Cottam Solar Project

Environmental Statement Chapter 7:
Climate Change

Prepared by Bureau Veritas
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Cottam
SOLAR PROJECT

Contents

Issue Sheet

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DCO Submission

Environmental Statement Chapter 7: Climate Change

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7 Climate Change

7.1 Introduction

7.1.1 This Chapter of the ES presents the findings of the Environmental Impact Assessment concerning the potential impacts of the Scheme on the Climate during the construction, operation and maintenance and decommissioning stages. The resilience of the Scheme to physical impacts caused by climate change has also been considered.

7.1.2 The following aspects will be evaluated in the climate change assessment process and will align with the requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations (2017) (Ref 7.1):

- Lifecycle greenhouse gas (GHG) impact assessment – The impact of GHG emissions arising from the Scheme on the climate over its lifetime;
- Climate Change resilience (CCR) Review – The resilience of the Scheme to climate change impacts; and
- In-combination Climate Change Impact (ICCI) – The combined impact of the Scheme and future climate change on the receiving environment.

7.1.3 This Climate Change Assessment has been undertaken by Bureau Veritas (see Statement of Competence **[EN010133/APP/C6.3.1.1]**).

7.2 Consultation

7.2.1 For this Scheme, the stakeholders that have been involved are statutory consultees, landowners, local communities, land managers and heritage groups.

7.2.2 Since September 2021, monthly meetings have been scheduled with all four host authorities involved in the Scheme (Lincolnshire County Council, Nottinghamshire County Council, Bassetlaw District Council and West Lindsey District Council). Climate change has been part of the discussions during these meetings.

7.2.3 The following table (Table 7.1) outlines the consultation to date and at what stage of the project this took place.

Table 7.1 – Main Matters Highlighted During Consultation

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Planning Inspectorate (EIA Scoping March 2022)	The ES should also consider how other developments cumulatively may affect the vulnerability of the Proposed Development to climate change e.g. any changes in flood flows, and cumulative GHG emissions/savings.	This has been addressed within the ES. In particular, three other nearby major Solar Projects have been taken into consideration (West Burton, Tillbridge and Gate Burton Solar Projects)	Cumulative Assessment (Ref 7.11 of this Chapter)
Planning inspectorate (EIA Scoping March 2022)	The ES should utilise the most up to date modelling available.	Latest UK Climate Projections (UKCP) and EA modelling has been used in the CCR and Hydrology assessment.	Referenced throughout
Bassetlaw District Council (EIA Scoping March 2022)	It is considered that a full climate change chapter should be scoped into the ES rather than a proportionate one to allow a full assessment to be undertaken in this regard.	Climate Change scoped into ES	n/a
Lincolnshire County Council (EIA Scoping March 2022)	The potential for a microclimate to be created by battery storage.	The design of the battery storage will allow for natural ventilation in order to prevent a microclimate from being generated.	Scheme Design
Lincolnshire County Council (EIA Scoping March 2022)	What is the energy consumption and associated carbon emissions of the battery system?	This is included within the ES	GHG assessment (Ref 7.8)

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Lincolnshire County Council (EIA Scoping March 2022)	What are the carbon emissions associated with the solar PV panels themselves –separated into manufacture, operation, and maintenance (and which panels are to be used – poly, multi, single crystal silicon)? Is the embedded carbon associated with the panel manufacture included in any payback of carbon (bearing in mind that the panels are likely to be imported)?	Solar Panel Types are Bifacial monocrystalline panels. Embodied carbon assessed as part of GHG assessment	GHG assessment (Ref 7.8)
Lincolnshire County Council (EIA Scoping March 2022)	Power losses and associated carbon footprint of connecting cables to the grid need estimating	Details on cabling are included and assessed as part of the GHG assessment	GHG assessment (Ref 7.8)
Lincolnshire County Council (EIA Scoping March 2022)	With regard to greenhouse Gas Emissions this should be directly compared to the number of years it will take for development to be carbon neutral. However, to get a true reflective understanding of the benefits/harm to the environment it should be compared to a least one fossil fuel, nuclear and at least one alternative renewable energy. It is considered that by doing this the clear environmental benefits should be highlighted and allow for careful consideration against the impacts of the development.	Assessed as part of GHG assessment	GHG assessment (Ref 7.8)
Natural England (EIA Scoping March 2022)	The ES should identify how the development affects the ability of the natural Environment to adapt to climate change, including, its ability to provide adaption for people.	CCR assessment included	CCR assessment (Ref 7.8)
University of Derby on behalf of Lincolnshire	Several queries, responses to which are provided below	Meeting with Lanpro, BV, UoD and LCC on 13/9/22	Discussed below

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
County Council (PEIR Response July 2022)			
Natural England (PEIR Response July 2022)	Consideration of net zero by 2050.	Calculation of Carbon Neutrality included	Ref 7.8

7.2.4 The following information is provided in response to queries raised on behalf of Lincolnshire County Council during the Statutory Consultation stage (July 2022).

7.2.5 The yearly production number for periods between 1994 -2018 of 1,100 kWh/kWp is based on fixed mounting structures and monofacial solar modules. The DCO application will retain the option to build either fixed mounting structures; or tracking mounting structures. Tracking mounting structures present a worst case scenario from a Climate Change perspective as additional materials are required compared to a fixed structure and therefore have been assessed in the ES. The current design is based on tracking mounting structures with backtracking technology, bifacial high efficiency modules. All these updated components will increase the energy output of the PV projects.

7.2.6 Single-axis tracking technology will be used as part of the design – axis oriented N-S with modules rotating E-W tracking with backtracking strategy for tracking arrays: when the mutual shadings begin, the tracking angle does not follow the sun anymore, but it instead goes back (decreases) so that no shading occurs. Generally, a solar panel system with a single-axis solar tracker installed sees a performance gain of anywhere between 10 to 30 percent compared to a fixed mounting system.

7.2.7 The proposed Energy Storage Facility (or BESS) will be located at Cottam 1. Following consultation with typical battery suppliers, for the purpose of the calculation of Greenhouse Gas Emissions, the batteries have been assessed as being replaced once over the anticipated 40 year lifespan of the project. The batteries will be recycled insofar as practical and with the technology available at the time of replacement.

7.2.8 The maximum total energy storage capacity assumed for the purpose of this assessment is either:

- Option A – 1,357MWh

- Option B – 2,773 MWh

7.2.9 A description of the Energy Storage Facility is provided in Chapter 4 of the ES 'Scheme Description' **[EN010133/APP/C6.2.4]**.

7.2.10 In response to queries raised by Derby University, acting on behalf of Lincolnshire County Council, during the consultation process, reference is made to National Grid's document on Future Energy Scenarios (7.35). As part of this, one of the key recommendations is to increase Wind and Solar energy generation to 66% of all energy generated of Britain's energy supply by 2030.

7.3 Policy Context

7.3.1 The following legislation, planning policy and guidance relating to climate change is relevant to the Scheme:

- Climate Change Act 2008 (Ref 7.2)
- Climate Change Act 2008 (2050 target amendment) (Ref 7.3)
- Carbon Budgets Order (2009) (Ref 7.4) Carbon Budget Order (2011) (Ref 7.5), Carbon Budget Order (2016) (Ref 7.6), Carbon Budget Order (2021) (Ref 7.7)
- National Policy Statement (NPS) EN-1 (Ref 7.8), with particular reference to paragraphs 2.2.9 and 4.8.2 in relation to climate impacts and adaptation; paragraphs 4.1.3 to 4.1.4 in relation to adverse effects and benefits; paragraphs 4.2.1, 4.2.3, 4.2.4, 4.2.8 to 4.2.10 in relation to Environmental Statement assessment methodology; 4.5.3 and 4.8.1 to 4.8.12 in relation to adaptation measures in response to climate projections; and paragraphs 5.7.1 to 5.7.2 in relation to climate projections, flood risk and the importance of relevant mitigation.
- The Revised (Draft) National Policy Statements for Energy; Business, Energy and Industrial Strategy Committee (Ref 7.9) has also been reviewed for relevant emerging policy;
- NPS EN-5 (Ref 7.10) – paragraph 2.4.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.4.2 in relation to ES requirements regarding climate change resilience. Draft update to NPS EN-5 (Ref 7.11) paragraph 2.6 in relation to Climate Change resilience.
- National Planning Policy Framework (NPPF) (Ref 7.12) – paragraphs 8, 20 and 149 in relation to adaptation, mitigation and climate change resilience; paragraphs 148 and 157 in relation to flood risk and damage to property and people; paragraphs 150 and 153 in relation to reduction of CO_2 emissions

through design and reduced energy consumption; and paragraphs 155 to 165 in relation to climate projections, associated flood risk and adaptation.

- Planning Practice Guidance, Climate Change (March 2019) (Ref 7.13)
- Lincolnshire County Council Carbon Management Plan (2019) (Ref 7.14)
- Nottinghamshire County Council Carbon Management Plan (2007) (Ref 7.15)
- West Lindsey District Council Sustainability, Climate Change and Environment Strategy (2021) (Ref 7.17)
- Central Lincolnshire draft Local Plan- in relation to Climate Change (Ref 7.18)
- Bassetlaw District Council Renewable and Low carbon study (2010) (Ref 7.19)
- Bassetlaw draft Local Plan (Ref 7.20), specifically policy ST50: Climate Change Mitigation and Adaptation

Climate Change Act 2008

7.3.2 The Climate Change Act 2008 sets a target year of 2050 for the reduction of targeted greenhouse gas emissions.

Carbon Budgets Order

7.3.3 As set out by the UK Government, under a system of carbon budgets, every tonne of greenhouse gases emitted between now and 2050 will count. Where emissions rise in one sector, the UK will have to achieve corresponding falls in another.

7.3.4 The Carbon Budgets have been used within this assessment to inform whether development emissions would be significant.

