiting global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels. The Agreement requires all parties to submit plans to reduce their emission (along with other climate action) every five years, starting in 2020. The carbon budgets are set by the Committee for Climate Change 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 30-5**.

Table 30-5 The Six UK Carbon Budgets

Budget	Carbon Budget Level (Mt CO_2e)	Reduction	
		UK Targets	Achieved by the UK
1st Carbon Budget (2008 to 2012)	3,018	25%	30%
2nd Carbon Budget (2013 to 2017)	2,782	31%	38%
3rd Carbon Budget (2018 to 2022)	2,544	37% by 2020	44%
4th Carbon Budget (2023 to 2027)	1,950	51% by 2025	-
5th Carbon Budget (2028 to 2032)	1,725	68% by 2030	-
6th Carbon Budget (2033 to 2037)	965	78% by 2035	-

33. 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.

34. In December 2020, the UK set a sixth carbon budget, recommending a reduction in UK GHG emissions of 78% by 2035 relative to a 1990 baseline (a 63% reduction from 2019) (Climate Change Committee (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.

35. As part of the sixth 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.

30.4.1.3.2 Guidance

36. Recently published IEMA guidance 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (2022) informs the evaluation and significance of GHG emission from the Projects. This guidance is a revision of the first iteration of the guidance released in 2017 (IEMA, 2017).

37. The 2022 IEMA guidance presents guidelines for undertaking GHG assessment and to distinguish different levels of significance. The guidance does not update IEMA's position that all emissions contribute to climate change, however it now provides relative significance descriptions to assist assessments specifically in the EIA context (detailed further in section 30.4.3.5).

30.4.2 Data and Information Sources

38. The sources that have been used to inform the assessment are listed in **Table 30-6**.

Table 30-6 Available Data and Information Sources

Data Source	Data Set	Year	Notes
BEIS (2022a)	Conversion factors for reporting of GHG emissions	2022	Emission factors for use in the GHG assessment, in particular for fuel consumption
Dolan and Heath, 2012	Life Cycle Greenhouse Gas Emissions of Utility Scale Wind Power	2012	Benchmarking of results from the GHG assessment
Jones and Hammond, 2019	Inventory of Carbon and Energy (ICE)	2019	Emission factors for embodied carbon in materials used in construction
Thompson and Harrison, 2015	Life Cycle Costs and Carbon Emissions of Offshore Wind Power	2015	Benchmarking of results from the GHG assessment and likely contribution of decommissioning activities to the over Projects footprint

30.4.3 Impact Assessment Methodology

39. **Chapter 6 EIA Methodology** provides a summary of the general impact assessment methodology applied. The purpose of this chapter is to consider the potential effects of the Projects on climate change. The following sections outline the methodology used to calculate GHG emissions both offset and created by the Projects.

40. The GHG assessment determines emission savings associated with the Projects. The assessment accounts for emissions arising from construction, operation and decommissioning phase activities associated with the Projects.

41. To help determine the significance and contextualise the outcomes of the GHG assessment, emissions from a 'Do Nothing' scenario are also quantified (see section 30.5.1). Emissions from this scenario are compared to the GHG assessment for the Projects to determine the GHG savings or carbon offset as a result of the Projects, the GHG payback period and the GHG intensity of electricity produced.

30.4.3.1 Context

30.4.3.1.1 GHG Emission Sources for Offshore Wind Farms

42. The construction, operation, maintenance, repowering, and decommissioning of wind farm projects entail the generation of GHG emissions, both from:

- Embedded carbon and GHGs from the offshore and onshore components. These are the emissions caused by the extraction and refinement of raw materials and their manufacture into the commodities and products that make up the components of the wind turbines (and their associated physical infrastructure), cables, etc.; and
- Carbon and other GHG emissions arising from the combustion of fuels and energy used over a project's lifetime. Emissions in this assessment are associated with marine vessels, helicopters, road transport vehicles and onshore plant equipment.

43. The release of emissions from these sources are small in comparison to emissions from fossil fuel generation of energy, therefore the emissions saved during the generation of electricity from wind (when compared to fossil fuel sources) outweigh those released from construction, operation and maintenance, and decommissioning activities.

