VikingCCS

Viking CCS pipeline

Preliminary Environmental Information Report Volume II

Main PEIR

Applicant: Chrysoar Production (U.K.) Limited,
a Harbour Energy Company
PINS Reference: EN070008
November 2022

Harbour Energy | AECOM

Chapter 15

Climate Change

Table of Contents

Tables

15 Climate Change

15.1 Introduction

15.1.1 This chapter of the Preliminary Environmental Impact Report (PEIR) presents the findings of an assessment of the likely significant effects on the climate as a result of the Viking CCS Pipeline (hereafter referred to as 'the Project') and of the impacts of climate change on the Project. For more details about the Project, refer to *Chapter 3: The Viking CCS Pipeline* of this PEIR.

15.1.2 In line with the requirements of The Infrastructure Planning (Environmental Impact Assessment) Regulations (2017) (Ref 15-1), consideration has been given to the following aspects of climate assessment:

- *Lifecycle greenhouse gas (GHG) impact assessment* – to identify the impact of GHG emissions arising over the lifetime of the Project on the climate;
- *Climate change resilience (CCR) assessment* – to understand the resilience of the Project to projected future climate change impacts, including damage to the Project caused by accidents resulting from climate change; and
- *In-combination climate change impact (ICCI) assessment* – to understand how the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Project.

15.2 Legislation, Policy and Guidance

15.2.1 A brief overview of the policy, legislative and guidance relevant to the climate change assessment have been reviewed and summarised in **Table 15-1**.

Table 15-1: Relevant Policy, Legislation and Guidance

Policy, Legislation or Guidance name	Relevance to Climate Change
International	
United Nations Framework Convention on Climate Change Paris Agreement (UNFCCC, 2016) (Ref 15-6)	The Paris Agreement requires all signatories to strengthen their climate change mitigation efforts to keep global warming to below 2°C this century and to pursue efforts to limit global warming to 1.5°C.
National	
UK Nationally Determined Contribution (Ref 15-7)	In 2020, the UK communicated its new Nationally Determined Contribution to the UNFCCC. Within this, the UK has committed to reducing GHG emissions by at least 68% by 2030 compared to 1990 levels.
Climate Change Act 2008 (Ref 15-2)	The Climate Act 2008 was amended in 2019 to revise the existing 80% reduction target and legislate for Net Zero emissions by 2050. This target is supported by a system of legally binding five-year 'carbon budgets' and an independent body, the

Policy, Legislation or Guidance name	Relevance to Climate Change
	Committee on Climate Change (CCC), to advise on budgets and monitor progress. The UK carbon budgets restrict the amount of GHG emissions the UK can legally emit in a defined five-year period. The 6th Carbon Budget was set in the Carbon Budget Order 2021, which came into force in June 2021 (Ref 15-26) and is the first budget to reflect the amended trajectory to Net Zero by 2050.
The Infrastructure Planning (Environmental Impact Assessment) Regulations ('the EIA Regulations') (Ref 15-1)	The EIA Regulations state that an EIA (where relevant) must include: *"a description of the likely significant effects of the development on the environment resulting from… 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".*
Planning Policy Context	
Overarching National Policy Statement for Energy (EN-1) and National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Ref 15-9)	National Policy Statement (NPS) EN-1 and EN-4 describes the national policy for energy infrastructure in relation to climate impacts and adaptation; adverse effects and benefits; in relation to the EU Directive and ES requirements; in relation to adaptation measures in response to climate projections; and in relation to climate projections, flood risk and the importance of relevant mitigation. EN-1 promotes Carbon Capture and Storage as an emerging technology that the Government is aiming to facilitate and encourage, including for gas-fired generating stations. Paragraph 2.2.23 of EN-1 states that "*The UK must therefore reduce over time its dependence on fossil fuels, particularly unabated combustion. The Government plans to do this by improving energy efficiency and pursuing its objectives for renewables, nuclear power and carbon capture and storage. However some fossil fuels will still be needed during the transition to a low carbon economy*". This Policy Statement further states the benefits of having a diverse mix of power generation, including energy supply security as fossil-fuel generation that can be brought online quickly to meet demand and can complement baseload supply from nuclear and renewables. However, these fossil-fuel power generators will need CCS to be low carbon. In addition, NPS Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) states that "*information in this NPS may be useful in identifying impacts to be considered in applications for pipelines intended to transport other substances*". In NPS EN-4 applies to the climate change assessment, in particular Section 2.2 which sets out considerations to

Policy, Legislation or Guidance name	Relevance to Climate Change
	ensure that new energy infrastructure is resilient to climate change.
The National Planning Policy Framework (Ministry of Housing, Communities and Local Government (MHCLG), 2021) (Ref 15-10)	The revised National Planning Policy Framework (NPPF) sets out the Government's planning policies for England. While the NPPF does not set specific policies for Nationally Significant Infrastructure Projects (NSIP), its policies may be of relevance to decision making. Those policies of relevance to climate change and sustainability assessment include those achieving sustainable development and meeting the challenge of moving to a low carbon economy, climate change, flooding and coastal change. Paragraph 152 of the NPPF states that : *"the planning system should support the transition to a low carbon future in a changing climate (…) It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."* Paragraph 154 states that: *"New development should be planned for in ways that (…) can help to reduce greenhouse gas emissions, such as through its location, orientation and design."* Paragraph 155 states that: *"To help increase the use and supply of renewable and low carbon energy and heat, plans should:* *a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and 53 In line with the objectives and provisions of the Climate Change Act 2008.* *c) identify opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply systems and for collocating potential heat customers and suppliers."*
National Planning Practice Guidance on Climate Change (MHCLG, 2019) (Ref 15-11)	This guidance describes how to identify suitable mitigation and climate adaptation measures to incorporate into the planning process, stating that: *"Effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases… Planning can also help*

Policy, Legislation or Guidance name	Relevance to Climate Change
	increase resilience to climate change impact through the location, mix and design of development."
Net Zero Strategy (Department for Business, Energy & Industrial Strategy (BEIS), 2021) (Ref 15-12)	This strategy sets out policies and proposals for decarbonising all sectors of the UK economy to meet a net zero target by 2050. The strategy includes an ambition to deliver four carbon capture, usage and storage (CCUS) clusters, capturing 20-30 $MtCO_2$/year across the economy, including 6 $MtCO_2$/year of industrial emissions, per year by 2030. Teesside and the Humber, Merseyside and North Wales are identified among potential carbon capture cluster locations.
Local Planning Policy and Strategy	
North Lincolnshire Council Local Development Framework (North Lincolnshire Council, 2011) (Ref 15-21)	Sets out the North Lincolnshire Council's spatial vision, strategy and policies to deliver the strategy up to 2026. The Core Strategy covers several policies related to climate change, including the following, which will be considered in the assessment: Policy CS16 North Lincolnshire Landscape, Greenspace and Waterscape; Policy CS17 Biodiversity; Policy CS18 Sustainable Resource Use and Climate Change; Policy CS19 Flood Risk; and Policy CS20 Sustainable Waste Management.
North Lincolnshire Carbon Management Strategy (North Lincolnshire Council, 2017) (Ref 15-22)	Details the North Lincolnshire Council's plan for reducing carbon from 2017 to 2022. It states that this area is one of the top five most vulnerable coasts in the UK.
North East Lincolnshire Council Environmental Policy Statement (2016) (Ref 15-23)	Sets out North East Lincolnshire Council's priorities towards consuming resources more efficiently, eliminating waste and supporting & developing the green economy & infrastructure, including a commitment to support environmentally responsive local economic growth.
East Lindsey District Council Environment Policy (2020) (Ref 15-24)	The East Lindsey District Council Environment Policy Theme Two covers mitigating and adapting to climate changes, including working collaboratively to support the wider District in taking action to tackle climate change with urgency and working with local businesses to support the development of a low carbon economy.
West Lindsey District Council Sustainability, Climate Change and	West Lindsey District Council's Sustainability, Climate Change and Environment Strategy and action plan are