National Policy Statement

7.3.5 National Planning Policy Statement (NPS) EN-1 is the overarching policy statement for Energy. NPS EN-3 is focused on Renewable Energy and NPS EN-5 is focused on Electricity Network Infrastructure.

7.3.6 Section 1.7.5 of NPS EN-1 states that *As required by the SEA Directive, Part 3 of the AoS of EN-1 also includes an assessment of reasonable alternatives to the policies set out in EN-1 at a strategic level. In particular, this involved a generic assessment of alternatives which placed more emphasis on three key drivers of policy which are highly relevant to the planning context: securing low cost energy (Alternative A1); reducing greenhouse gas emissions (Alternative A3); and reducing other environmental impacts of energy infrastructure development (Alternative A4)*

7.3.7 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.

National Planning Policy Framework (2021)

7.3.8 Paragraph 153 of the National Planning Policy Framework (NPPF) states that, *"153. Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."*

Planning Practice Guidance

7.3.9 The planning practice guidance supplements the NPPF states and states: *In addition to supporting the delivery of appropriately sited green energy, effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases. In doing so, local planning authorities should ensure that protecting the local environment is properly considered alongside the broader issues of protecting the global environment. Planning can also help increase resilience to climate change impact through the location, mix and design of development.*

Lincolnshire County Council Carbon Management Plan (2019)

7.3.10 This document sets out the County Council's 5-year Carbon Management Plan. It seeks to '*Ensure local and structural development plans are updated with latest climate projections. Some of the measures that could build resilience to weather and climate-related hazards, such as building codes and zoning regulations, may be less effective if they are not regularly updated to incorporate the latest climate change projections, as well as other changes including shifts to societal structures, demography, environmental degradation, poverty and inequality. Policy tools for urban and country planning should incorporate climate change mitigation, climate change adaptation and disaster risk management considerations and good practice.'*

Central Lincolnshire draft Local Plan

7.3.11 The Central Lincolnshire Draft Local Plan has been reviewed for relevant policies to this ES Chapter.

7.3.12 *Policy S15: Wider Energy Infrastructure The Joint Committee is committed to supporting the transition to net zero carbon future and, in doing so, recognises and* *supports, in principle, the need for significant investment in new and upgraded energy infrastructure. Where planning permission is needed from a Central Lincolnshire authority, support will be given to proposals which are necessary for, or form part of, the transition to a net zero carbon sub-region, which could include: energy storage facilities (such as battery storage or thermal storage); and upgraded or new electricity facilities (such as transmission facilities, sub-stations or other electricity infrastructure. However, such proposals should take all reasonable opportunities to mitigate any harm arising from such proposals, and take care to select appropriate locations for such facilities thereby minimising harm arising.*

Bassetlaw draft Local Plan,

7.3.13 The Bassetlaw draft Local Plan has been reviewed for policies relevant to this ES Chapter and the following considered relevant and referenced for the production of this assessment.

7.3.14 *POLICY ST50: Reducing Carbon Emissions, Climate Change Mitigation and Adaptation 1. All proposals, including the change of use of existing buildings and spaces, should seek to reduce carbon and energy impacts in their design and construction in accordance with Policy ST35. Proposals should incorporate measures that address issues of climate change mitigation through:*

a) ensuring no adverse impact on local air quality;

b) directing development towards locations that minimise the need to travel and maximise the ability to make trips by sustainable modes of transport; Bassetlaw Local Plan 2020-2037: Publication Version August 2021 175

c) incorporating passive and energy efficient materials and/or technologies where appropriate;

d) requiring compliance with relevant national building standards such as meeting BREEAM very good-excellent standards;

e) promoting the retrofitting of existing buildings, including incorporating measures to reduce energy consumption;

f) providing for electric vehicle charging capability and charging infrastructure in new development, and/or providing infrastructure that supports car-free living, particularly in town centres;

g) ensuring that major development makes an appropriate financial contribution to the Bassetlaw carbon offsetting fund;

h) making best use of available opportunities to reduce the impact of climate change on biodiversity and the natural environment by providing space for habitats and species to move through the landscape and for the operation of natural processes;

i) minimising the use of natural resources over the development's lifetime, such as minerals and consumable products, by reuse or recycling of materials in construction, and by making the best use of existing buildings and infrastructure;

2. All new development should be designed to improve resilience to the anticipated effects of climate change. Proposals should incorporate measures that address issues of adaptation to climate change through:

a) designing layouts so that the orientation of buildings and spaces take the opportunity to maximise solar gain;

b) using appropriate materials that enable buildings to ventilate efficiently by day and night;

c) adapting surface materials and drainage design to reduce the risk of flooding to land, property and people as a result of more extreme rainfall in accordance with Policy ST52;

d) promoting water efficiency by residential development meeting the tighter Building Regulations optional requirement of 110 litres per person/per day;

e) using integrated water management systems to manage runoff and provide a nonpotable water supply;

f) providing green/blue infrastructure, and where possible, retaining existing trees and woodlands to reduce the 'urban heating effect' during warmer summers; and

g) using urban greening methods within the design of new buildings.

Sturton Ward Neighbourhood Plan Review 2021 – 2037

7.3.15 Due to the presence of the cable route, the Sturton Ward Neighbourhood Plan has been reviewed. While specific to low carbon homes, the principles of the following section are considered relevant and has been included within the preparation of this ES Chapter:

Policy 12: Energy efficiency, renewable energy and climate change

1. Proposals for the development of low carbon homes that maximise water efficiency and the generation of renewable and low carbon energy resources will be supported where, either individually or cumulatively, it can be demonstrated that adverse impacts have been mitigated.

2. In particular proposals for low carbon homes should...

a) not have an unacceptably adverse impact on the amenity of residents and visitors (including noise, vibration, views and vistas, shadow flicker, water pollution, odour, air quality, emissions, sensitivity and character of landscape);

7.4 Assessment Methodology

7.4.1 The methodologies described in the following section have been developed in line with the relevant planning policy and appropriate industry guidance for assessing GHGs (Ref 7.21) and climate change resilience and adaptation (Ref 7.22) in EIA.

7.4.2 While the lifecycle GHG impact assessment assesses the significance of the GHG impact of the Scheme, the CCR review does not assess the significance as only a review of the impacts is required in line with the Institute of Environmental Management and Assessment (IEMA) guidance.

GHG Impact Assessment

7.4.3 All GHG emissions arising over the course of the Scheme will be assessed through the Lifecycle GHG impact Assessment. Direct emissions from activities taking place within the parcels, indirect emissions from activities outside the Site and embodied carbon within construction materials are all considered as part of the study area for the GHG impact assessment.

7.4.4 The Applicant has provided data and information that underpins the lifecycle GHG impact assessment, which has been evaluated using the methodology set out below.

7.4.5 In line with the GHG Protocol, the potential effects of the Scheme on the climate as a result of the development have been assessed (Ref 7.23). It has been identified that materials and activities will likely produce the greatest amount of GHG emissions and mitigation efforts will concentrate on these priority areas. The IEMA document 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance' has been used to inform the methodology for the GHG impact assessment (Ref 7.21).

7.4.6 The approach to assessing emissions follows the different stages of the scheme including construction, operation and maintenance and decommissioning.

7.4.7 The Department for Business, Energy and Industrial Strategy (BEIS) 2021 emissions factors guidance (as shown below) has been used as a calculation-based methodology for estimating the anticipated GHG emissions arising during the construction, operation and maintenance and decommissioning activities of the Scheme (Ref 7.24):

Activity data x GHG emissions factor = GHG emissions value

7.4.8 The seven Kyoto Protocol GHGs have been considered in this assessment, which are in-line with the 'GHG protocol' (Ref 7.23):

- 1. Carbon dioxide (CO_2);
- 2. Methane (CH_4);
- 3. Nitrous oxide (N_2O);
- 4. Sulphur hexafluoride (SF_6);
- 5. Hydrofluorocarbons (HFCs);
- 6. Perfluorocarbons (PFCs);
- 7. Nitrogen trifluoride (NF_3).

7.4.9 It should be noted that within this assessment, 'GHG emissions' represent all seven Kyoto Protocol GHGs. The unit of $kgCO_2e$, (kilograms CO_2 equivalent) tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (Megatonnes of CO_2 equivalent) captures CO_2 as well as the other greenhouse gases of concern and has been used as the unit to quantify greenhouse gases within this assessment.

Significance criteria

7.4.10 The sensitivity of the receptor (global climate) to increases in GHG emissions is always defined as 'high' as any additional GHG impacts could compromise the UK's ability to reduce its GHG emissions and therefore meet its future 5-year carbon budgets and Net Zero by 2050 target. The extreme importance of limiting global warming to below 2°C this century is broadly asserted by the International Paris Agreement, the United Nations Climate Change Conferences (COP27) and the climate science community.

7.4.11 Standard GHG accounting and reporting practices have been followed to assess the effect of the Scheme. The IEMA guidance states that 'it is up to the GHG practitioner's professional judgement to decide which tool is most appropriate for the project at hand with regards for assessing the magnitude of GHG impacts'. The GHG accounting method is deemed most appropriate for this part of the assessment.

7.4.12 With reference to national carbon budgets, these can be used to investigate the significance of the Scheme's GHG emissions and potential impact to the climate.

7.4.13 Emission sources that are <1% of a given emissions inventory can be excluded through the concept of 'de minimis' contribution. This has been supported by both the Department for Business, Energy and Industrial Strategy and Publicly Available Specification PAS:2050 (2011) (Ref 7.25).

7.4.14 For this assessment, future emissions inventory scenarios have been supported by UK national carbon budgets. At present, the sixth carbon budget (2033 – 2037) has been set and detailed by the Government and formally adopted into legislation before parliament under the Carbon Budget Order 2021 (Ref 7.7). The amount of GHGs that the UK can emit over the 5-year period (2033 – 2037) is 965 million tonnes of carbon dioxide equivalent.