44. There are inherent uncertainties associated with carrying out GHG footprint assessments for offshore wind farm projects, although the approach to determine emissions from individual source groups is well defined and are adopted in this assessment.

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

46. **Table 30-7** provides a summary of the percentage of the total GHG emissions associated with the different phases of an offshore wind farm development as provided within Thomson and Harrison (2015).

Table 30-7 Summary of Offshore Wind Farm GHG Emissions (Thomson and Harrison, 2015)

Phase	% of total GHG emissions
Construction	78.4
Operation and Maintenance	20.4
Decommissioning	1.2

47. The report highlights that the greatest proportion of emissions are associated with the manufacture and installation of the wind farm components. Decommissioning accounts for the smallest proportion, only 1.2%, of total life cycle GHG emissions. A more detailed breakdown of emissions is given in Thomson and Harrison (2015) for an offshore wind farm with steel foundations. This is reproduced in **Plate 30-2**.

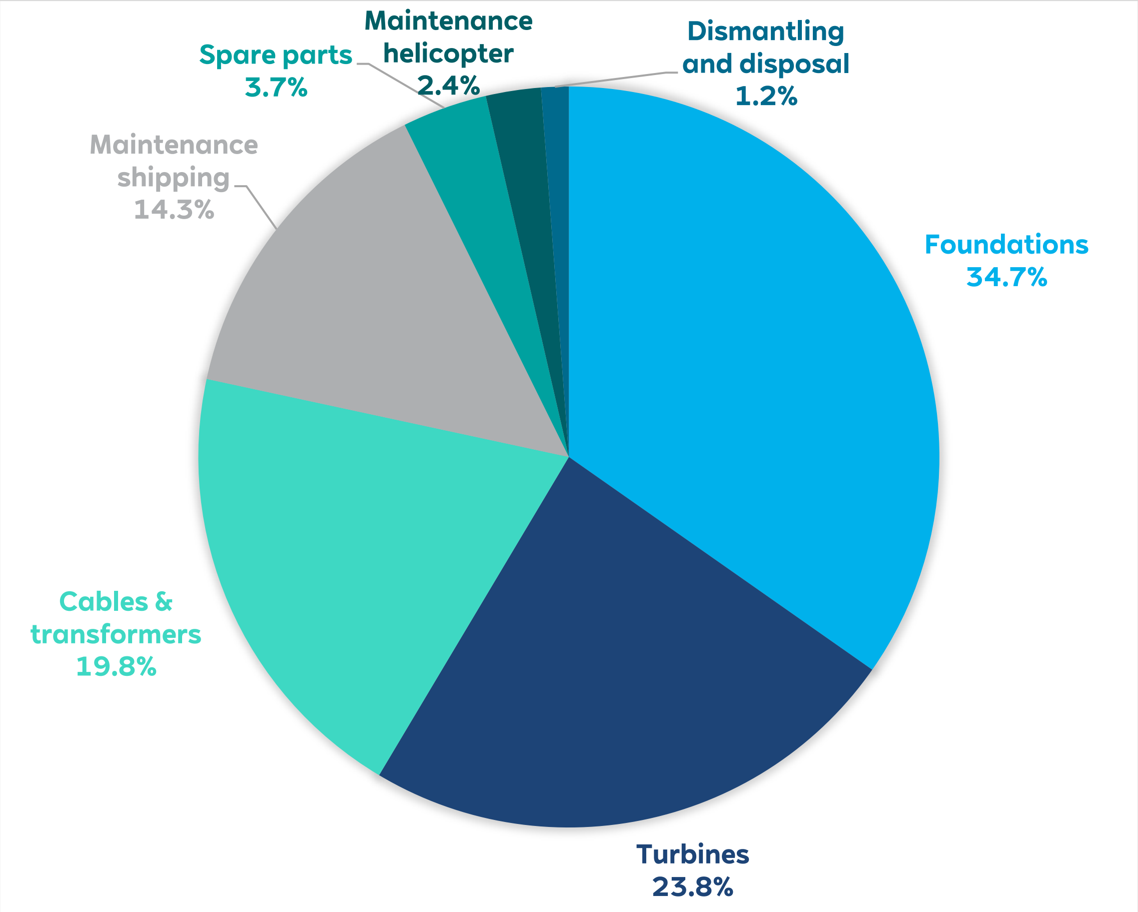

Plate 30-2 Summary of offshore wind farm GHG emissions (Thomson and Harrison, 2015)

48. Of the components or phases shown in **Plate 30-2**, GHG emissions associated with foundation fabrication and installation accounts for the largest proportion of emissions (34.7%), followed by manufacture and installation of the turbines (23.8%) and the cables and transformers (19.8%).