Policy, Legislation or Guidance name	Relevance to Climate Change
Environment Strategy (2021) (Ref 15-25)	designed to achieve the ambition of net zero carbon emissions across the district by 2050.
Guidance	
IEMA: Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022) (Ref 15-13)	EIA Guidance published by IEMA in 2022 will be followed. This provides a framework for the consideration of GHG emissions in the EIA process, in line with the 2014 European Union (EU) Directive. The guidance sets out how to: • Identify the GHG emissions baseline in terms of GHG current and future emissions; • Identify key contributing GHG sources and establish the scope and methodology of the assessment; • Assess the impact of potential GHG emissions and evaluate their significance; and • Consider mitigation in accordance with the hierarchy for managing project related GHG emissions (avoid, reduce, substitute, and compensate).
IEMA: Environmental Impact Assessment Guide to: Climate Chance Resilience and Adaptation (2020) (Ref 15-14)	The IEMA Guidance for assessing climate change resilience and adaptation in EIA will be followed. It provides guidance for consideration of the impacts of climate change within project design. The guidance sets out how to: Define climate change concerns and environmental receptors vulnerable to climate factors; Define the environmental baseline with changing future climate parameters; and Determine the resilience of project design and define appropriate mitigation measures to increase resilience to climate change.
The GHG Protocol (World Resources Institute and World Business Council for Sustainable Development (WRI & WBCSD, 2015) (Ref 15-15)	The GHG Protocol provides overarching guidance on developing GHG inventories and reporting standards.

15.3 Scoping Opinion and Consultation

15.3.1 A request for an EIA Scoping Opinion was made to the Planning Inspectorate in 2022 as part of the EIA Scoping Process. The Scoping Opinion was received on 5 May 2022. The comments received in the Scoping Opinion relevant to the climate change assessment are presented in **Table 15-2**.

15.3.2 A separate ICCI assessment has been scoped out of the Climate Change assessment on the basis that any identified in-combination climate change impacts will be addressed in other relevant chapters of the PEIR and supporting planning documents.

Table 15-2: Summary of EIA Scoping Opinion in relation to Climate Change

Section Reference to Scoping Opinion	Applicant's proposed matter	Planning Inspectorate / prescribed consultee comments	Project Response
Planning Inspectorate Table 18-7 and Table 18-14	In Combination Climate change	The Inspectorate accepts the reasoning presented and agrees that an assessment of 'in combination climate change' as described in the Scoping Report (the combination of future climate conditions and the Proposed Development) can be scoped out of the ES.	No response required.
Planning Inspectorate Table 18-8	Parameters to scope into the climate change resilience review	The information provided within Table 18-8 [of the Scoping Report], in relation to the Proposed Development's vulnerability to climatological and meteorological events, should be reviewed alongside the information in Table 20-3 (Major Accidents and Disasters) [in the Scoping Report] to ensure consistency in the ES's approach where these matters overlap.	The Project's vulnerability to climatological and meteorological events has been reviewed alongside the Major Accidents and Disasters. Only wave surges have been scoped into the Major Accidents and Disasters under Natural Hazards - Climatological and Meteorological as the Project is located in an area at risk of tidal flooding. It will be ensured that there is consistency in the approach of assessment of wave surges.
Anglian Water	Movement of water supply and recycling network	To minimise the carbon cost of the project the design and construction of the project should minimise and if possible,	There are Anglian Water assets which intersect with the Draft Order Limits. These assets would be crossed in a method which will be agreed with Anglian Water. It is not thought at this time that the Project would require the

Section Reference to Scoping Opinion	Applicant's proposed matter	Planning Inspectorate / prescribed consultee comments	Project Response
		avoid the need to move the water supply and water recycling network. If this is not possible then Protective Provisions will be required to protect the supply of water and management of wastewater for local communities by Anglian Water.	water supply or recycling network to be relocated. Protective Provisions would be included in the Draft DCO if required.
Lincolnshire County Council	Methodology	The proposed methodology for climate and biodiversity related assessment are sound.	No response required

Consultation

15.3.3 Further consultation will be undertaken with statutory parties including the Environment Agency and the relevant Local Planning Authorities on climate change targets, aims, commitments, other projects, plans and policy that affect climate and baseline data, as well as any known future developments in close proximity to the Project.

15.4 Assessment Methodology

Impact Assessment Methodology

Lifecycle GHG Impact Assessment

15.4.1 The potential effects of the Project on the climate during construction have been calculated in line with the GHG Protocol (Ref 15-15) and the GHG 'hot spots' (i.e. materials and activities likely to generate the largest amount of GHG emissions) have been identified. This will enable priority areas for mitigation to be identified. This approach is consistent with the principles set out by the Institute for Environmental Management and Assessment (IEMA) document 'Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref 15-13).

15.4.2 This lifecycle approach considers emissions from the following lifecycle stages of the Project. Where activity data allows, expected GHG emissions arising from the construction, operation and maintenance, and decommissioning activities, and embodied carbon in materials of the Project, have been quantified using a calculation-based methodology.

15.4.3 GHG emissions have been preliminarily assessed using a calculation-based methodology as per the below equation (Ref 15-16):

Activity data x GHG emissions factor = GHG emissions value

15.4.4 The Department for Business, Energy and Industrial Strategy 2022 emissions factors (Ref 15-17) and embodied carbon data from the Inventory of Carbon and Energy V3.0 (ICE) (Ref 15-18) have been used as the primary source of emissions factors for calculating GHG emissions.

15.4.5 In line with applicable guidelines from the World Business Council for Sustainable Development (WBCSD) / World Resources Institute (WRI) Greenhouse Gas Protocol initiative (Ref 15-15), the GHG emissions study will be reported as tonnes of carbon dioxide equivalent (tCO_2e) and consider the seven Kyoto Protocol gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6); and
- Nitrogen Trifluoride (NF_3).

15.4.6 These GHGs are broadly referred to in this chapter under an encompassing definition of 'GHG emissions'.

15.4.7 Where data are not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 15-13).

15.4.8 **Table 15-3** summarises the key anticipated GHG emissions sources associated with the Project, agreed as part of the scoping process described in section 15.3.

Table 15-3: Potential Sources of GHG Emissions

Lifecycle Stage	Activity	Primary emission sources
Product Stage	Use of products and/or materials required to build the proposed pipeline and associated infrastructure	Embodied GHG emissions associated with extraction of required raw materials and the manufacturing of finished materials and components.
Construction process stage	On-site construction activity including emissions from construction compounds	GHG emissions from grid electricity use during construction. GHG emissions from fuel consumed by construction vehicles and plant.
	Land use change	GHG impact of changes to carbon sink value of the Site.
	Water Use	GHG emissions from the provision and treatment of water.
	Travel of construction workers Transportation of construction materials (where these are not included in product-stage embodied GHG emissions)	GHG emissions arising from the fuel use for vehicles transporting workers to the construction site.
	Disposal of waste materials generated by the construction process.	Emissions arising from the transportation and treatment of waste.
Operation stage	Operation and maintenance of the Proposed Development	Emissions arising from fuel consumed by maintenance vehicles and plant. Embodied GHG emissions within the materials used for maintenance. Grid electricity use during operation of the development
Decommissioning stage	On-site decommissioning activity	Energy (electricity, fuel, etc.) consumption from plant and vehicles, generators on site.
	Worker travel	GHG emissions from fuel consumption for transportation of workers

Lifecycle Stage	Activity	Primary emission sources
	Transportation and disposal of waste materials	GHG emissions from transportation and final treatment (disposal or recycling) of waste

Climate Change Resilience Assessment

15.4.9 The EIA Regulations (Ref 15-1) require the inclusion of information on the vulnerability of the Project to climate change. Consequently, an assessment of climate change resilience for the Project has been undertaken which identifies potential climate change impacts in accordance with IEMA Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (Ref 15-14).