7.4.15 Developments that have emissions <1% of the current carbon budget would unlikely impact the UK's capacity to reach its net zero by 2050 target, as set out in the Climate Change Act 2008 (2050 Target Amendment). Developments which would result in reduction in emissions would also have a positive contribution towards meeting the 2050 target.

7.4.16 The following criteria summarized in Table 7.1 will be used to assess the magnitude of the GHG impact associated with the Scheme, as it is applicable for this type of assessment.

Table 7.2 – GHG Impact Assessment magnitude criteria

Magnitude	Magnitude Criteria
High	GHG emissions >1% of the applicable annual National carbon budget
Low	GHG emissions <1% of the applicable annual National carbon budget

7.4.17 The purpose of the UK national carbon budgets is to the reduce the amount of GHG emissions that the UK can release over the 5-year period (Ref 7.26). At the time of writing, the UK is in the 3rd carbon budget period with the 4th carbon budget commencing in 2023.

7.4.18 It is expected that the construction stage of the Scheme will occur during the 4th national carbon budget (2023 – 2027). The operational stages of the Scheme will occur during the 4th (2023 – 2027), 5th (2028 – 2032) and 6th (2033 – 2037) carbon budgets. As the current carbon budgets are only available up to 2037 and the Scheme is expected to be operational past this; all assumptions past 2037 will use the 6th Carbon Budget. Using professional judgement; the significance of the impacts associated with GHG emissions produced by the Scheme will be determined.

7.4.19 As shown in Table 7.2, the UK national carbon budgets up to 2037 show the future amount of GHG emissions that the UK will be able to emit.

Table 7.3 – National Carbon Budgets

Carbon Budget	Total budget ($MtCO_2e$)
3rd (2018 – 2022)	2,544

4th (2023 – 2027)	1,950
5th (2028 – 2032)	1,725
6th (2033 – 2037)	965

7.4.20 Any amount of increase or reduction in GHG emission is considered significant in relation to the impact on the sensitivity of the global climate. The traditional EIA Criteria is not considered a suitable method for climate change mitigation, as highlighted by IEMA guidance on Assessing GHG emissions and Evaluating their Significance (Ref 7.21). Therefore, for this assessment, the following criteria (Table 7.3) will be used to determine the magnitude of significance.

Table 7.4 – Matrix for the significance of Effects for GHG Impact Assessment

Magnitude	Significance
Low (<1% of carbon budget)	Minor significance
High (>1% of carbon budget)	Major significance

7.4.21 For the purpose of this assessment, 'minor' is not considered a significant effect in EIA terms and 'Major' is considered a significant effect in EIA terms.

7.4.22 As set out in the Climate Change Act 2008 (2050 target amendment); it is mandatory for the UK to reach net zero by 2050 by reducing and offsetting its emissions. Carbon budgets have only been established up to 2037 and budgets beyond 2037 are presently not known. Although it is anticipated that the total budget of emissions will decrease over time; any emissions that are released are likely to be significant as it would impact the UK's ability to achieve future carbon budgets and reach the net zero target by 2050.

Climate Change Resilience Review

7.4.23 For the CCR Review, the Scheme itself; during construction, operation and decommissioning, is considered the receptor. The climate resilience review will provide a description of how the Scheme will be impacted by climate change impacts and how it will be designed to be more resilient to the impacts identified during the review of the UK Climate Projections 2018 (UKCP18) data (Ref 7.26).

7.4.24 UKCP18 data and historic climate data from the Met Office have been acquired to establish the future and historic baseline climate conditions (Ref 7.27).

7.4.25 The Scheme's design has been adapted to include CCR measures as set out within the Hydrology, Flood Risk and Drainage Chapter of the ES **[EN010133/APP/C6.2.10]**.

7.4.26 EIA regulations require information regarding the vulnerability of the Scheme to climate change. An assessment has been developed based on the IEMA 'Environmental Impact Assessment Guide to: Climate Change Resilience and

Adaption' document (Ref 7.21), which assesses the Scheme's resilience to potential impacts caused by climate change.

7.4.27 As part of the review, the Scheme's associated infrastructure and assets will be incorporated. This includes the risks associated with an increased frequency of extreme weather events, as highlighted by UKCP18 projects and the Scheme's resilience against gradual climatic changes.

7.4.28 Vulnerable and sensitive receptors will be identified and the sensitivity of the receptors determined using quantifiable data, where available. The susceptibility and vulnerability of the receptor will be considered alongside its value and importance.

7.4.29 The susceptibility of the receptor will be determined using the following scale:

- **High susceptibility** = receptor has no ability to withstand/not be substantially altered by the projected changes to the existing/prevailing climatic factors (e.g. lose much of its original function and form).
- **Moderate susceptibility** = receptor has some limited ability to withstand/not be altered by the projected changes to the existing/prevailing climatic conditions (e.g. retain elements of its original function and form).
- **Low susceptibility** = receptor has the ability to withstand/not be altered much by the projected changes to the existing/prevailing climatic factors (e.g. retain much of its original function and form).

7.4.30 The vulnerability of the receptor will be determined using the following scale:

- **High vulnerability** = receptor is directly dependent on existing/prevailing climatic factors and reliant on these specific existing climate conditions continuing in future (e.g. river flows and groundwater level) or only able to tolerate a very limited variation in climate conditions.
- **Moderate vulnerability** = receptor is dependent on some climatic factors but able to tolerate a range of conditions (e.g. a species which has a wide geographic range across the entire UK but is not found in southern Spain).
- **Low vulnerability** = climatic factors have little influence on the receptors.

7.4.31 The importance of the receptor is associated with the economic value the receptor represents. Due to the scale of the Scheme this is considered to be high for all receptors.

7.4.32 The likely effects of climate change on the development will be evaluated to identify the magnitude i.e., the degree of change from the relevant baseline conditions. Magnitude is based on a combination of likelihood and consequence.

7.4.33 The criteria to assess the likelihood of climate change impact is defined in Table 7.4. The consequence of the climate risk will be determined using professional judgement and supporting evidence.

Table 7.5 – Criteria to Assess Likelihood of Climate Change Impact

Level of Likelihood	Definition of Likelihood
Very unlikely	It is highly improbable that the impact will occur during the operational phase or the construction phase of the assets or systems.
Unlikely	Impact is not expected to occur during the operational phase or the construction phase of the assets or systems
As likely as not	Impact may occur during the operational phases or the construction phase of the assets or systems
Likely	Impact is expected to occur during the lifespan of the assets or systems or the construction phase.
Very likely	It is highly probable that the impact will occur during the lifetime of assets or systems including the construction phase.

7.4.34 The receptor sensitivity and magnitude of effect will be combined to reach an overall judgement on the significance of the likely environmental effect. As there is no legislative definition of 'significance' the conclusion of whether an effect is significant will be based on the outcomes of the CCR review.

7.4.35 Mitigation measures which have been incorporated into the Scheme will be considered as part of the review of potential impacts. Existing resilience measures that are already present or planned will also be identified by the review.

In Combination Climate Change Impacts

7.4.36 The ICCI assessment methodology has been developed in line with the IEMA 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation' guidance document (Ref 7.22).

7.4.37 The guidance defines an ICCI effect as 'When a projected future climate impact (e.g. increase in temperatures) interacts with an effect identified by another topic and exacerbates its impact. For example, if the biodiversity topic identifies an effect on a habitat or species receptor due to a project/scheme, such as loss of habitat, and in addition projected future higher temperatures will increase the vulnerability of this habitat to fragmentation, this is an ICCI.'

7.5 Assessment Assumptions and Limitations

7.5.1 Assumptions in calculation of GHGs from each source are provided when discussing the methodology used to calculate the total CO_2e for each different source including for construction worker movements. Some more overarching assumptions are included within this section.

Assumptions for Construction Plant

7.5.2 Fuel use for construction plant is not known. It is not expected that emissions from construction plant would be significant and best practice measures are included in the draft Outline Construction and Environmental Management Plan (OCEMP) **[EN010133/APP/C7.1]** to limit emissions during the construction phase.

Assumptions for Embodied Carbon in Production of Materials

7.5.3 All assumptions made within the calculations for estimating the embodied carbon of the materials used for the Scheme have been set out within the individual sections detailed in Section 7.8.

Assumptions for Transport of Materials

7.5.4 As it is anticipated that the PV panels will be sourced from China or a country of similar distance from the UK, there will be an increase in embodied carbon and transport emissions, which would otherwise be lower if sourced from Europe[1]. Therefore, the manufacture and transport of products will likely be the largest sources of GHG emissions from the Scheme.

7.5.5 HGV and sea freight distances assumed for transportation of materials and waste are outlined below. The country of origin for materials have been chosen as Europe and China, and assumptions have been made around the specific ports used based on proximity to relevant manufacturing facilities within each country.

- HGV transport of materials within China prior to sea freight transportation – 150km (based on the average distance of a number of major manufacturing centres in and around Shanghai to the nearest port);
- HGV transport of materials within Europe, including distance prior to, and following, sea freight transportation – 1,750km (based on half of the reasonable maximum distance equipment might be transported within Europe, plus the distance between Dover and the Site);

[1] A supply chain statement (PINS Reference EN010133) forms part of the DCO application and is in accordance with the statement made on Solar Energy UK (Ref 7.33)

- Sea freight distance from China to England –21,880km (based on the sea freight distance between Shanghai and Dover);
- Sea freight distance from Europe to England –50km (based on the sea freight distance between Calais and Dover);

7.5.6 For HGV transportation of materials, the UK Government GHG 2021 Conversion Factors for 'Rigid HGV >7.5-17t' and 'Articulated HGV >3.5 – 33t' has been applied, including well-to-tank (WTT) emissions[2]. It has been assumed that HGVs are 50% laden.

7.5.7 For sea freight transportation, the UK Government GHG 2022 Conversion Factors for 'General Cargo –Average' has been applied, including WTT emissions.