49. GHG emissions from shipping movements during maintenance operations over the operational lifetime of the example wind farm contributed 14.3%. This value may appear to be unexpectedly high, but the vessel movements contribution is associated with an assumed 20-year operational lifespan of the wind farms considered in the studies. Emissions derived from spare parts (3.7%), helicopter movements (2.4%) and dismantling and disposal (1.2%) are all small in comparison. The operation and maintenance phase of the Projects is anticipated to be 32 years and is therefore longer than the wind farms considered in these studies.

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

30.4.3.1.2 GHG Intensity of Offshore Wind Farm Energy

51. In a report investigating carbon emissions of wind power (Thomson and Harrison, 2015), the GHG emissions intensity (expressed as grammes (g) of CO_2e per kilowatt-hour (kWh) of electricity generated) of electricity from 18 technical studies was analysed. These were found to vary quite widely, between approximately 5 and 33 g CO_2e per kWh. There was no clear relationship between the metrics for either turbine rating (in MW) or capacity factor.

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

53. It is noted that these studies were published in 2012 and 2015, and it is acknowledged that there have subsequently been significant advances in the technology, infrastructure and components used for offshore wind farms. Therefore, additional published sources are reviewed to evaluate the average GHG intensity of energy produced offshore wind farms, and these are presented in **Table 30-8**. As shown, the range of energy intensities for offshore wind farms across the range of studies is 7.8 to 25.5 g CO_2e per kWh.

Table 30-8 Review of Average Carbon Emissions per kWh

Wind Farm sizes	Energy intensity (gCO_2e per kWh)	Source
12 x 5MW	32	Chen *et al.* (2011), referenced in Bhandari *et al.* (2020)
N/A	6	IEA World Energy Outlook (2012), referenced in Siemens Gamesa (n.d.) and Ørsted (2021)
100 x 2.5MW	13.7	Arvesen and Hertwich (2012), referenced in Bhandari *et al.* (2020)
80 x 4MW	10.9*	Bonou *et al.* (2016), referenced in Bhandari *et al.* (2020)
100 x 6MW	7.8*	Bonou *et al.* (2016), referenced in Bhandari *et al.* (2020)
28 x 3.6MW	25.5*	Yang *et al.* (2018), referenced in Bhandari *et al.* (2020)
*Offshore wind farm studies published from 2016 onwards		

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

55. Assumptions and simplifications to the methodology are made in certain areas and a precautionary approach is adopted for the assessment to allow for this. These assumptions and simplifications are referred to in section 30.4.6 and the worst case scenario set out in **Table 30-2.**

30.4.3.2 Assessment Approach

56. In this assessment the term 'GHG' or 'carbon' encompasses carbon dioxide (CO_2) and the six other gases as 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 in this assessment are expressed in carbon dioxide equivalent (CO_2e), which recognises that different gases have notably different global warming potentials (GWPs).

57. GHG emissions arising from activities in the construction, operation and maintenance, and decommissioning phases of the Projects are predicted within a defined project boundary (see section 30.3.1), in accordance with the GHG protocol (World Resources Institute and World Business Council on Sustainable Development, 2015).

58. To assist with the determination of the significance of the Projects in relation to GHG emissions (as discussed in section 30.4.3.5), three parameters are calculated to contextualise the GHGs emitted during the life cycle of the Projects in relation to the benefits of providing renewable energy. These include:

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

30.4.3.3 Emission Calculations

59. GHG emission sources arising from the Projects are categorised into five main source groups, as detailed in **Table 30-9**.