15.4.10 The assessment has included all infrastructure and assets associated with the Project. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UKCP18 projections (Ref 15-13).

15.4.11 The review of potential impacts and the Project's vulnerability to climate change considers the mitigation measures that have been embedded into the design of the Project as discussed in Section 15.7 on Mitigation.

15.4.12 **Table 15-4** details the parameters which have been scoped into the climate change resilience assessment.

Table 15-4: Parameters Scoped into the Climate Change Resilience Assessment

Parameter	Scoped In/ Out	Rationale for Scoping Conclusion
Extreme weather events	In	The Project may be vulnerable to extreme weather events such as storm damage to structures and assets.
Increased average temperatures and incidence of heatwaves	In	Extremes in temperatures may result in heat stress of materials and structures.
Increased frequency of heavy precipitation events	In	The Project may be vulnerable to changes in precipitation, for example, land subsidence and damage to structures and drainage systems during periods of heavy rainfall.
Sea level rise	In	The Project is located in an area that is susceptible to sea level rise. Specifically, approximately the first 3 km of the Scoping Boundary (Section A – Corridor 1) intersects with Flood Zone 2 and 3 associated with the tidal flooding from the Humber Estuary. Additionally, the last 9km (from the crossing of the B1200 onwards) of this corridor (Section E – Corridor 2) lies within the tidal flood zone 2-3 from the North Sea.

15.4.13 Once potential climate risks have been identified, the likelihood of their occurrence during the project phase is categorised. Likelihood is categorised into five levels depending on the probability of the hazard occurring. **Table 15-5** presents the likelihood levels and definitions used. This is in line with the definitions presented in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (Ref 15-30).

***Table 15-5:* Description of likelihood for climate change hazard/impact will occur**

Likelihood Category	Description (probability of occurrence)
Very likely	90-100% probability that the hazard/impact will occur.
Likely	66-90% probability that the hazard/impact will occur.
Possible, about as likely as not	33-66% probability that the hazard/impact will occur.
Unlikely	>10-33% probability that the hazard/impact will occur
Very unlikely	0-10% probability that the hazard/impact will occur

15.4.14 The consequence of an impact has been measured using the criteria detailed in **Table 15-6**. The probability and consequence have taken into account mitigation measures secured via the implementation of the Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP) and Decommissioning Environmental Management Plan (DEMP) which will be a requirement of the DCO.

Table 15-6: Level of consequence for Climate Change Risk

Consequence of Impact	Measure of Consequence for Climate Change Resilience
Very high	Permanent damage to structures/assets; complete loss of operation/service; complete/partial renewal of infrastructure; serious health effects, possible loss of life; extreme financial impact; and exceptional environmental damage.
High	Extensive infrastructure damage and complete loss of service; Some infrastructure renewal; major health impacts; major financial loss; and considerable environmental impacts.
Medium	Partial infrastructure damage and some loss of service; moderate financial impact; adverse effects on health; and adverse impact on the environment.
Low	Localised infrastructure disruption and minor loss of service; no permanent damage, minor restoration work required; and small financial losses and/or slight adverse health or environmental effects.
Very low	No damage to infrastructure; no impacts on health or the environment; and no adverse financial impact.

Significance

Lifecycle GHG Assessment

15.4.15 The global climate has been identified as the receptor for the purposes of the GHG assessment. The sensitivity of the climate to GHGs is considered to be high.

15.4.16 As per IEMA guidance, any GHG emissions or reductions from a project might be considered to be significant, as all emissions contribute to climate change. The rationale for classification is as follows:

- Any additional GHG impacts could compromise the UK's ability to reduce its GHGs and therefore the ability to meet its carbon budgets;
- The extreme importance of limiting global warming to below 2°C this century, as broadly asserted within the Paris Agreement, national legislation and community support. Additionally, a recent report by the IPCC highlighted the importance of limiting global warming below 1.5°C (Ref 15-30); and
- A disruption to global climate is already having diverse and wide-ranging impacts to the environment, society, economy and natural resources. Known effects of climate change include increased frequency and duration of extreme weather events, temperature changes, rainfall and flooding, and sea level rise and ocean acidification. These effects are largely accepted to be negative, profound, global, likely, long-term to permanent, and are transboundary and cumulative from many global actions (Ref 15-31).

15.4.17 The environmental impact associated with GHG emissions is a national and global issue. Consequently, the potential significance of the proposed Project's lifecycle GHG emissions will be assessed by comparing the estimated GHG emissions from the Project against the reduction targets defined in the Climate Change Act 2008 (Ref 15-2) and associated five-year, legally binding carbon budgets.

15.4.18 The significance level of project-related emissions has been determined using IEMA's (2022) five levels of significance. The significance criteria are not solely based on whether a development emits GHG emissions alone but on how it makes a relative contribution towards achieving the UK Government's target of net zero. The definitions for IEMA's levels of significance are provided in **Table 15-7.**

Table 15-7: Significance Levels as per IEMA Guidance

Effects	Significance level	Description
Significant	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 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	Significance level	Description
		effects falls short of fully contributing to the UK's trajectory towards net zero.
Not significant	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.
Significant	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.

15.4.19 IEMA guidance states that it is challenging to identify fixed numerical thresholds against which to identify the significance of a proposed project regarding the net change in GHG emissions. Therefore, the GHG assessment should present context for the GHG emissions, and it is down to the practitioner's professional judgement on how best to contextualise a project's GHG impact. To determine if the Project makes a relative contribution towards achieving the UK Government's target of net zero the impact of the Project's GHG emissions will therefore be put into context of the UK's carbon budgets.

15.4.20 The Climate Change Act 2008 established a system of five yearly carbon budgets. Each carbon budget represents the total amount of GHG emissions that may be emitted by the UK during each 5-year period, measured in $MtCO_2e$. The carbon budgets are consistent with furthering the achievement of the UK climate objective and include all GHG emissions. Based on advice from the Climate Change Committee UK parliament has legislated for the first six carbon budgets. The 6th carbon budget covering the period 2032 to 2037 is the first budget to align with the trajectory required for the UK to meet its net zero by 2050 carbon target.

15.4.21 The CCC have proposed figures for carbon budgets beyond the 6th carbon budget based on achieving net zero, and that these proposals are included in **Table 15-8** for context, but they are not yet approved or legislated for.

15.4.22 **Table 15-8** shows the current, future and proposed UK carbon budgets up to 2050. A preliminary assessment of the impact of GHG emissions from the Project on the global climate has been carried out. This assessment involved a comparison of overall emissions

from the Project with the UK's national carbon budgets and is summarised in Section 15.8 below.

Table 15-8: UK Carbon Budgets

Carbon Budget period	National Carbon budget ($MtCO_2e$)
3rd (2018-2022)	2,544
4th (2023-2027)	1,950
5th (2028-2032)	1,725
6th (2033-2037)	965
7th (2038-2042)[1]	*526*
8th (2043-2047)	*195*
9th (2048-2050)	*17*

15.4.23 Consideration will be given to the emissions which are expected to be avoided as a result of the delivery of the wider Viking CCS Project, noting that the emission reductions should not be double counted.

Climate Change Resilience Assessment

15.4.24 The CCR Assessment is qualitative and provides commentary on how the Project will be resilient to climate change within the context of current and predicted future climate conditions.

15.4.25 Following identification of climate hazards, the likelihood and consequences have been assessed according to **Table 15-5** and **Table 15-6** respectively.