Assumptions for Climate Change Resilience

7.5.8 Climate change projections are subject to uncertainties due to the complexity of the climate system and uncertainty over future greenhouse gas emission levels and modelling uncertainties used to develop the Met Offices predictions.

7.5.9 To address these uncertainties, UKCP18 provides a range of likely climate changes to give a lower and upper estimates. This allows for provision of a greater level of confidence for the magnitude and impact of climate change effects.

7.6 Baseline Conditions

7.6.1 The baseline environmental conditions of the Scheme are described in this section. Additionally, reference to the surrounding area in relation to GHG emissions and climatic conditions is discussed.

GHG impact Assessment

Current Baseline

7.6.2 Due to the nature of the Sites (i.e. Cottam 1, 2, 3a and 3b), which comprises mainly arable land – current baseline GHG emissions are largely derived from agricultural practice. However, this is dependent on the soil, vegetation type present and the fuel use of vehicles and other agricultural machinery.

7.6.3 The current land use is considered to have minor levels of associated GHG emissions. For the purposes of the GHG assessment, a conservative approach assuming the existing Sites have zero baseline emissions has been used.

[2] Well-to-tank emissions, also known as upstream or indirect emissions, are the GHG emissions released into the atmosphere from the production, processing, and delivery of a fuel to the point of use.

Future Baseline

7.6.4 For the lifecycle GHG impact assessment, the baseline is a 'business as usual' scenario whereby the Scheme is not implemented. The baseline comprises existing carbon stock and sources of GHG emissions at the Sites from the existing activities on-site. In this case the future baseline is also based on a zero emissions scenario.

Climate Change Resilience Review

Current Baseline

7.6.5 Historic climate data acquired by the Met Office from the closest Met Office Station to the Scheme (Waddington) for the 30-year climate period of 1981 – 2010 will provide the current baseline for the CCR Review (Ref 7.27). This is summarized in Table 7.6 below.

Table 7.6 - Historic Climate data

Climatic Factor	Month	Figure
Average annual maximum daily temperature (°C)	-	13.6
Warmest month on average (°C)	July	21.5
Coldest Month on average (°C)	February	1.3
Mean annual rainfall levels (mm)	-	614.1
Wettest month on average (mm)	July	59.5
Driest month on average (mm)	February	36.1

Historic 10-year averages for the East and Northeast of England obtained from the Met Office have identified gradual warming and increased rainfall between 1969 – 2018. The table below summarizes these findings.

Table 7.7 – Historic climate data for 10-year averages for temperature and rainfall for the East and Northeast of England region

Climate period	Climate variables	
	Mean Maximum annual temperatures (°C)	Mean annual rainfall (mm)
1969 - 1978	12.0	709.2
1979 - 1988	11.8	792.5
1989 - 1998	12.7	713.5
1999 - 2008	13.2	829.8
2009 - 2018	13.1	785.2

Future Baseline

7.6.6 It is anticipated that the future baseline will be different from the current present-day baseline, due to changes in climate. For this assessment, UKCP18 probabilistic projections have been provided for 20-year periods from 2020 - 2079 and obtained for the following climate variables which includes annual and seasonal changes in climatic conditions over the land area of the Scheme:

- Mean annual air temperature;
- Mean summer air temperature;
- Mean winter air temperature;
- Maximum summer air temperature;
- Minimum winter air temperature;
- Mean annual precipitation;
- Mean summer precipitation;
- Mean winter precipitation;
- Mean annual cloud cover;
- Mean summer cloud cover; and
- Mean winter cloud cover.

7.6.7 A 25 km^2 grid square that encompasses the Scheme's location has been used to analyse the UKCP18 probabilistic projections. Temperature, precipitation, and cloud anomalies are considered relative to the 1981 – 2000 baseline. These variables are illustrated in Table 7.8, Table 7.9 and Table 7.10.

7.6.8 There are a range of different climate scenarios also known as Representative Concentration Pathways (RCPs) used in UKCP18 that help inform future trends in emissions (Ref 7.26). For this assessment RCP 8.5 has been used, which assumes a 'business as usual' pathway for climate change as recommended by the IEMA guidance.

7.6.9 The impact of climate change will be determined over the course of the Scheme's design life, which is estimated to be 40 years for the purpose of the EIA. For the assessment, the climatic impacts of GHG emissions at the 10%, 50% and 90% probability levels up to 2079 are included which covers the assessment up to the 2066 estimated decommissioning date.

Table 7.8 – Predicted changes in temperature variables (°C)

Climate Variable	Time Period		
	2020 – 2039	2040 - 2059	2060 - 2079
Mean annual air temperature anomaly at 1.5 m (°C)	+ 0.99 (+0.33 to +1.66)	+1.75 (+0.83 to +2.73)	+2.7 (+1.23 to +4.25)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.18 (+0.35 to +2.03)	+2.17 (+0.83 to +3.55)	+3.29 (+1.09 to +5.57)
Mean winter air temperature anomaly at 1.5 m (°C)	+0.94 (-0.02 to +1.92)	+1.60 (+0.40 to +2.90)	+2.43 (+0.70 to +4.17)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.27 +(0.19 to +2.43)	+2.43 (+0.76 to +4.22)	+3.67 (+1.03 to +6.44)
Minimum winter air temperature anomaly at 1.5 m (°C)	+0.86 (-0.11 to +1.89)	+1.56 (+0.29 to +3.00)	+2.36 (+0.65 to +4.28)

Table 7.9 – Predicted changes in precipitation variables (%)

Climate Variable	Time Period		
	2020 – 2039	2040 - 2059	2060 - 2079
Annual precipitation rate anomaly (%)	+1.57 (-3.15 to 6.59)	-1.20 (-8.4 to +6.23)	-1.18 (-6.64 to +4.42)
Summer precipitation rate anomaly (%)	-5.44 (-25.22 to +15.00)	-17.27 (-37.91 to +3.84)	-23.85 (-51.34 to +4.07)
Winter precipitation rate anomaly (%)	+3.79 (-5.13 to +13.38	+7.68 (-4.46 to +20.39)	+12.86 (-3.06 to +29.0)

Table 7.10 – Predicted changes in cloud cover variables (%)

Climate Variable	Time Period		
	2020 – 2039	2040 - 2059	2060 - years
Annual total cloud anomaly (%)	-1.66 (-4.74 to +1.14)	-1.20 (-8.4 to +6.23)	-1.18 (-6.64 to +4.42)
Summer total cloud anomaly (%)	-3.64 (-10.34 to +2.69)	-8.21 (-18.51 to +1.88)	-23.85 (-51.34 to +4.07)
Winter total cloud anomaly (%)	-0.19 (-2.15 to +1.62)	+0.13 (-2.01 to +2.06)	+5.22 (-1.65 to +2.68)

7.6.10 For the Climate Change Resilience Review, the Scheme and all associated infrastructure and assets are considered as a sensitive receptor.

7.7 Embedded Design Mitigation

7.7.1 Various GHG mitigation measures are embedded within the Scheme and are included within the Outline Construction Environmental Management Plan

[EN010133/APP/C7.1] and Outline Construction Traffic Management Plan **[EN010133/APP/C6.3.14.1]** accompanying the DCO application and these measures are secured by a Requirement in the draft DCO.

7.7.2 This embedded mitigation will be implemented to reduce the GHG impact of the Scheme. Specific embedded mitigation measures include:

- Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable;
- Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Scheme by employing good industry practice measures;
- Designing, constructing and implementing the Scheme in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content where feasible;
- Reusing suitable infrastructure and resources already available within the Sites where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements);
- Encouraging the use of lower carbon modes of transport by identifying and communicating local bus connections and pedestrian and cycle access routes to/ from the Scheme to all construction staff, and providing appropriate facilities for the safe storage of cycles;
- Liaising with construction personnel for the potential to implement staff minibuses and car sharing options;
- Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Scheme;
- Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and
- Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.

7.7.3 Regular planned maintenance of the Scheme will also be conducted during operation to optimise efficiency.

7.7.4 An Outline Decommissioning Statement **[EN010133/APP/C7.2]** has been included with the application. Similar measures to the CEMP will be developed prior to the decommissioning phase to encourage the use of lower-carbon and more climate change resilient methods. It would not be appropriate to specify such requirements now as the decommissioning environment beyond 2065 is likely to be considerably different to today.

7.7.5 Further climate change resilience measures embedded within the Scheme, particularly in relation to flood risk, are outlined below. The specific flood risk impacts and associated mitigation measures are discussed in more detail in Chapter 10: Hydrology, Flood Risk and Drainage, of the ES **[EN010133/APP/C6.2.10]** and include:

- Access to the Site during construction and operation will be taken from permeable and existing farm tracks accessed from the local highway network. This limits the potential for increased surface water runoff rates and sedimentation effects during construction.
- Non-flood sensitive infrastructure forming the wider development (PV arrays and cabling) have been sequentially located outside the 1 in 100 plus climate change annual probability extent (1% +CC) or where this is not possible restricted to areas which experience less than 1 m depth of flooding during the same event. Depending on the final type of panel chosen, during a flood event the lowest point of the panels will be at least 0.6m off the ground. For areas of flooding higher panels may be considered as a mitigation strategy (see Chapter 10: Hydrology, Flood Risk and Drainage), and would need to be elevated 600mm above the flood level.
- Critical infrastructure within the Scheme (the conversion units, substations and energy storage compounds) have been sequentially located within Zone 1, an area with a "Low probability of flooding" and therefore in land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

7.7.6 Health and safety plans and risk assessments developed for construction and decommissioning activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves. This will include for the provision of flood defence equipment (e.g. sandbags) on site and best practice health management measures for construction staff working in heat such as wearing loose clothing, staying hydrated and applying sun protection.

7.8 Assessment of Likely Impacts and Effects

GHG Impact Assessment

7.8.1 For each lifecycle stage of the Scheme (production, construction, operation and maintenance, and decommissioning), the associated GHG emissions are identified and assessed.