Table 30-9 Emission Source Groups Considered in the Assessment

Source Name	Phase	Onshore or offshore	Definition	Project sources
Embodied emissions in materials	Construction, operation and maintenance	Both	Embodied emissions within materials comprise GHGs released throughout the supply chain, and includes the extraction of materials from the ground, transport, manufacturing, assembly and its end-of-life profile.	Embodied emissions are quantified for the main construction materials to be used for the onshore and offshore components of the Projects including foundations, wind turbines (tower, nacelle, rotor, blades), scour protection, export cables (onshore and offshore), offshore platforms and the onshore substations. The requirement for spare (or replacement) parts during operation is not known at this stage, therefore the likely composition of emissions in terms of the overall footprint of the Projects are obtained from existing literature.
Marine vessels	Construction, operation and maintenance	Offshore	GHG emissions are released in exhaust gases from the combustion of fossil fuels on marine vessels.	Emissions associated with the movement of marine vessels for the offshore component of the Projects are calculated. Emissions from vessels associated with installation of foundations, wind turbines and cables, as well as supply and support, accommodation and commissioning vessels are also quantified. Emissions from marine vessel movements during the operation and maintenance phase are also quantified.

Source Name	Phase	Onshore or offshore	Definition	Project sources
Helicopter	Construction, operation and maintenance	Offshore	GHG emissions are released in exhaust gases arising from the combustion of fossil fuels on helicopters.	Emissions associated with helicopters movements during construction, operation and maintenance are quantified in the assessment.
Road vehicles	Construction, operation and maintenance	Onshore	GHG emissions are released 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 operation are included within the assessment.
Plant and equipment	Construction	Onshore	Emissions are released from Non-Road Mobile Machinery (NRMM) as a result of fuel combustion.	Emissions from the use of NRMM during construction of the onshore component of the Projects are quantified. This included the landfall, trenchless crossing, cable installation, main onshore compound and substation works.

60. Details on all the activities that will take place during the construction, operation and maintenance, and decommissioning phases are not fully known at this stage, therefore some assumptions have been made in order to quantify GHG emissions at PEIR stage, as detailed section 30.4.6. These assumptions are based on indicative data from similar projects or professional judgement. Specific information related to these phases will be provided for the assessment at the ES stage, which will enable a refinement of GHG emissions calculations to be undertaken. Emissions from decommissioning are derived from previous studies (Thomson and Harrison, 2015), where it is established that this phase would contribute approximately 1.2% of the carbon footprint.

61. The approach to quantifying GHG emissions for each of the source groups detailed in **Table 30-9** is provided in **Appendix 30.1**. The total operational life of the Projects is anticipated to be 32 years.

30.4.3.3.1 Embodied Emissions in Materials

62. The list of key offshore components of the Projects for which the embodied emissions are determined is detailed in **Appendix 30.1.**

63. The approach to determining embodied emissions from materials used for the Projects is detailed in **Appendix 30.1.**

30.4.3.3.2 Marine Vessels

64. Marine vessels will be used to bring materials and components to the wind farm site, install infrastructure (wind turbines, offshore substation platforms, foundations and cables), provide crew accommodation and support during construction, commissioning and for operation and maintenance activities. The current working assumptions for offshore vessel logistics is detailed in section 30.1.2 of **Appendix 30.1** and may be refined at the ES stage.

65. 65. Full details of the approach undertaken to determine GHG emissions from marine vessels is detailed in **Appendix 30.1**.

30.4.3.3.3 Helicopters

66. Helicopter movements associated with the Projects will result in the release of GHG emissions. Section 30.3 of **Appendix 30.1** outlines the requirement for helicopter use in support of the Projects.

67. The methodology for determining GHG emissions from helicopter movements associated with the Projects is provided in **Appendix 30.1**.

30.4.3.3.4 Road Traffic Vehicles

68. Road traffic vehicle movements associated with the construction, operation and maintenance phases of the Projects will result in the release of GHG emissions. GHG emissions are calculated from the total kilometres travelled by HGVs and staff transport to and from the onshore construction sites, and also during the operation and maintenance phase. Full details of the methodology are provided in **Appendix 30.1**.

30.4.3.3.5 Plant and Equipment

69. Fuel consumption associated with the operation of NRMM for the onshore components of the Projects are calculated based on the estimated use of each item of plant and equipment, with representative engine sizes and indicative construction plant and equipment for construction activities at landfall and along the onshore export cable corridor provided.