15.4.26 The PEIR presents embedded adaptation measures to demonstrate how the Project will be adapted to future climate conditions.

15.4.27 The CCR Assessment has identified the significance of effects by evaluating the combination of the likelihood of the climate-related impact occurring, and the consequence, as per the risk assessment matrix in **Table 15-9**. The assessment has taken into account mitigation and enhancement measures.

[1] National Carbon Budget values for the 7th, 8th and 9th budget periods have not been formally adopted by the UK Parliament; they are based on annual values in the net-zero balanced pathway as published by the CCC, and are consistent with earlier carbon budget totals.

Table 15-9: Significance of Effect Matrix (where 'S' is significant and 'NS' is not significant)

		Likelihood of climate-related impact occurring			
		Negligible	**Low**	**Moderate**	**High**
Measure of consequence	**Negligible**	Negligible (NS)	Negligible (NS)	Low (NS)	Low (NS)
	Low	Negligible (NS)	Low (NS)	Low (NS)	Moderate (S)
	Moderate	Low (NS)	Low (NS)	Moderate (S)	High (S)
	High	Low (NS)	Moderate (S)	High (S)	High (S)

15.5 Study Area

Lifecycle GHG Impact Assessment

15.5.1 The Study Area for the lifecycle GHG impact assessment considers all GHG emissions arising over the lifecycle of the Project. This includes direct GHG emissions arising from activities within the Draft Order Limits and indirect emissions from activities outside the Draft Order Limits (for example, the transportation of materials to the Project boundary and embodied carbon within construction materials).

15.5.2 The Study Area also includes activities that may be avoided or displaced as a result of the Project, including consideration of the emissions which are expected to be avoided as a result of the delivery of the wider Viking CCS Project.

Climate Change Resilience (CCR) Assessment

15.5.3 The Study Area for the CCR Assessment is the Draft Order Limits i.e. it covers all land, assets and infrastructure which constitute the Project, during construction, operation, and decommissioning.

15.6 Baseline Environment

Lifecycle GHG Impact Assessment

15.6.1 Current land use within the Draft Order Limits consists of predominantly arable land and managed hedgerows and trees. Trees are present individually in some areas, as well as in rows and within small woodland areas. The abundance of vegetation within the Draft Order Limits suggests a relatively high carbon sink potential. Also, current land use within the Draft Order Limits has minor levels of associated GHG emissions as the land use is largely agricultural. Baseline agricultural GHG emissions are dependent on soil and vegetation types present, and fuel use for the operation of vehicles and machinery.

15.6.2 The lifecycle GHG impact assessment for the Project comprises of the Viking CCS pipeline and associated infrastructure within the Draft Order Limits and are included in Section 15.8.

15.6.3 For the GHG Assessment, the baseline is the ‘business as usual’ scenario where the Project is not constructed, operated, and decommissioned. The baseline typically consists of the

GHG emissions from the existing carbon stock within the soil and the above- and below-ground vegetation with the Draft Order Limits.

15.6.4 While the current land use within the Draft Order Limits will have minor levels of associated GHG emissions, it is anticipated that these emissions will not be material in the context of the overall Project. Therefore, for the purposes of the lifecycle GHG impact assessment, a net GHG emissions baseline of zero is applied.

Climate Change Resilience Assessment

15.6.5 The current baseline for the assessment of the climate change risks to the Project (the CCR assessment) will be based on historic climate data obtained from the Met Office (Ref 15-3) recorded by the closest meteorological station (Cleethorpes, 13 miles from the Project) for the period 1991-2020. This data is listed in **Table 15-10** below.

Table 15-10: Historic Climate Data 1991-2020

Climatic Variable	Month	Value
Average annual maximum daily temperature (ºC)	-	14.05
Warmest month on average (ºC)	August	21.08
Coldest month on average (ºC)	January	1.99
Mean annual rainfall levels (mm)	-	600.71
Wettest month on average (mm)	November	63.40

15.6.6 The Met Office historic 10-year averages for the 'England and North East England' region identify gradual warming (although not uniformly so) between 1969 and 2018, with increased rainfall also. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in **Table 15-11**.

Table 15-11: Historic 10-year Averages for Temperature and Rainfall for the England Southeast and Central South Region

Climate Period	Climate Variable	
	Mean maximum annual temperatures (°C)	Mean annual rainfall (mm)
1971-1980	12.0	710
1981-1990	12.2	732.1
1991-2000	12.6	750.8
2001-2010	13.1	801.5
2011-2020	13.3	803.5

Future Baseline

15.6.7 The future climatic baseline will be determined through the UK Climate Impacts Programme UK Climate Projections 2018 (UKCP18) (Ref 15-4) detailed in **Table 15-12** and **Table 15-13**.

15.6.8 As the design life of the Project is expected to be an initial 25 years, the vulnerability assessment has considered a scenario that reflects a high level of greenhouse gas emissions at the 10%, 50% and 90% probability levels up to the 2070s' time period and to assess the impact of climate change over the whole lifetime of the Project where possible.

15.6.9 For the purpose of the assessment, UKCP18 probabilistic projections for pre-defined 30-year periods for the following average climate variables have been obtained and will be further analysed:

- Mean Sea Level Rise;
- Mean annual temperature;
- Mean summer temperature;
- Mean winter temperature;
- Maximum summer temperature;
- Minimum winter temperature;
- Mean annual precipitation;
- Mean summer precipitation; and
- Mean winter precipitation:

15.6.10 Projected temperature and precipitation variables are presented in **Table 15-12** and **Table 15-13**, respectively. UKCP18 probabilistic projections have been analysed for the 25 km grid square in which the Project is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2000 baseline.

15.6.11 UKCP18 uses a range of possible scenarios, classified as Representative Concentration Pathways (RCPs), to inform differing future emission trends. These RCPs "*… specify the concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to preindustrial levels."* RCP8.5 has been used for the purposes of this assessment as a worst-case scenario.

15.6.12 As the design life of the Project is expected to be at least an initial 25 years, the CCR assessment has considered a scenario that reflects a high level of GHG emissions at the 10%, 50%, and 90% probability levels up to 2069 to assess the impact of climate change over the lifetime of the Project.

15.6.13 The projections were updated on 17 August 2022. The methodology was updated to improve: consistency between maximum, minimum and mean temperature; consistency in the downscaling; statistical treatment of precipitation particularly at the wet and dry extremes; representation of annual and decadal variability; and adjustment of the data in the 1981-2000 baseline period to ensure the anomalies average to zero. The combination of the improvements means that all variables are modified to some degree.

15.6.14 **Table 15-12**, **Table 15-13** and **Table 15-14** below show projected changes in temperature (expected to increase), precipitation (expected to increase in winter and decrease in summer) and sea level rise (expected to increase). The climate projections do not take account of the Project.

Table 15-12: Projected Changes in Temperature Variables (°C), 50% Probability (10% and 90% probability in parentheses)

Climate Variable	Time Period	
	2020-2049	2040-2069
Mean annual air temperature anomaly at 1.5 m (°C)	+1.0 (+0.5 to +1.6)	+2.2 (+1.0 to +2.7)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.3 (+0.5 to +2.0)	+3.4 (+1.0 to +3.4)
Mean winter air temperature anomaly at 1.5 m (°C)	+0.9 (+0.2 to +1.7)	+1.6 (+0.5 to +2.8)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.4 (+0.3 to +2.4)	+2.4 (+0.9 to +4.0)
Minimum winter air temperature anomaly at 1.5 m (°C)	+0.9 (+0.2 to +1.7)	+1.6 (+0.5 to +2.7)

Table 15-13: Projected Changes in Precipitation Variables (%), 50% Probability (10% and 90% probability in parentheses)

Climate Variable	Time Period	
	2020-2049	2040-2069
Annual precipitation rate anomaly (%)	+0.4 (-6.5 to +7.3)	-2.4 (-11.7 to +7.0)
Summer precipitation rate anomaly (%)	-8.1 (-24 to +7.7)	-14.7 (-37.1 to +7.5)
Winter precipitation rate anomaly (%)	+4.4 (-4.1 to +13.7)	+14.3 (-4.3 to +21.6)

Table 15-14: Projected Changes in Sea Level Variables, 50% Probability (10% and 90% probability in parentheses)

Climate Variable	Time Period	
	2020-2049	2040-2069
Time mean sea level anomaly (m)	+0.18 (+0.14 to +0.23)	+0.33 (+0.25 to +0.42)

Planned Surveys

15.6.15 No surveys are planned as part of the climate change considerations, but engagement will be undertaken with relevant environmental disciplines and the engineering design team to discuss the climate change assessment and identify mitigation measures for incorporation into the design of the Project.