7.8.2 A summary of the anticipated GHG emissions arising from the Scheme are shown below:

Table 7.11: Possible sources of GHG emissions

Lifecycle Stage	Activity	Primary emission sources
Construction Stage	The extraction of raw materials and manufacturing of products necessary to make equipment. This stage is anticipated to create a significant input to GHG emissions, due to the materials that contain high levels of embodied carbon, complex manufacturing processes and equipment design.	GHG emissions that are embodied within the product. GHGs that are produced during manufacturing
	Construction activity on-site. Construction materials that are transported and not integrated in embodied GHG emission. Equipment required is likely to require shipment, due to overseas origin. Construction workers that would need transportation to the site. Waste produced during the construction process that need to be disposed. Water use	Energy consumption on-site. Commuting construction workers. Transportation of materials to the sites and the amount of fuel consumed. Transportation of workers to the sites and resulting GHG emissions. GHG emissions produced from the transportation and removal of waste materials Treatment of wastewater and supply of potable water
Operation Stage	Scheme operation Scheme maintenance Replacement materials (i.e. batteries and replacement panels)	GHG emissions from maintenance. The operational aspects are expected to be negligible in the context of overall GHG emissions. Emissions from routine maintenance are expected to be negligible. However, the periodic replacement of

Lifecycle Stage	Activity	Primary emission sources
	Water use on site for fire suppression and cleaning panels	components has the potential to have significant impacts given the complexity of the equipment involved.
Decommissioning Stage	Decommissioning activity occurring on-site	Energy consumption of on-site vehicles and generators.
	Removal and transportation of any waste materials	GHG emissions generated from the transportation and disposal of waste materials. This has the potential to be significant given the complexity of the design of the equipment, and the use of materials with high associated waste treatment emissions.
	Workers that would need to be transported to the site	Transportation of workers to site and resulting GHG emissions

7.8.3 For the purposes of this assessment, it has been considered that any increase in GHG emissions compared to the baseline has the potential to have an impact, due to the high sensitivity of the receptor (global climate) to increases in GHG emissions. This is in line with the IEMA guidance (Ref 7.21), which states that all GHG emissions have the potential to be significant. The application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments. GHG impacts will be put into context in terms of their impact on the UK's 5-year carbon budgets, including sub-sectoral budgets for energy generation, which set legally binding targets for GHG emissions.

7.8.4 While it is important to understand the GHG impacts at each individual lifecycle stage, it is also important to understand the net lifecycle GHG impact of the Scheme due to the long-term, cumulative nature of GHG emissions over the assessed lifetime of the Scheme.

7.8.5 Therefore, the net impact of the Scheme is also identified and assessed, taking into account the renewable energy generation and the benefit of this in the context of the wider energy generation sector and the National Grid average GHG intensity. This overall assessment, which accounts for all GHG emissions over the assessed lifetime of the Scheme, compares the Scheme's GHG intensity to the National Grid average GHG intensity to quantify the net GHG impact of the Scheme compared with other predicted grid energy generation sources.

Construction (2024 - 2026)

7.8.6 The construction period will take approximately 24 months. Construction activities will be carried out Monday to Friday 07:00-18:00 and between 08:00 and 13:30 on Saturdays.

7.8.7 The construction phase for the Scheme includes the preparation of the Sites, installing the access tracks, erection of security fencing, assembly and erection of the Solar PV arrays, installation of the inverters/transformers and grid connection.

7.8.8 The construction of the energy storage system element of the Scheme will include the preparation of the Sites, installation of the access roads, erection of security fencing, assembly of the battery system, and installation of the switch-room and grid connection.

7.8.9 Two options are being considered with for the energy storage facility which will have an effect on the number of products used at each site. These are referred to as 'Option A' and 'Option B'.

7.8.10 Calculations for the embodied carbon within the various products to be used on site and the sources for each are set out below.

High Voltage Cables

7.8.11 Indicative cable lengths were provided by the Applicant for the whole of the Cottam Scheme and these were used to set out an indicative total cable length of 110,400m based on multiple cables being required per circuit. The cable lengths are understood to be the same for both Option A and Option B.

7.8.12 Total weight per meter was provided for the two main materials used within the cables: copper and aluminium.

Table 7.12: Materials of $kgCO_2e$ in High Voltage Cables

Material	kg/m	total kg	$kgCO_2e/kg$*	tCO_2e
Copper	21	2,318,400	2.71	6,283
Aluminium	10.7	1,181,280	6.67	7,878
Total				14,160

**Ref 7.28*

Low Voltage Cables

7.8.13 Indicative cable lengths were provided for:

- Low Voltage DC Electrical Cabling (string to combiner box)
- Low Voltage DC Electrical Cabling (combiner box to inverter)
- Medium Voltage Electrical Cabling (from Power Station to Sub Station)

7.8.14 A breakdown of materials was not provided but total weights have been. It has been assumed that the material split will be the same as the high voltage cables.

Table 7.13: Materials of $kgCO_2e$ in Low Voltage Cables

Material	kg/m	total kg	$kgCO_2e/kg$*	tCO_2e
Copper	21	476,028	2.71	1,290
Aluminium	10.7	242,547	6.67	1,618
Total				2,702

**Ref 7.28*

Solar PV Modules

7.8.15 The total number of modules for each option is shown below:

- Option A - 1,320,624
- Option B - 1,307,496

7.8.16 Anticipating advances in technology, Option A proposes a smaller area for energy storage, with Option B allowing for a more extensive area. In the Option A scenario, solar panels will be constructed where land is not required for energy storage. Option B being the larger energy storage facility where less solar PV modules will be required.

7.8.17 The total weight of an individual panel is anticipated to be 33.4kg and have approximately 156 individual solar cells as set out in the product details as supplied by the Applicant. The primary materials which go into construction of a solar panel are silicon, steel and glass.

7.8.18 The Global Silicon Council have produced a document, "Silicon-Chemistry Carbon Balance: An assessment of Greenhouse Gas Emissions and Reductions" (Ref 7.35) which states that each cell contains approximately 11g of silicon. Silicon has an embodied carbon value of $6kgCO_2e/kg$. Based on these figures, it is calculated that each panel has 1.584kg silicon and an embodied carbon value of $9.504kgCO_2e$. The total embodied silicon from panels at the development is $13,597tCO_2e$ for Option A and $13,462tCO_2e$ for Option B.

7.8.19 The surface area for the panel is anticipated to be $2.80m^2$. A value of 2.5kg per mm thickness per m^2 as derived from Ref 7.24 and glass thickness of 3.2mm. The glass weight per panel is therefore 22.36kg. An embodied carbon value of $1.437kgCO_2e$

has been taken from Ref 7.33 for glass. This gives a total of 42,437tCO_2e for glass used across the development in Option A and 42,051tCO_2e for Option B.

7.8.20 It has been assumed that the remaining weight of the panel which is not silicon or glass is steel. This gives a weight of 9.32kg steel per module. Using a value of 3.03kgCO_2e/kg this gives a total of 28.2kgCO_2e per module. The steel at all solar panels at the development is 37,300tCO_2e in Option A and 36,929tCO2e in Option B.

7.8.21 Through consultation with Solarport, a supplier of solar panel mounting equipment, it is understood that each MW of electricity generated requires around 30 tonnes of mounting equipment. It has been assumed that all mounting equipment will be primarily steel.

7.8.22 A value of 3.03kgCO_2e/kg has been used as derived from Ref 7.24. Based on the above and knowing that the development will generate 600MW, a value of 53,540tCO_2e has been derived for the mountings. This is the same for both option A and Option B.

7.8.23 The total embodied carbon for all panels and mounting associated with all parcels (i.e. Cottam 1, 2, 3a and 3b with the variations in Cottam 1 accounting for the changes in Option A and Option B), accounting for the materials used in development is:

- **Option A – 93,334tCO_2e**
- **Option B – 92,406tCO_2e**

Transformers, Inverters and Switchgear

7.8.24 To calculate the embodied carbon associated with the production of the transformers to be used on site, the material breakdown of a typical transformer as reported in a lifecycle assessment produced by Hegedic et al (2016) (Ref 7.29) was used as a benchmark to estimate material quantities associated with the transformers required for the Scheme.

7.8.25 For the purpose of this assessment, a total of 5 x 400/33kV transformers with inverters and switchgear will be installed at Cottam 1. At Cottam 2, 3a and 3b a total of 5 x 132/33kV transformers with inverters and switchgear will be installed.

7.8.26 Information has been provided for the amount of oil to be used with the 400/33kV transformer (77.7 tons). The same ratio has been assumed to be used for the 133/33kV transformers.

7.8.27 The materials used in transformers are oil, steel, copper and plasterboard as set out in Ref 7.29. The proportions of typical material are also shown in Ref 7.29. As the weight of oil is known, the remaining materials have been proportioned out appropriately.

Table 7.14: Materials of kgCO_2e in Transformers Inverters and Switchgear

Material	Total Weight (tonnes)	kgCO_2e/kg	tCO_2e
Steel	1,161	2.364	2,744
Copper	304	2.710	825
Plasterboard	76	0.390	30
Oil	584	1.401	819

The total embodied carbon for Transformers, inverters and switchgear is **4,418tCO_2e.**

Energy Storage

7.8.28 Following consultation with LeClanché battery suppliers, a value of 100kgCO_2e per kwh was provided as a realistic worst case for the purposes of this assessment. The assessed kWh battery storage for each option has been assumed to be:

Option A 1,357MWh

Option B 2,773MWh

7.8.29 Based on the above assumptions the total CO_2e from batteries is:

Option A 135,700tCO_2e

Option B 277,300tCO_2e

Water Use

7.8.30 Water use has been provided for:

- Water consumed for Construction and cleaning of HGV, modules & equipment in litres
- Potable and non-potable water for drinking and sanitary purpose in litres.