70. The approach in determining construction plant and equipment GHG emissions is detailed in **Appendix 30.1**.

30.4.3.4 Definitions of Sensitivity and Magnitude

71. This assessment is undertaken in accordance with the general methodology presented within **Chapter 6 EIA Methodology**; however, a topic-specific assessment methodology and approach to determining impact significance is provided within IEMA guidance (IEMA, 2022), as set out in the following sections.

30.4.3.4.1 Sensitivity

72. 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.

30.4.3.4.2 Magnitude

73. The principal purpose of the GHG assessment is to determine emissions saved following the implementation of the Projects. The magnitude is determined by comparing the changes in emissions associated with the replacement of electricity from fossil fuel sources in the 'Do Nothing' scenario, with renewable offshore wind.

30.4.3.5 Significance

74. The 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".

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

76. The updated IEMA guidance provides relative significance descriptions to assist assessments, specifically in the EIA context. Section VI of the updated IEMA guidance (IEMA, 2022) describes five distinct levels of significance which are not solely based on whether project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a science-based 1.5°C aligned transition towards net zero. These are presented in **Table 30-10**.

Table 30-10 Assessment Significance Criteria

Significance	Definition
Major adverse	The Projects' 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.

77. For the purposes of the EIA, major and moderate adverse and beneficial impacts are deemed to be significant.

30.4.4 Cumulative Effect Assessment Methodology

78. The global atmosphere is the receptor for the GHG assessment. Emissions of GHG's to the atmosphere have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. This is taken into account in defining the receptor (i.e. the global atmosphere) as high sensitivity.

79. The IEMA guidance (IEMA, 2022) states that effects of GHG emissions from specific cumulative projects should therefore not be individually assessed, as there is no basis for selecting which projects to assess cumulatively over any other. The GHG assessment is therefore considered to be inherently cumulative, and no additional consideration of cumulative effects is required.

30.4.5 Transboundary Effect Assessment Methodology

80. As noted above for cumulative impacts, the receptor for the GHG assessment is the global atmosphere, and therefore emissions of GHGs have an indirect transboundary impact. As the GHG emissions are assessed in context of the UK carbon budgets and the aspirations to reduce GHG emissions in line with climate agreements, the transboundary impacts of GHGs emitted by the Projects are not considered to require a separate assessment.

30.4.6 Assumptions and Limitations

81. This preliminary assessment is considered to be an interim stage in the EIA process. The results presented in the following sections are based on early design assumptions and initial assessments which will be refined and presented in the ES to be submitted as part of the DCO application.

82. A number of assumptions are made in the GHG assessment, as set out in **Table 30-11**. Further details of the methodology adopted to quantify GHG emissions from the Projects are presented in **Appendix 30.1**.

Table 30-11 Assumptions and Limitations of the GHG Assessment

ID	Assumption / Limitation	Discussion
1	Some quantities for materials to be used during construction are not currently available	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).
2	Recycled content of construction materials is unknown	It has been assumed that all steel used on the Projects is virgin steel to provide a precautionary assessment. However, it is likely that steel used in construction would have a high recycled content, and thus a lower embodied carbon content than has been assumed in this assessment.
3	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.
4	The specific nature and composition of some materials, such as the type of concrete or steel to be used, was unknown which may affect the embodied carbon within a material.	If there is variation across different compositions of the same material, the 'General' option within the ICE database is chosen, if available, or the median value if not. This approach is considered to be appropriate in the absence of specific material information
5	The origin port of some marine vessels was not known at the time of the assessment, which affects how far the vessels have to travel to the site, and subsequently the quantity of emissions released.	As the majority of emissions will be released from vessels whilst at the site during installation, the changes to the transit time for marine vessels will have a limited effect in terms of the overall GHG footprint. However, the most likely origin port known at the time of the assessment are used to derive GHG emissions during vessel transit.
6	Operation and maintenance emissions	Many sectors are anticipated to decarbonise over the next 30 years, and during operation and maintenance, it is likely that the emissions intensity of producing materials and the movement of marine vessels will be less than the present day. Therefore, emissions associated with the operation and maintenance phase of the Projects are likely to be a significant overestimation.