15.7 Mitigation

Embedded Mitigation

15.7.1 EIA is an iterative process which informs the development of a project's design. Where the outputs of the preliminary assessment identify likely significant effects changes to the design can be made or mitigation measures can be built-in to the proposal to reduce these effects.

15.7.2 This type of mitigation is defined as embedded mitigation, as mitigation measures which have been identified and adopted as part of the evolution of the Project design ("embedded" into the Project design).

15.7.3 The design of the Project will be further developed to reflect the findings of ongoing environmental studies, comments raised during this statutory consultation and ongoing engagement with stakeholders. As the design develops, the embedded mitigation measures will also be refined as part of an iterative process.

Additional Mitigation

15.7.4 A Preliminary Draft Construction Environmental Management Plan (CEMP) has been prepared and can be found in PEIR Volume IV - Appendix 3.1. This includes a preliminary mitigation register which includes measures to help reduce the GHG impact of the Project. The mitigation presented in the Draft CEMP will be secured through a requirement within the DCO, which requires a CEMP to be submitted for approval after the grant of development consent.

15.7.5 The mitigation measures comprise of:

- *M1: Adopting the Considerate Constructors Scheme to assist in reducing pollution, including GHGs, from the Project by employing best practice measures which go beyond the statutory requirements;*
- *K1: Adopting an Energy Reduction Plan which includes measures to identify and implement all cost-effective efficiency measures;*
- *K2: A cost benefit analysis will be undertaken to confirm generation use is optimised. This can be considered as part of the Energy Reduction Management Plan;*

- *K3: Develop a Sustainable Procurement Plan to identify the risks and opportunities of procurement against a broad range of social, environmental and economic issues. This will form part of the Final CEMP;*
- *K4: Develop a Materials Management Plan which includes best practice measures on suitability for use, certainty of use and quantities required; and*
- *K5: Develop the outline Site Waste Management Plan attached to the Draft CEMP. This will be required to include measures to ensure waste produced or held on a site is disposed of safely, efficiently and lawfully, and meets Harbour Energy's environmental targets.*

15.7.6 Additional climate change resilience mitigation measures, particularly in relation to flooding, which are also secured in the Preliminary Draft CEMP are outlined below. The specific flood risk impacts and associated mitigation measures are discussed in more detail in *Chapter 11: Water Environment* of the PEIR. These measures include:

- *G2: Establish the location and condition of existing land drainage and compile a record. Subject to landowner/occupier agreement, existing drains should be restored, or new drains established to help prevent damage to soil structure, maintain work areas in a dry condition and to enable current drainage systems to continue to operate through the construction period; and*
- *G11: Following installation of the pipeline, topsoil and excavated material will be reinstated and a post-construction drainage system installed to ensure no detriment to the existing land drainage regime.*

15.7.7 The preliminary assessment is undertaken with the assumption that the embedded and additional mitigation measures are in place.

15.8 Preliminary Assessment of Effects

GHG Assessment

Effects during enabling works and construction

15.8.1 This section presents preliminary findings of the GHG impact assessment for the construction of the Project. It identifies any likely significant effects that are predicted to occur.

15.8.2 In order to assess the magnitude of the climate change impacts as a result of GHG emissions associated with construction of the Project, the GHG emissions that would be associated with the Project activities are calculated based on the assumptions listed below.

- As stated in *Chapter 3: The Viking CCS Project* for the purposes of this assessment, the construction phase is currently anticipated to cover approximately 1-year period and construction of the Project will be completed by the end of 2027;
- Where sufficient detail was available, a bill of quantities was provided from the Project team engineers and converted to carbon emissions using emission factors from the ICE database V3 (Ref 15-18) and BEIS 2022 Emission Factors (Ref 15-17); and
- It is reasonable to assume that the construction workers will be based in nearby accommodation and will travel an average distance of 25 km (one way) to the construction site. It was assumed all transport will take place in a diesel Light Goods Vehicle, with an occupancy rate of 10 workers per vehicle.

15.8.3 For product transport, the following has been assumed:

- Whilst the actual supplier for the pipe has yet to be confirmed, for the purposes of this assessment, it is assumed that the steel used in the pipeline will be sourced from a steel foundry from overseas and will be transported to site by Cargo Ship and Heavy Goods Vehicle (HGV);
- For the purpose of the assessment, all other equipment at the Immingham, Theddlethorpe and Block Valve Sites would be manufactured in the United Kingdom and transported to site by HGV travelling 200 km;
- The provided Bill of Quantities was used to determine the material wastage quantities. A 5% wastage rate was applied for the steel used for the pipeline. No wastage rate was applied for all other equipment, assuming all metal products will be manufactured offsite specifically for the Project; and
- It was assumed that 100% of wastage material would be sent to landfill. BEIS 2022 emission factors were used to determine carbon values for wastage.

15.8.4 As detailed in **Table 15-15**, using the assumptions listed above, the total construction related GHG emissions from the Project are calculated to be around 69,539 tCO_2e with a large majority of construction emissions being associated with the embodied carbon of materials.

Table 15-15: Preliminary Construction Emissions

Project Activity/ Emission Source	GHG Emissions (tCO2e)	GHG Emissions as a proportion of emissions generated throughout the construction
Plant emissions and enabling works	885	1%
Construction Materials, primarily steel pipeline	64,803	93%
Transport of Materials	3,791	5%
Construction Worker Commuting	58	<1%
Construction Waste	2	<1%
Total GHG emissions over construction period (tCO2e)	69,539	

Effects during Operational Phase

15.8.5 To assess the magnitude of impacts as a result of GHG emissions associated with the operation of the Project, GHG emissions associated with the Project activities are calculated based on the assumptions and listed below.

- As stated by *Chapter 3: The Viking CCS Pipeline*, the anticipated design life of the pipeline will be for an initial 25 years (but could be extended through appropriate maintenance);
- The electricity consumption of the Project was sourced from the Project's team engineers;
- Grid decarbonisation during the operation of the Project was estimated based off emission factors by the HM Treasury Green Book (Ref 15-31);

- Worker commuting was not included in the Preliminary GHG Assessment due to the number of operational staff on site being negligible.

15.8.6 As detailed in **Table 15-16**, using the listed assumptions, the lifetime operational GHG emissions from the Project within its Draft Order Limits are calculated to be approximately 2,913 tCO_2e with 100% of operational emissions associated with electricity usage onsite. Assuming that emission-related activities are similar during the initial 25-year development, annual emissions are expected to be approximately 351 tCO_2e in 2027 and will decrease to approximately 32 tCO_2e from 2049 onwards due to projected electricity grid decarbonisation.