Table 7.15: Construction Water Use Emissions

Scenario	Water use during construction/ annum (million litres)	Water Supply emissions (kgCO2e/ million litres	kgCO_2e/ annum	tCO_2e/ construction phase
Option A	17.5	149	2,600	**5.20**
Option B	17.7	149	2,631	**5.26**

**Ref 7.28*

Waste

7.8.31 Waste streams during the construction phase which have been assessed for their Greenhouse Gas Emissions include:

- Sewage Waste
- Excavated Ground material

7.8.32 Sewage waste generated during construction has been estimated at 26,323m^3. Using the emissions from Ref 7.28 of 0.727kgCO_2e/m^3 for Water Treatment, the total estimated emissions from sewage waste have been calculated at **7.16tCO_2e.**

7.8.33 The estimated ground material expected to be excavated which will not be suitable for refill or compaction has been calculated at 62,671m^3. Using a typical value for mixed construction and demolition weight by cubic metre of 1.2 tonnes per m^3, the total estimated emissions from excavation material waste have been calculated at **81.22tCO_2e.**

Packaging of Materials

7.8.34 Packaging for the solar modules and mounting system information has been provided as set out below. As the volume has been provided but not the weight, typical conversion factors have been used to calculate the total weight and the total emissions from the packaging materials to be used.

Table 7.16: Option A Packaging Materials Embedded GHG Emissions

Packaging Item	Total Volume (m^3)	Assumed Ratio of Volume to Weight for Material	Total Weight (tonnes)	kgCO_2e/ tonne for material *	Total tCO_2e
Pallet Wood	16,349	0.7	11,444	313	3,578
Polyurethane Foam pad for cushioning between modules	13,049	0.024	313	2,601	814
Paper and Board	9,517	0.6	5,710	829	4,733
Corner pieces and edge spacers made of HDPE	238	0.024	6	3,270	19
Pallet Nails	n/a	n/a	2.7	3,030	8
Total					**9,152**

**Ref 7.24*

Table 7.17: Option B Packaging Materials Embedded GHG Emissions

Packaging Item	Total Volume (m^3)	Assumed Ratio of Volume to Weight for Material	Total Weight (tonnes)	$kgCO_2e$/ tonne per material *	Total tCO_2e
Pallet Wood	16,190	0.7	11,333	313	3,543
Polyurethane Foam pad for cushioning between modules	12,922	0.024	310	2,601	807
Paper and Board	9,424	0.6	5,655	829	4,687
Corner pieces and edge spacers made of HDPE	235	0.024	6	3,270	18
Pallet Nails	n/a	n/a	2.7	3,030	8
Total					**9,063**

**Ref 7.24*

Vehicle Movements

7.8.35 A 1-way distance of 30km per journey has been assumed for the worker transportation calculations, which is a conservative estimate as, where possible, staff will be located within 30km of the Sites according to currently available data. The UK Government 2021 emissions factors for 'Average car' and 'Average Diesel van', including WTT emissions, have been applied to this distance and total worker numbers to calculate GHG emissions associated with worker transport.

7.8.36 The intention is for any non-local workers to use local accommodation and use minibuses to transport them to the Sites which will reduce the overall vehicle construction worker vehicle trips as set out in the Transport and Access Chapter (Chapter 14) of the ES **[EN010133/APP/C6.2.14]**.

7.8.37 There are 466 forecast daily construction worker movements (two way trips) and an estimated construction period of 529 days. Assuming that 32 trips will be by shuttlebus and 434 trips will be by car

Table 7.18 – Construction GHG Emissions

Vehicles	Number of Trips	Average Distance	kgCO2e/km	$kgCO_2e$	tCO_2e
Bus	16,928	**30**	0.0965	490,07	49
Cars	229,586	30	0.17048	1,174,195	1,174
Subtotal					1,223

7.8.38 The total HGV trips for the site have been provided in Chapter 14 as 29,624 two way trips and are set out below. This assessment has assumed that half of the HGV trips will be from Europe with a total journey distance of 1,750km and half will be from China with a total journey distance of 500km. It is assumed that half of delivery vehicles will be articulated HGVs and half will be Rigid HGVs. To account for delivery to and from the site, it is assumed that vehicles will be 50% laden.

Table 7.19 – Construction GHG Emissions

Vehicles	Number Trips	Distance	kgco2e/km	kgCO2e	tCO2e
HGV artic (China to site)	7,406	500	0.80322	2,974,324	2,974
HGV rigid (China to site)	7,406	500	0.63623	2,355,960	2,356
HGV artic (Europe to site)	7,406	1,750	0.80322	10,410,133	10,410
HGV rigid (Europe to site)	7,406	1,750	0.63623	8,245,859	8,246
Total					23,986

Shipping of Materials

7.8.39 Based on the above calculations of material weights and assuming half of products would come from China and half from Europe the below calculations are made. Shipping distance from Shanghai to Dover is 21,880km and Calais to Dover is 50km.

Table 7.20 – Option A Shipping GHG Emissions

Source	Shipping Weight (tonnes)	Distance (km)	$kgCO_2e$/tonne/km*	$kgCO_2e$	tCO_2e
Shipping from China	35,238	21,880	0.01323	10,201942	10,202

Source	Shipping Weight (tonnes)	Distance (km)	$kgCO_2e$/tonne/km*	$kgCO_2e$	tCO_2e
Shipping from Europe	35,238	50	0.01323	23,313	23

*General Average Cargo Ship from Ref 7.24

Table 7.21 – Option B Shipping GHG Emissions

Source	Shipping Weight (tonnes)	Distance (km)	$kgCO_2e$/tonne/km*	$kgCO_2e$	tCO_2e
Shipping from China	58,804	21,880	0.01323	17,024,627	17,025
Shipping from Europe	58,804	50	0.01323	38,905	39

*General Average Cargo Ship from Ref 7.24

Energy Use

7.8.40 Electricity for temporary site security during construction tenure and Electricity for office cabin and welfare centres is provided during the construction phase. Option A and B both require the same energy use.

Table 7.22 – Energy usage during Construction Phase

Total Energy usage (kwh)	Total kg CO_2e per kwh	tCO_2e over construction phase
1,385,735	0.19338	268

Summary of Construction GHG

7.8.41 During the construction stage, the greatest impact of GHGs is the result of embodied carbon in the materials used for construction. As mentioned previously; the PV panels are expected to be sourced from China or a country of similar distance. The manufacture and supply of PV panels and Batteries will be the largest source of GHG emissions. The differences in GHG during the construction phase from the Option A and Option B products and activities are shown below.

Table 7.23 – Construction GHG Emissions - Option A

Emissions Source	Emissions (tCO_2e)	% Construction Emissions
Products (PV arrays including mounting)	93,334	31.5
Products (Transformers)	4,098	1.4
Products (High voltage cables)	14,160	4.8

Emissions Source	Emissions (tCO_2e)	% Construction Emissions
Products (Low voltage cables)	2,729	0.9
Products (Batteries)	135,700	45.7
Transportation of Materials	11,884	4.0
Worker Transportation	25,209	8.5
Waste	76	0.0
Water Usage	3	0.0
Energy Usage for Construction Period	268	0.1
Packaging	9,152	3.1
Total	**296,613**	**100.0**

Table 7.24 – Construction GHG Emissions - Option B

Emissions Source	Emissions (tCO_2e)	% Construction Emissions
Products (PV arrays including mounting)	92,406	20.8
Products (Transformers)	4,098	0.9
Products (High voltage cables)	14,160	3.2
Products (Low voltage cables)	2,702	0.6
Products (Batteries)	277,300	62.4
Transportation of Materials	19,189	4.3
Worker Transportation	25,209	5.7
Waste	76	0.0
Water Usage	3	0.0
Energy Usage for Construction Period	268	0.1
Packaging	9,063	2.0
Total	**444,475**	100.0

Significance of Effect (Construction)

7.8.42 Worst case total GHG emissions from the construction phase are estimated to equate to around 444,475 tCO2e in Option B.

7.8.43 GHG emissions from construction activities will be limited to the duration of the construction programme (anticipated to be 2 years). When annualised, the total annual construction emissions equate to around 222,237tCO2e.

7.8.44 Table 7.25 presents the estimated construction emissions against the carbon budget period during which they arise. Construction emissions will fall under the 4th UK carbon budget.

7.8.45 As the construction phase and the first three years of the operation phase both fall within the 4th carbon budget, the annual emissions of each phase have been compared to the relevant annualised carbon budgets to enable assessment of the phases individually.

Table 7.25 – Construction GHG Emissions

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Annual Construction Emissions for the Scheme During Carbon Budget Period (tCO_2e)	Construction Emissions for the Scheme as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	221,992	0.057%

7.8.46 Annual emissions from the construction of the Scheme do not contribute to equal to or more than 1% of the annualised 4th carbon budget. The magnitude of effect is therefore considered low. GHG emissions from the construction of the Scheme are considered to have a **minor adverse significant effect** on the climate. A negligible significant effect is not possible where any GHG emissions are released to the atmosphere. The overall effect from Construction is considered **not significant** in EIA terms.

Operation (2026–2066)

7.8.47 GHG emissions will be generated as a result of operational activities such as the transportation of operational workers to and from the Site, water consumption, and replacement of on-site materials.

Water Consumption

7.8.48 912m^3 of water is required on site for fire suppression. Ref 7.24 gives a value of 0.149kgCO^2e per cubic metre of water. This accounts for 135.89kgCO_2e of water use during operation or 0.135tCO_2e.

7.8.49 This is assuming the water is never replaced. If it does need to be replaced, the associated emissions are considered negligible.

7.8.50 Over the lifespan of the project, water will be used for cleaning of the panels and for some supply of drinking water on site as set out below:

Option A 7.8 million litres

Option B 7.8 million litres

7.8.51 Based on a water supply 149kgco2e/million litres gives a total of **47tCO_2e** water use during lifespan of operation of the project.