ID	Assumption / Limitation	Discussion
7	Where there are multiple options for possible project parameters, the worst case are selected including, material quantities, vessel movements, plant and equipment operational requirement.	This approach provides a conservative assessment as there may be unrealistic combinations of Projects parameters which are used in determining the worst case scenario. This approach is applied for the following: • Material quantities for the construction stage of the Projects. See section 30.1.1 of **Appendix 30.1** for details • Movement of marine vessel on site during construction. See section 30.1.2 of **Appendix 30.1** for details. • Helicopter movements during the construction / commissioning, operation, and maintenance. See section 30.1.3 of **Appendix 30.1** for details. • Plant and equipment for onshore components. See section 30.4.3.3.5 and section 30.1.5 of **Appendix 30.1.**

30.5 Existing Environment

30.5.1 Baseline 'Do Nothing' Scenario

83. To help determine the significance and contextualise the outcomes of the GHG assessment, consideration of a baseline or 'Do Nothing' scenario is required.

84. The UK electricity grid mix currently includes a number of different energy sources, including gas, nuclear, onshore and offshore wind, coal, bioenergy, solar and hydroelectric.

85. The growth of renewable energy is key to the UK's Energy Strategy and net zero targets, and a transition away from electricity generated by fossil fuels. Therefore, to evaluate the impact of the Projects, it is assumed that electricity produced by fossil fuels is displaced, as detailed section 30.5.1.1**.**

30.5.1.1 Energy Produced by the Projects

86. The approximate quantity of energy produced by the Projects both annually and over the lifetime of the Projects is quantified from the approach advocated by RenewableUK (2022), where the installed capacity (assumed to be a maximum of 3,000 MW) is multiplied by the hours in the year (8,760) and by the appropriate average load or capacity factor for the Projects. For new build offshore wind farms, BEIS advises that the load factor is 63.1% (BEIS, 2021).

87. The anticipated energy produced by the Projects is:

- Approximately: 16,582,680 MWh per year; and
- Approximately: 497,480,400 MWh over the 32 year lifetime of the Projects.

30.5.1.2 GHG Emissions from the 'Do Nothing' Scenario

88. In the 'Do Nothing' scenario, where the Projects are not constructed, it has been assumed that the energy produced by the Projects will be produced using gas instead, as this is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2022b).

89. The quantity of GHG emissions produced from the generation of electricity that the Projects will provide by gas in the 'Do Nothing' scenario is presented in **Table 30-12**. This has been quantified by multiplying the anticipated energy generated by the Projects by the estimated CO_2 emissions from gas supplied electricity (372 tCO_2 per GWh) (BEIS, 2022b). 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, are other GHGs to be included.

Table 30-12 Do Nothing Scenario Baseline GHG Emissions

Timeframe	Anticipated energy produced by the Projects	GHG emissions from electricity generated from gas (tonnes CO_2)
Per year	16,583 GWh per year	6,172,916
Duration of the Projects (32 years)	530,646 GWh	197,533,309

30.6 Assessment of Significance

30.6.1 Potential Effects During Construction, Operation and Decommissioning

90. One of the principal purposes of the Projects is to make a contribution to tackling climate change by generating renewable electricity, therefore helping decarbonise the UK's grid.

91. This section presents the GHG emissions associated with the construction, operation and maintenance, and decommissioning of the Projects. The carbon benefits of the Projects are then listed, including the amount of GHG emissions saved (or offset) and the GHG intensity of the electricity produced by the Projects and the carbon payback period. The scenario adopted for the assessment is the 'together' scenarios where the Projects are developed sequentially as this is considered to be the worst case.

30.6.1.1 Quantification of the Projects GHGs

92. The results of the GHG assessment for the Projects are shown in **Table 30-13**. These values include emissions associated with the Projects lifetime, including construction, an operational lifetime of 32 years and decommissioning.