Table 15-16: Preliminary Operational Emissions (within Draft Order Limits)

Project Activity/ Emission Source	GHG Emissions (tCO2e)	GHG Emissions as a proportion of emissions generated throughout Operation
Operational Energy Usage – Killingholme Site	1,020	35%
Operational Energy Usage – Theddlethorpe Site	1,674	57%
Operational Energy Usage – Block Valve	219	8%
Total GHG emissions over operational period (tCO2e)	**2,913**	**100%**

15.8.7 In addition to the preliminary operational emissions listed above in **Table 15-16.** The GHG assessment also needs to consider the anticipated GHG impacts of the wider Viking CCS Project to abate carbon emissions from large industrial emitters at the Immingham Industrial Site that sit outside of the Draft Order Limits. As stated by *Chapter 3: The Viking CCS Pipeline*, the Project aims to transport and store up to 10 million tonnes of CO_2 annually by 2030. This anticipated GHG activity needs to be assessed against the significance criteria detailed in **Table 15-7**.

15.8.8 The vast majority of the overall GHG impact come from the sequestration of CO_2 emissions from the Immingham industrial site, resulting in the Project being carbon negative relative to a without-project baseline. This net impact figure does not account for any additional emissions from the CO_2 capture process at the Immingham industrial site.

15.8.9 It is important to note that the GHG emissions associated with CO_2 capture and sequestration will be considered separately for the significance assessment as these GHG emissions fall out with the Project's Draft Order Limits.

Decommissioning Phase

15.8.10 This section presents preliminary findings of the GHG impact assessment for the decommissioning of the Project. It identifies any likely significant effects that are predicted to occur and then highlights the mitigation and enhancement measures that are proposed to minimise any adverse significant effects.

15.8.11 In order to assess the magnitude of the climate change impacts as a result of GHG emissions associated with operation of the Project, the GHG emissions that would be associated with the Project activities are calculated based on the assumptions and listed below.

- The pipeline will remain in-situ and will not be disposed of at the end of its operational life;
- All other equipment at the Immingham, Theddlethorpe and Block Valve Sites will be decommissioned and removed from site for disposal;
- BEIS 2022 Emission Factors were applied to the material quantities to generate emission values for the waste disposal. It was assumed that 100% of material will be sent to landfill. This is a reasonable worst-case scenario. It is expected a separate waste management strategy will be produced for the decommissioning phase of the Project;
- The equipment will be transported a distance of 100km to the waste disposal site and a HGV will be used. This is a reasonable worst case scenario. The BEIS 2022 Emission Factor for a HGV were applied to provide an estimate of the likely GHG impact in the absence of readily available future emissions factors for HGV transport that might apply at the time of decommissioning; and
- The decommissioning phase of the Project will require 50% of the manpower required for the construction phase. All vehicles used to transport decommissioning workers were all EV powered van's (up to 3.5 tonnes). This was used in place of LGVs as emission factors are unavailable for EV LGVs.

15.8.12 As detailed in **Table 15-17**, using the listed inclusions and exclusions, the total GHG emissions from the Project are calculated to be approximately 8 tCO_2e with the majority (80%) of emissions associated with the transport of workers to and from the Project site. The remaining emissions are associated with the recycling and disposal of onsite equipment.

15.8.13 As noted above, emissions from the transportation of waste materials and workers are based on the most recent vehicle emissions factors. The UK Government's Transport Decarbonisation Plan (Ref 15-32) sets out ambitions to decarbonise all aspects of road transport by 2050, so the actual transport emissions at the time of future decommissioning are likely to be significantly lower than the figures presented in **Table 15-17** below.

Table 15-17: Preliminary Decommissioning Phase

Project Activity/ Emission Source	GHG Emissions (tCO2e)	GHG Emissions as a proportion of emissions generated throughout Decommissioning
Waste Material Transport	1.37	18%
Worker Transport	6.20	79%
Material Disposal	0.24	3%
Total GHG emissions over Decommissioning period (tCO2e)	**7.81**	**100%**

Overall Project Impacts

15.8.14 This section presents preliminary findings of the GHG impact assessment for the overall project including the Construction, Operational and Decommissioning phases. It identifies any likely significant effects that are predicted to occur during the whole Project.

15.8.15 As detailed in **Table 15-18**, the total GHG emissions from the Project are calculated to be approximately 72,458 tCO_2e. It is anticipated however the Project will be carbon negative due to a significant quantity of carbon emissions being sequestered through the wider Viking CCS Project.

Table 15-18: Preliminary overall GHG emissions

Project Activity/ Emission Source	GHG Emissions (tCO2e)	GHG Emissions as a proportion of lifetime emissions
Construction Phase	69,537	96%
Operational Phase	2,913	4%
Decommissioning Phase	8	<1%
Lifetime GHG emissions (tCO2e)	**72,458**	**100%**

Preliminary Significance

GHG Emissions Impact Assessment

15.8.16 As stated in Section 15.5, all emissions are considered to be potentially significant. To contextualise the level of significance, **Table 15-19** details the Project's emissions and compares these to the UK's 4th, 5th and 6th carbon budgets to determine if the Project aligns with the UK's Government's 2050 net zero target.

15.8.17 The Project has significantly lower emissions compared to the 4th, 5th and 6th carbon budgets. The Project's trajectory is fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type.

15.8.18 The UK Carbon budgets only include GHG emissions emitted within the UK. In the GHG assessment, it was assumed the steel used in the pipeline was sourced from overseas. These GHG emissions have been included in the Significance assessment to present a conservative worst-case scenario for the GHG Assessment.

15.8.19 It is anticipated that the majority of these residual emissions beyond 2050 will result from the operational and decommissioning phases. It is anticipated that direct operational emissions will decrease over time due to continuing grid decarbonisation, machinery, and vehicle electrification, in line with the UK's net-zero carbon emissions trajectory. For the decommissioning phase, it is anticipated that the GHG emissions will be negligible due to decarbonisation of surface transport and improvements in waste management.

Climate Change Resilience Assessment

Effects during Construction

15.8.20 During enabling works and construction, receptors such as the construction work force, construction plant, vehicles, materials and the construction programme may be vulnerable to a range of climate risks. These could include:

- Inaccessible construction site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- Health and safety risks to the workforce during severe weather events;

- Unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- Damage to construction materials, plant and equipment, including damage to temporary buildings/facilities within the site boundary, such as offices, compounds, material storage areas and worksites, for example as a result of stormy weather.

15.8.21 The key climate change hazards that could impact the Project during the construction phase and the adaptation methods to increase the resilience of the Project are detailed in **Table 15-23**.

Effects during Operational Phase

15.8.22 The key climate change hazards that could impact the Project during the operational phase and the adaptation methods to increase the resilience of the Project are detailed in **Table 15-24**.

15.8.23 **Table 15-24** also presents the assessment of significance of effects using the likelihood criteria, consequence criteria and significance criteria presented in **Table 15-5**, **Table 15-6** and **Table 15-7** respectively.

Preliminary Significance

Climate Change Resilience Assessment

15.8.24 Potential climate risks to the construction and operation phases, including the likelihood, consequence and significance are detailed in **Table 15-23** and **Table 15-24**.

15.8.25 Future climate change projections have been reviewed, and the sensitivity of assets has been examined before commenting on the adequacy of the climate change resilience measures built into the Project. As a result of the proposed resilience measures, no significant climate change risks during the construction and operation phases have been identified.

Greenhouse Gas Assessment

Table 15-19: Contribution of the Project's GHG Emissions to the UK Carbon Budgets

Carbon budget period	Lifecycle Stage	Carbon budget (tCO_2e)	Project GHG emissions (tCO_2e)	Percentage of Carbon Budget from Project
4th (2023-2027)	Construction & Operation	1,950,000,000	69,897	0.0358%
5th (2028-2032)	Operation	1,725,000,000	1,239	0.00007%
6th (2033-2037)	Operation	965,000,000	573	0.00006%
Projected Carbon Budgets				
7th (2038 – 2042)	Operation	526,000,000	351	0.00007%
8th (2043 – 2047)	Operation	195,000,000	231	0.00012%
9th (2048 – 2050)	Operation	17,000,000	102	0.00060%

15.8.26 Based on the significance criteria laid out in **Table 15-7** it can be determined on a preliminary basis that the Project within its Draft Order Limits will likely result in a **Minor Adverse** effect on the climate that is **Not Significant**.