Replacement Parts

7.8.52 Through consultation with a battery supplier, it is understood that the lifespan for the proposed battery units are expected to require replacing as part of the development. While technology may have improved and some of the assumptions used which underpin the embodied carbon values, as a conservative approach, it has been assumed that the embodied carbon at replacement will be the same as during the construction phase.

7.8.53 It has been assumed that 0.04% of panels will require replacement each year based on supplier input. This has been calculated based on the embodied carbon of the products as set out in the construction phase and applied to the estimated 40 year development lifespan.

Operational Waste

7.8.54 There is anticipated to be 1,912m^3 of sewage waste from the Scheme per annum. Using the waste water value methodology as per the construction phase this gives a total of **20.8tCO_2e** over the project's 40 year lifespan.

Maintenance Travel

7.8.55 Assuming a 30km distance of travel, the operational phase of the project would generate approximately **10 tCO_2e** as a result of operational workers travelling to and from the Sites twice a month for maintenance.

7.8.56 As shown from the GHG emissions associated with worker transportation, it is likely the GHG emissions associated with the additional operational activities will be small compared to emissions from energy consumption.

7.8.57 The operational GHG emissions calculated reflect a worst-case as the calculations for worker transportation and maintenance will have been carried out using current emissions factors to estimate emissions over the operational lifetime of the Scheme. However, carbon and emissions associated with energy and fuel use throughout the supply chain are anticipated to be lower in the future as a result of grid decarbonisation and machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050.

Energy Usage

7.8.58 There will be some required energy use for operation of the site from for the surveillance and monitoring system and for the office and O&M room. While it is anticipated that greenhouse gas emissions from energy will reduce over the lifespan of the Scheme, in part due to the nature of the Scheme itself which will result in energy generation creating fewer greenhouse gases, as a worst case assumption the baseline year greenhouse gas emissions have been assumed over the estimated 40 year project lifespan. Option A and B have the same required energy usage.

Table 7.26 – Operation GHG Emissions

Total Energy usage (kwh)	Total kg CO_2e per kwh	tCO_2e over project lifespan
92,259,200	0.19338	**17,841**

Summary of Operational Effects

The below summary provides estimated GHG emissions over the whole operational period. As shown, the production of replacement batteries at the midpoint of the projects lifespan is the greatest contribution to GHG emissions during operation.

Table 7.27 – Operation GHG Emissions Summary – Option A

Emissions Source	Emissions (tCO2e)	% Operational Emissions
Maintenance trips	10	0.01
Replacement batteries	135,700	80.48
Replacement PV modules	14,933	8.86
Water Usage	47	0.03
Operational Waste	88	0.05
Energy Usage for Operational Period	17,841	10.58
Total	**168,619**	**100.0**

Table 7.28 – Operation GHG Emissions Summary– Option B

Emissions Source	Emissions (tCO2e)	% Operational Emissions
Maintenance trips	10	0.00
Replacement batteries	277,300	89.43
Replacement PV modules	14,785	4.77
Operational Waste	88	0.03
Water Usage	47	0.02
Energy Usage for Operational Period	17,841	5.75
Total	**310,071**	**100.00**

Future Climate Change

7.8.59 Future climate change impacts, as identified in Section 7.6, may affect the lifetime energy generation modelled. For example, cloud cover is projected to decrease, which is expected to increase solar resource and have a positive impact on the productivity of the solar PV modules. This benefit, however, is assumed to be counterbalanced by temperature increases projected, which are anticipated to have a negative impact on the efficiency of the solar PV modules and on energy transmission losses (Ref 7.24). Any overall positive or negative effect is not anticipated to have a material impact on the outcome of the assessment.

7.8.60 Energy generation from the Scheme during the first year of operation is estimated to be 945,000 MWh. A 0.4% degradation factor has been used for each subsequent year with a 1% reduction in the first year based on typical products to be used with the proposed mountings, resulting in an estimated energy generation figure of 800,168MWh in the final year of operation, and a total energy generation figure of around 35,590,658 MWh over the estimated 40-year assessed lifetime.

7.8.61 Based on the total energy generation of the Scheme and the worst-case assumption for total lifespan project GHG emissions of 754,545tCO_2e, in Option B, the intensity of the Scheme is estimated to be 21.2gCO_2e/kWh. This compares favourably with fossil fuel electricity generation and is comparable with other low carbon energy generation as shown in Table 7.14 (Ref 7.32). It is considered that of the below renewable energy types, the only other viable use for the land would be for onshore Wind which would have a slightly lower but comparable GHG intensity.

Table 7.29 – Comparison of energy intensities of various forms of energy generation Energy Generation

Energy Generation Type	GHG Intensity (gCO_2e/kWh)
Combined Cycle Gas Turbine (CCGT)	380 to 500
Nuclear	5 to 55
Offshore Wind	5 to 24
Onshore Wind	7 to 20
Cottam Solar Project	**21.2**

7.8.62 A further calculation has been completed to understand at what point the GHG reductions from National Grid through the use of renewable energy at the scheme would offset the calculated worst-case emissions generated from the products and the construction phase. It also accounts for annual emissions generated by the scheme from water use, replacement products and energy consumption on site.

7.8.63 The calculation has used the UK Government Conversion factor for UK Electricity from 2022 (Ref 7.24) to calculate the tCO_2e saved by the scheme year on year compared with a scenario using existing UK grid. The calculations accounts for 0.4% reduction in efficiency per year with a 1% reduction in the first year.

7.8.64 It is acknowledged that the emissions from energy usage is expected to be reduced in future years as the UK becomes less reliant on fossil fuels but this is not reflected within the calculations in Table 7.31. Table 7.30 shows the expected year for the operation of the scheme to offset the construction emissions.

Table 7.30 – Calculation of Savings to Offset Construction GHG Emissions

Year of Operation	GHG Savings as a Result of Scheme (tCO_2e)	Offset from Development Emissions (tCO2e)
Construction Phase	-	443,985
Year 1	174,992	268,993
Year 2	173,165	103,580
Year 3	172,441	-61,110
Year 4	171,720	-225,078
Year 5	171,003	443,985

7.8.65 As shown above, it is expected that the savings from the scheme would result in offsetting the construction emissions within 4 years of operation. Assuming baseline values for emissions from the Scheme, over the estimated 40 year lifespan there would be a reduction of **5,973,729 tCO_2e** from the Scheme compared to a scenario where the Scheme does not go ahead.

Other Greenhouse Gas Considerations

7.8.66 While sulphur hexafluoride (SF_6) is a potential source of GHG emissions over the lifetime of the Scheme (i.e. derived from certain electric items such as gas-insulated switchgear and gas-insulated transformers during production, operation through leakage, and dismantling), it has not been possible to quantify fugitive emissions from the leakage of SF_6 due to insufficient research data being available on this topic. SF_6 is one of the seven GHGs identified by the Kyoto Protocol (Ref 7.23) due to its high Global Warming Potential (GWP) of 23,900 for the 100-year time horizon as set out in the protocol. GWP is defined as the heat absorbed by any greenhouse gas in the atmosphere, as a multiple of the heat that would be absorbed by the same mass of carbon dioxide (CO_2). CO_2 has a GWP of 1.

7.8.67 It is not anticipated that SF_6 emissions will significantly affect the overall outcome of this assessment, however. For example, total annual SF_6 emissions from the National Grid Transmission Network in 2015-2016 equated to 216,645 tCO_2e (Widger and Haddad, 2018; Ref 7.30) and are assumed to be similar each year. As the Scheme will provide less than 1% of total generation capacity to the National Grid Transmission Network, and as switchgear and transformers are not limited to power generation facilities but can be found all across the network, it is anticipated that the Scheme's contribution to this total will be minimal.

Significance of Effect (**Operation**)

7.8.68 As previously stated, the operational stage of the Scheme will encompass the 4th 2023 – 2027), 5th (2028 – 2032) and 6th (2033 – 2037) national carbon budgets, however, budgets beyond this have not been published yet. Due to the nature of the Scheme; it is unlikely that any emissions derived from the operational stage will produce GHG emissions >1% of the 4th, 5th, and 6th carbon budgets. It is anticipated that the magnitude of effect is likely to be low.

7.8.69 Compared to other types of electricity generation; the Scheme is expected to have a **major beneficial significant effect** on the climate.

Decommissioning (2066 - 2067)

7.8.70 During the decommissioning stage, total GHG emissions will be supplied; including the source of emissions, any related emissions and the contribution of each emission source (as a percentage) to the overall GHG emissions produced.

7.8.71 As the decommissioning activities associated with the Scheme will occur far into the future; there is uncertainty over the total estimate of GHG emissions that will be produced. Therefore, prior to decommissioning, a Decommissioning Plan will be prepared which will be in accordance with the Outline Decommissioning Plan. It is assumed that GHG emissions during decommissioning will be broadly the same as construction without the added production GHG emissions associated with creating the materials to go on site. The below is assumed for decommissioning which shows that emissions will be far lower than construction and the main source of emissions will be from worker transportation.

7.8.72 Removal of the parts has assumed the total weight of materials will be recycled as average construction and demolition waste in line with Ref 7.24.

Table 7.31 – Summary of Decommissioning GHGs

Emissions Source	Emissions (tCO_2e)	% Construction Emissions
Worker Transportation	24,720	98.59
Removal of onsite materials	81	0.32
Water Usage	5	0.02
Energy Usage for Decommissioning Period	268	1.07
Total	**25,074**	**100.00**

Significance of Effect (Decommissioning)

7.8.73 The projected lifespan of the Scheme is estimated to be 40 years so it is unknown at this stage what the effects will be in the future. However, based on the above of the development, it is expected that the magnitude of effect will be low.