Table 30-13 GHG Emissions for the Projects

Phase	Source	GHG emissions (tonnes CO_2e)	% of phase GHG footprint	Total GHG emissions per phase (tonnes CO_2e)	% of overall GHG footprint
Construction	Embodied emissions in materials: offshore	10,001,047	87%	11,492,856	95%
	Embodied emissions in materials: onshore	130,399	1.1%		
	Marine vessels: transit	159,788	1.4%		
	Marine vessels: activity on site	1,118,068	9.7%		
	Helicopters	21,328	0.19%		
	Plant and equipment: landfall, onshore cable corridor and onshore substation	25,278	0.2%		
	Road vehicles	36,951	0.3%		
Operation and Maintenance	Marine vessels	443,062	96.1%	461,274	3.8%
	Helicopters	1,025	0.2%		
	Road vehicles	120	0.03%		
	Spare parts	17,066	3.7%		
Decommissioning	1.2% of total*	145,243	1.2%	145,243	1.2%
Total		12,099,377			
*refer to **Table 30-7**					

93. The results in **Table 30-13** show that construction phase of the Projects is anticipated to have the highest emission contribution. Embodied carbon in construction materials is expected to be the largest source of emissions from the Projects, contributing approximately 88.1% of the overall construction phase emissions for both onshore (1.1%) and offshore (87%) components. As stated in **Appendix 30.1** and section 30.4.6**,** there is likely to be an overestimation of embodied carbon in materials and future emission factors, and some of the assumptions adopted in this assessment will be refined at the ES stage.

94. Emission from sources considered in the assessment are predicted to be approximately 12 million tonnes. Contextualization of the results are presented in section 30.6.1.

30.6.1.1.1 GHG Intensity of Electricity Production

95. The approach and calculation estimating the amount of energy produced by the Projects is presented in section 30.5.1.1. The anticipated levels and associated GHG intensity of electricity generated by the Projects is presented in **Table 30-14**.

Table 30-14 Electricity Generation and GHG Intensity for the Projects

Annual electricity generation (GWh p.a.)	Electricity generated by the Projects (GWh)	GHG intensity of electricity produced by the Projects (g CO_2e per kWh)
16,583	530,646	9.6

96. The GHG intensity of the electricity produced by the Projects is therefore 9.6 g CO_2e per kWh. When compared with the other offshore wind farm life cycle studies (Thomson and Harrison 2015; Dolan and Heath 2012, see **Table 30-8**), the GHG intensity of the Projects is within the lower range.

30.6.1.2 GHG Emission Savings or Carbon Offset

97. In the 'Do Nothing' scenario, it is assumed that the electricity generated by the Projects will be produced using gas, as this is the most common form of new plant in terms of fossil fuel combustion. The quantity of GHG emissions produced from the generation of electricity from gas is presented in **Table 30-15**, along with the GHG footprint of the Projects as presented in section 30.6.1.1. These values are used to derive the total carbon offset by the Projects. It is noted that the emission factor for electricity supplied by gas is in units of CO_2 rather than CO_2e, however, CO_2 is likely to form the main contribution to the generation of electricity.

98. The data presented in shows that the estimate levels of GHG savings over the 32 year lifespan of the Projects will be approximately 198 million tonnes CO_2e.

Table 30-15 GHG Savings from the Projects

Anticipated energy produced by the Projects (GWh)	GHG emissions from electricity generated from gas (tonnes CO_2)	Project GHG emissions (tonnes CO_2e)	GHG emissions saved (tonnes CO_2e)
530,646	197,533,309	12,099,377	185,433,932

30.6.1.2.1 GHG Payback Period

99. To estimate the 'GHG payback' of the Projects, it is assumed that electricity produced by gas is displaced (as detailed in the 'Do Nothing' scenario in section 30.5.1). Using this approach, the GHG payback of the Projects is 1.95 years from the time when the Projects becomes fully operational, as set out in **Table 30-16**.