15.8.27 Beyond the Draft Order Limits, the Project forms part of a wider Viking CCS Project to abate carbon emissions from large industrial emitters at the Immingham Industrial Site. This broader project will result in a significant reduction in carbon emissions based on projected carbon capture rates. These avoided indirect emissions will far outweigh any direct emissions resulting from the operations of the Project over its operational lifetime.

15.8.28 On this basis, the Project as part of the wider Viking CCS Project causes a reduction in atmospheric GHG concentrations compared to the 'Do Nothing' Scenario. Therefore, based on the IEMA Significance guidance in **Table 15-7**, the Project within the wider CCS scheme will result in a **Beneficial** effect on the climate that is **Significant**.

15.8.29 To further supplement the reporting of Significance concise summary tables have been produced (see **Table 15-20**, **Table 15-21** and **Table 15-22**) below.

Table 15-20: Summary of Construction Impacts

Receptor	Potential Impact	Duration	Mitigation	Likely significance of effect	Confidence in Prediction
Climate	Effect of GHG emissions on the global climate	Long term impacts: Impacts from Project activities whose effects will occur for longer than 2 year.	Mitigation measures are stated in Section 15.7.	Based on the significance criteria as set out in Section 15.4 the Project is **Not Significant** (Minor Adverse).	The confidence rating attached to the climate change assessment is **Moderate**. The information presented in this PEIR on likely construction activities and use of products/materials required for the Project is preliminary. For the Environmental Statement (ES), a full description of construction activities and products/materials information will be available for the full climate assessment, which will increase the confidence in the assessment outcome to high.

Table 15-21: Summary of Operational Impacts

Receptor	Potential Impact	Duration	Mitigation	Likely significance of effect	Confidence in Prediction
Climate	Effect of GHG emissions on the global climate	Long term impacts: Impacts from Project activities whose effects will occur for longer than 2 year.	Mitigation measures are stated in Section 15.7.	Based on the significance criteria as set out in Section 15.4 the Project within the Draft Order Limits is **Not Significant** (Minor Adverse). The wider Viking Project including GHG activities occurring outside the Draft Order Limits is **Significant (Beneficial)** based on the significance as set out in Section 15.4.	The confidence rating attached to the climate change assessment is **Moderate**. The information presented in this PEIR on the operation and maintenance of the Project is preliminary. For the Environmental Statement (ES), a full description of required operational and maintenance of the Project will increase the confidence in the assessment outcome to high.

Table 15-22: Summary of Decommissioning Impacts

Receptor	Potential Impact	Duration	Mitigation	Likely significance of effect	Confidence in Prediction
Climate	Effect of GHG emissions on the global	Medium term impacts: Impacts from Project activities that will last more than 3 months, and whose effects may continue after the completion of the project activity but will in total be less than 2 years.	Mitigation measures are stated in Section 15.7.	Based on the significance criteria as set out in Section 15.4 the Project is **Not Significant** (Minor Adverse).	The confidence rating attached to the climate change assessment is **Low**. For the preliminary climate change assessment, the full decommissioning strategy had not been developed. However, it is anticipated that GHG impacts as a result of decommissioning activities will be low, and it is not likely that this will have a material impact on the climate due to the Project.

Table 15-23: Climate Change Resilience Assessment Summary: Construction Phase

Potential climate changes	Potential impacts on the Project	Adaptation / Resilience measures	Likelihood of climate related impact occurring (2020-2049) (Probability of Occurrence based on Table 15-5)	Measure of Consequence occurring (based on Table 15-6)	Significance Level (2020-2049) (based on Table 15-9)
Increased frequency and severity of extreme weather events	Damage to construction equipment due to storm events or intense rainfall. Damage to drainage systems, gutters and downpipes due to flooding from intense rainfall. Flooding from drainage systems during intense or prolonged rainfall.	*Chapter 11: Water Environment* of the PEIR includes: • Establish the location and condition of existing land drainage and compile a record. Subject to landowner/occupier agreement, existing drains should be restored, or new drains established to help prevent damage to soil structure, maintain work areas in a dry condition and to enable current drainage systems to continue to operate through the construction period.	Possible	Low	Low (Not Significant)
Increased winter precipitation	Flooding from drainage systems during intense or prolonged rainfall. Restricted access to sites (such as heavy rain resulting in flooding of heavy roads sources of power supply or inundation of sites) Water-logged land due to prolonged rainfall which inhibits the movement of construction machinery Flooding of the construction sites Damage to equipment	*PEIR Volume IV: Appendix 3.1: Preliminary Draft CEMP* of the PEIR includes: • Establish a Flood Warning and Evacuation Plan which contains information on flood emergency response actions. • Surface water runoff from the pipeline spread will be managed to prevent discharge of silted water into any surface watercourse or drain. Details to be included in the Drainage Management Plan. • Where necessary and subject to agreement with the landowner/occupier, new field drains will be installed to aid recovery from the construction activities and ensure site work areas are appropriately drained.	Possible	Low	Low (Not Significant)
Increased Summer Temperatures	Potential damage to access roads due to prolonged exposure to high intensity temperatures. Overheating of equipment/machinery Increased heat stress/heat exhaustion of workers	*PEIR Volume IV: Appendix 3.1: Preliminary Draft CEMP of the PEIR includes:* • Infrastructure and equipment should be designed with materials that can withstand future temperature increases. • Provide workers with access to drinking water and sunscreen to mitigate against effects of dehydration and heat exhaustion.	Possible	Low	Low (Not Significant)

Table 15-24: Climate Change Resilience Assessment Summary: Operation Phase

Potential climate changes	Potential impacts on the Project	Adaptation / Resilience measures	Likelihood of climate related impact occurring (2020-2049) (Probability of Occurrence based on Table 15-5)	Likelihood of climate related impact occurring (2040-2069) (Probability of Occurrence based on Table 15-5)	Measure of Consequence occurring (Table 15-6)	Significance Level (2020-2049) (based on Table 15-9)	Significance Level (2040-2069) (based on Table 15-9)
Increased frequency and severity of extreme weather events	Damage to equipment due to storm events or intense rainfall. Damage to drainage systems, gutters and downpipes due to flooding from intense rainfall. Flooding from drainage systems during intense or prolonged rainfall.	*Chapter 11: Water Environment* of the PEIR includes: • Following installation of the pipeline, topsoil and excavated material will be reinstated and a post-construction drainage system installed to ensure no detriment to the existing land drainage regime.	Possible	Possible	Low	Low (Not Significant)	Low (Not Significant)
Increased winter precipitation	Flooding from drainage systems during intense or prolonged rainfall. Restricted access to sites (such as heavy rain resulting in flooding of heavy roads sources of power supply or inundation of sites) Water-logged land due to prolonged rainfall which inhibits the movement of construction machinery Flooding of the sites Damage to equipment	*PEIR Volume IV: Appendix 3.1: Preliminary Draft CEMP* of the PEIR includes: • Establish a Flood Warning and Evacuation Plan which contains information on flood emergency response actions. • Surface water runoff from the pipeline spread will be managed to prevent discharge of silted water into any surface watercourse or drain. Details to be included in the Drainage Management Plan.	Possible	Possible	Low	Low (Not Significant)	Low (Not Significant)
Increased Summer Temperatures	Potential damage to equipment and infrastructure due to prolonged exposure to high intensity temperatures resulting in overheating of equipment/machinery.	*PEIR Volume IV: Appendix 3.1: Preliminary Draft CEMP* of the PEIR includes: • When designing the Project in detail, ensure sufficient shading is provided where equipment/machinery is stored. • Key access roads should be designed with materials that can withstand future temperature increases.	Possible	Possible	Low	Low (Not Significant)	Low (Not Significant)