Table 30-16 GHG 'Payback'

Parameter	Value	Unit
Energy produced by Projects	16,583	GWh per year
CO_2e intensity of electricity generated by natural gas	372	tonnes CO_2e per GWh
Annual CO_2e from gas-generated electricity (i.e. saved per year)	6,172,916	tonnes
Total CO_2e released by the Projects (total: construction / 32 year operation and maintenance / decommissioning)	12,099,377	tonnes
Time taken for Projects generated CO_2e to be paid back	1.96	years

30.6.1.2.2 Comparison to UK Carbon Budget

100. The provision of renewable energy will play an important role in meeting the UK Carbon Budgets and contributing to net zero aspirations. The six UK Carbon Budgets are detailed in **Table 30-5.**

101. During construction, total GHG emissions from the offshore aspects of the Projects are predicted to contribute approximately 0.59% of the 4th UK Carbon Budget (between 2023 and 2027) over the five year period. This assumes that all of the construction will take place within the period 2023 – 2027, which is likely to be an overestimation as some emission activities will take place in beyond 2027. GHG emissions during construction are temporary and form a relatively small component of the 4th UK Carbon Budget.

102. The total GHG savings associated with the Projects is estimated to be 198 million tonnes CO_2e. For context, this GHG savings as a result of the Projects (over an assumed five year period) equates to 3.2% of the 6th UK Carbon Budgets (2033-2037).

30.6.1.3 Magnitude of Impact – DBS East and DBS West Together

103. The scenario where the Projects are developed together will represent the highest level of GHG emission savings, as more renewable energy capacity will be available to help contribute to the decarbonisation of the UK electricity grid.

104. The scenario where the Projects are developed sequentially will represent the scenario with the highest release of emissions from Project related activities. The sequential development of the Projects will require an extended construction phase, leading to higher emissions from the increased use of marine vessels, helicopters, road traffic vehicles and plant and equipment, compared with the other development scenarios. This is the scenario presented in the emission calculations in **Table 30-13**.

105. Under the sequential scenario, total GHG savings associated with the Projects is estimated to be 198 million tonnes CO_2e.

106. Emissions released from the concurrent scenario is expected to be less due to the anticipated reduction in construction duration compared with the sequential scenario and the potential for efficiencies in construction activities to reduce resource consumption, therefore the potential for GHG savings under this scenario are higher than those in the sequential scenario which are presented in this chapter.

30.6.1.4 Magnitude of Impact – DBS East or DBS West in Isolation

107. The scenario where the Projects are developed in isolation would result in less emissions from activities during construction, operation and decommissioning. However, there is less potential for GHG savings, as there would be less renewable energy capacity if just one of the Projects is implemented. Therefore, the in isolation scenario is no worse than the sequential or concurrent scenarios, and is not assessed further.

30.6.1.5 Significance of Effect

108. As noted in section 30.4.3.5, the significance of a project in relation to GHG emissions is dependent on the net GHG impacts and comparisons to the without Projects or 'Do Nothing' baseline and net zero aspirations.

109. As noted in section 30.6.1.2, the Projects will result in a reduction in the release of GHGs to the atmosphere by approximately 185 million tonnes CO_2e, compared to the 'Do Nothing' baseline (i.e. electricity produced by gas), and will provide a renewable source of electricity which beneficially contributes to the UK's goal of achieving net zero emissions by 2050. It is therefore considered that the impacts of the Projects will be of **beneficial** significance in relation to reducing GHG emissions, when compared to the relevant baseline scenario. This is considered to be significant in EIA terms.

30.7 Potential Monitoring Requirements

110. The Projects are not anticipated to require any specific monitoring requirements with respect to GHG emissions.

30.8 Interactions

111. The global atmosphere is the receptor for the GHG assessment, therefore the impacts identified and assessed in this chapter do not have the potential to interact with each other. No further assessment of interactions is therefore undertaken.

30.9 Inter-relationships

112. 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 inter-relationships with this topic.

30.10 Summary

113. A summary of the impacts on climate change identified in the assessment are provided in **Table 30-17.** The receptor for the GHG assessment is the global atmosphere, which is considered to be highly sensitive. The assessment calculated the magnitude of emissions savings associated with the Projects is approximately 198 million tonnes. This is a beneficial effect, which is considered to be significant in EIA terms.

Table 30-17 Summary of Potential Likely Significant Effects on Climate Change

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect	Residual Cumulative Effect
Construction, operation and maintenance, and decommissioning							
GHG emissions during construction, operation and maintenance and decommissioning	Global atmosphere	High	Emissions saving of 198 million tonnes CO_2e.	Beneficial	N/A	Beneficial	N/A

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