Potential climate changes	Potential impacts on the Project	Adaptation / Resilience measures	Likelihood of climate related impact occurring (2020-2049) (Probability of Occurrence based on Table 15-5)	Likelihood of climate related impact occurring (2040-2069) (Probability of Occurrence based on Table 15-5)	Measure of Consequence occurring (Table 15-6)	Significance Level (2020-2049) (based on Table 15-9)	Significance Level (2040-2069) (based on Table 15-9)
Sea Level Rise	Flooding of the Theddlethorpe Facility; Damage to Infrastructure and Equipment	N/A	Unlikely	Possible	Very Low	Low (Not Significant)	Low (Not Significant)

15.9 References

Ref 15-1 Her Majesty's Stationery Office (HMSO) (2017) The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. Available at: http://www.legislation.gov.uk/uksi/2017/572/pdfs/uksi_20170572_en.pdf [Accessed 11 August 2022].

Ref 15-2 HMSO (2008) Climate Change Act 2008. Available at: http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf [Accessed 11 August 2022].

Ref 15-3 Met Office (2021). UK Climate Averages (online). Available: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages [Accessed 10 August 2022]

Ref 15-4 UK Climate Impacts programme (UKCIP) (2018) UK Climate Projections 2018 (UKCP18). Available at: https://www.metoffice.gov.uk/research/collaboration/ukcp [Accessed 10 August 2022].

Ref 15-5 HMSO (2009) The Carbon Budgets Order 2009. Available at: http://www.legislation.gov.uk/uksi/2009/1259/pdfs/uksi_20091259_en.pdf [Accessed 10 August 2022].

Ref 15-6 UNFCCC (2016). Conference of the Parties, Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015. FCCC/CP/2015/10 (online). Available: https://unfccc.int/sites/default/files/resource/docs/2015/cop21/eng/10a01.pdf [Accessed 10 August 2022]

Ref 15-7 UK Government (2020). United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution (online). Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/943618/uk-2030-ndc.pdf [Accessed 10 August 2022]

Ref 15-8 HMSO (2019) The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/ukdsi/2019/9780111187654. [Accessed 10 August 2022]

Ref 15-9 Department of Energy and Climate Change (DECC) (2011) Overarching National Policy Statement for Energy (EN-1) and National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf and https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47857/1941-nps-gas-supply-oil-en4.pdf [Accessed 11 August 2022].

Ref 15-10 Ministry of Housing, Communities and Local Government (MHCLG) (2021) National Planning Policy Framework (NPPF). Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed 11 August 2022].

Ref 15-11 MHCLG (2014, updated March 2019) National Planning Practice Guidance: Climate Change. Available at: https://www.gov.uk/guidance/climate-change [Accessed 11 August 2022].

Ref 15-12 Department for Business, Energy & Industrial Strategy (BEIS) (2021) .Net Zero Strategy: Build Back Greener. Available at: https://www.gov.uk/government/publications/net-zero-strategy [Accessed 13 August 2022].

Ref 15-13 IEMA (2022). Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (online). Available: https://www.iema.net/preview-document/assessing-greenhouse-gas-emissions-and-evaluating-their-significance [Accessed 15 August 2022]

Ref 15-14 IEMA (2020). Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (online). Available: https://www.iema.net/resources/news/2020/06/26/iema-launch-timely-new-eia-guide-for-climate-change-resilience-and-adaptation. [Accessed 15 August 2022]

Ref 15-15 WRI & WBCSD (2015). The GHG Protocol. A Corporate Accounting and Reporting Standard. Revised Edition (online). Available: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf [Accessed 10 August 2022]

Ref 15-16 Defra (2009). Guidance on how to measure and report your greenhouse gas emissions (online). Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69282/pb13309-ghg-guidance-0909011.pdf [Accessed 10 August 2022]

Ref 15-17 BEIS (2022). Greenhouse Gas Reporting: Conversion Factors 2022 (online). Available: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021 [Accessed 10 August 2022]

Ref 15-18 University of Bath (2019). The Inventory of Carbon and Energy. Version 3 (online). Available: https://circularecology.com/embodied-carbon-footprint-database.html [Accessed 15 August 2022]

Ref 15-19 Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., Sparks, T., and Garforth, J. (2020). State of the UK Climate 2019. International Journal of Climatology. Volume 40, Number S1, July 2020.The Royal Meteorological Society Journal of Climate Science (online). Available: https://rmets.onlinelibrary.wiley.com/doi/epdf/10.1002/joc.6726 [Accessed 10 August 2022]

Ref 15-20 Department of Energy and Climate Change (2013). Guidance on Annual Verification for emissions from Stationary Installations.

Ref 15-21 North Lincolnshire (2011) Local Development Framework. Available at:https://www.northlincs.gov.uk/planning-and-environment/planning-policy-local-development-framework/#1591178700859-b856fc83-069c [Accessed 12 August 2022]

Ref 15-22 North Lincolnshire (2017) Carbon Management Plan 2017-2022. Available at: https://www.northlincs.gov.uk/wp-content/uploads/2019/05/Carbon-Management-Plan-2017.pdf [Accessed 12 August 2022]

Ref 15-23 North East Lincolnshire Council (2016) Environmental Policy Statement. Available at: http://www.nelincs.co.uk/wp-content/uploads/2016/10/Environment-Policy-Final-June-16.pdf [Accessed 12 August 2022]

Ref 15-24 East Lindsey District Council (2020) Environment Policy. Available at: https://www.e-lindsey.gov.uk/media/17771/Environment-Policy-

FINAL/pdf/Environment_Policy_FINAL.pdf?m=637468277570800000 [Accessed 12 August 2022]

Ref 15-25 West Lindsey District Council (2021) Sustainability, Climate Change and Environment Strategy. Available at: https://www.west-lindsey.gov.uk/my-services/my-community/sustainability-climate-change-and-environment/sustainability-climate-change-and-environment-strategy/ [Accessed 12 August 2022]

Ref 15-26 Climate Change Committee (2020) The Sixth Carbon Budget - The UK's path to Net Zero. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget/ [Accessed 16 August 2022]

Ref 15-27 European Committee for Standardisation (2012). BS EN 15804:2012 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products. Available at: https://standards.globalspec.com/std/14306124/EN%2015804 [Accessed 28 September 2022]

Ref 15-28 British Standard Institution (2011). PAS 2050:2011. Specification for the assessment of the life cycle greenhouse gas emissions of goods and services. Available at: https://www.en-standard.eu/pas-2050-2011-specification-for-the-assessment-of-the-life-cycle-greenhouse-gas-emissions-of-goods-and-services/ [Accessed 28 September 2022]

Ref 15-29 IPCC (2014). Fifth Assessment Report 2014 [online]. Available at: https://www.ipcc.ch/assessment-report/ar5/ [Accessed 28 September 2022]

Ref 15-30 IPCC (2021). Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Available at: https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/ [Accessed 28 September 2022]

Ref 15-31 HM Treasury (2020). The Green Book. Available at: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020 [Accessed 29 September 2022]

Ref 15-32 Department for Tranport (2020). Transport Decarbonisation Plan. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/932122/decarbonising-transport-setting-the-challenge.pdf#:~:text=The%20Transport%20Decarbonisation%20Plan%20%28TDP%29%20will%20set%20out,every%20single%20mode%20of%20transport%20by%202050.%20 [Accessed 09 November 2022]