7.8.74 It should be noted that the embodied carbon within the products would not require consideration within the decommissioning process as they would not need to be produced again or shipped as a result of decommissioning of the scheme. It is therefore likely that decommissioning effects would be lower than construction. The assumption is for a closed loop disposal within the UK.

Overall GHG Impact

7.8.75 It is anticipated that the construction and decommissioning stages of the Scheme will result in a minor adverse impact on the climate which is not significant in EIA terms. Conversely, the overall operational stage will likely have a major significant beneficial effect.

Climate Change Resilience Review

7.8.76 In the sections below; associated impacts and effects of climate change during the construction, operation and decommissioning stages of the Scheme are discussed.

7.8.77 The receptor for the review of climate change resilience is the Scheme itself, including all infrastructure, assets, and workers on-site during construction, operation, and decommissioning. The sensitivity of the receptors has been evaluated based on their vulnerability, susceptibility to climate change associated impacts and their overall importance.

Table 7.32 – Sensitivity of Receptors

Receptors	Vulnerability	Susceptibility	Importance	Overall Sensitivity
Buildings and infrastructure including equipment and building operations	Moderate	Moderate	High	Medium
Human Health including construction workers and site users	Moderate	Moderate	High	Medium

Construction (2024 - 2026)

7.8.78 Due to projected changes in climate and increased environmental extremes; sensitive receptors during the construction process may be vulnerable. The climate risks are summarised in the table below.

Table 7.33 – Construction Phase Climate Risks

Climate Risk	Receptor	Consequence	Likelihood of Impact	Magnitude of Effect
Increased probability of extreme weather events	Buildings and Infrastructure	Restriction to site access and working hours causing delay to construction	As likely as not	Medium
Increased heatwaves	Human Health	Poor working conditions impacting specific construction activities	Likely	High
Increase rainfall events	Human Health	Poor working conditions impacting specific construction activities	Likely	High

7.8.79 The climatic changes expected to take place during the construction phase have the potential to cause delays to the construction schedule due to the occurrence of severe weather events. The extreme weather conditions may also impact the health and safety of the workers on site. Nonetheless, the construction phase takes place within the early stages of the 2020 – 2039 range of climate scenarios as detailed in Table 7.8, Table 7.9 and Table 7.10. As a consequence, the expected climate changes are not as severe and will likely be able to be mitigated against through best working practices such as working in heat risk assessment (e.g. staying hydrated, wearing sun protection).

Operation (2026 - 2065)

7.8.80 The projected changes in climate and increased environmental extremes are likely to be more severe during the estimated 40 years life span of the Scheme. The climate risks are summarised in the table below.

Table 7.34 – Operation Phase Climate Risks

Climate Risk	Receptor	Impact	Likelihood of Impact	Magnitude of Effect
Increased frequency of severe weather events	Buildings and Infrastructure	Damage to infrastructure/assets due to heat stress or storm/flood damage	As likely as not	High
Increased summer and winter temperatures	Buildings and Infrastructure	Increase in the ambient temperature of energy storage units, resulting in higher ventilation and cooling requirements	As likely as not	High
Increased summer temperatures	Human Health	Health and safety risk due to increased risk of fire	As likely as not	High

Climate Risk	Receptor	Impact	Likelihood of Impact	Magnitude of Effect
Increased winter precipitation	Human Health	Health and safety risk due to increase in surface water flooding and standing water leading to land subsidence	As likely as not	High

Decommissioning (2065 – 2067)

7.8.81 During the decommissioning stage, the impacts of climate change are expected to worsen and increase. This may increase the vulnerability of sensitive receptors mentioned above for the construction process.

Overall CCR Impact

7.8.82 Based on the above assessment, without appropriate mitigation the Scheme is at high risk to climate change impacts.

7.8.83 Embedded mitigation measures to increase the resilience of the Scheme to climatic changes are outlined in previous sections.

7.8.84 The CCR review has considered the measures which are integrated into the design (see Section 7.7) and based on the outcomes of the assessment, are considered an adequate response to the projected climate change impacts to which the Scheme would be exposed.

7.8.85 The embedded mitigation through the design avoiding high flood risk areas is such that it is considered that the effects are mitigated in so far as is practicable.

In Combination Assessment

7.8.86 The greatest risk of in combination affects are of increased flooding events from extreme weather arising from a changing climate.

7.8.87 The risk of flooding as a result of increased rainfall from has been determined to be unlikely through the Hydrology assessment work and consultation with the Environment Agency and use of EA models, though there are cumulative risks of increased flooding as a result of Climate Change. The below is summarised from the Hydrology, Flood Risk and Drainage Chapter of the ES (please see associated Appendices to this chapter, for details of each of the 'Parcels' described).

Table 7.35 – Flood Risks from Climate Change

Area	Flood Risk Summary	Likelihood of Impact
Cottam 1	No flooding with a depth greater than 0.9 m is present across any of the Site parcels. Flooding with a depth between 0.6 – 0.9 m is present along the western boundary of Parcel 1 and the north-western corner of Parcel 2. The EA's Long-Term Flood Risk Map indicates that Surface Water flooding with a High Risk (>3.3% Annual Probability) of occurrence is present across the whole northern part of the Site and across the western and eastern extents of the southern part of the Site. Parcel 1 has High Risk areas associated with some land drains that cross the Parcel is the east and a topographical low point in the west. Parcels 2 and 3 have High Risk areas associated with the route of the River Till. There are multiple flow paths in the surrounding area that flow towards the Site. During the 0.1% AEP + CC scenario, the majority of the Site remains flood free however a greater proportion of the Site is shown to hold flooding with a depth greater than 0.9 m.	Very Low to High
Cottam 2	During the 0.1% AEP + CC scenario, a minor portion of Parcel 1 is encroached by flooding however the depths are shown to remain below 0.4 m. Flooding is shown on both side of the River Till within the centre of Parcel 2, with some areas indicated to have flooding reaching depths above 0.9 m. The majority of the northern Parcel 3 is shown to be flooded however the depths are shown to be below 0.7 across the entire parcel. The eastern extent of the southern Parcel 3 is shown to be impacted, with maximum flood depths	Very Low to High

Area	Flood Risk Summary	Likelihood of Impact
	above 0.9 m in the eastern area of the parcel that bounds the River Till. The EA's Long-Term Flood Risk Map indicates that Surface Water flooding with a High Risk (>3.3% Annual Probability) of occurrence is present across the Site. Parcel 1 has High Risk areas associated with some land drains that cross the Parcel is the east and a topographical low point in the west. Parcels 2 and 3 have High Risk areas associated with the route of the River Till. There are multiple flow paths in the surrounding area that flow towards the Site.	
Cottam 3	The EA's Long-Term Flood Risk Map indicates that the majority of the Site is at Very Low to Low (<0.1 - 1%) risk of Surface Water flooding. Isolated areas of the Site are at Medium to High Risk (1 - 3.3< % Annual Probability), notably on the north-eastern boundary of the Site for approximately 1 km. This forms a Surface Water flow path, running along the boundary and away from the Site northwards. Other isolated areas of Medium to High Risk on the Site are associated with minor topographic depressions which infill during rainfall events.	Very Low to Low
Cottam 3b	The EA 'Flood Risk from Surface Water' map (Figure 2) indicates that the Site is largely at Very Low risk (<0.1% annual probability) of surface water flooding. However, there are some small areas throughout the Site which are at Low to High risk (0.1 - ≥ 3.3% annual probability) of surface water flooding; these areas are generally confined to the north-east and south-western extents	Very Low to High

Area	Flood Risk Summary	Likelihood of Impact
Cottam Substation and Energy Storage area	The proposed substations and energy storage will generate increased surface water runoff when compared to the current use of the Application Site. This could potentially increase localised pluvial flooding on the Application Site.	Medium

7.8.88 While there is potential for some areas at the Cottam development to have increased chance of flooding as a result of the effects of Climate Change, the layout of the scheme has been designed in such a way as to minimise development of areas which are more at risk of flooding.

7.9 Additional Mitigation and Enhancement Measures

7.9.1 The GHG assessment has identified that the greatest source of tCO_2e during the construction phase is from embodied carbon from products.

7.9.2 While worst case assumptions have been made for the purpose of the GHG vehicle type around use of HGVs for transport of construction materials, wherever possible vehicles with lower carbon emissions should be used.

7.9.3 Climate Change mitigation forms part of the embedded mitigation as part of the scheme as its primary purpose is to deliver clean renewable energy. The scheme will contribute to the UK's Carbon Target of Net Zero by 2050.

7.9.4 The assessment has not identified the need for any additional mitigation or enhancement measures.

7.10 Residual Effects

7.10.1 During the different stages of the Scheme (construction, operation, and decommissioning), inevitable GHG emissions will be generated with associated transport, energy, and fuel-use.

7.10.2 Overall, the Scheme itself will provide major beneficial impacts and a net reduction in GHG.

7.10.3 The design has accounted for Climate Resilience through the design avoiding any potential flood risk zones, though there remains uncertainty to the extent of which severe weather events will affect the UK. While some panels may be placed in flood risk zones this will only be where predicted flooding is not deep enough to affect them. Other more sensitive electrical equipment will not be placed in flood risk zones.

7.11 Cumulative Effects

7.11.1 Cumulative GHG emissions are likely to arise due to the prevalence of other planned developments considered as part of the cumulative effects off the Scheme. With three of these planned developments being Nationally Significant Infrastructure Projects (NSIPs); consideration has been given to these within the ES. Specific consideration has been given to the following solar projects:

- West Burton
- Gate Burton
- Tillbridge

7.11.2 Although the Scheme will provide major beneficial impacts; it's important to consider other developments as the GHG emissions produced in conjunction may exceed >1% of the applicable carbon budget.

7.11.3 The Scheme is being developed in tandem alongside the nearby West Burton Solar Project. It is considered that there would be positive cumulative effects should both developments construction periods overlap as this could allow for consolidation of vehicle trips which would lead to less GHG emissions than if the construction periods were staggered. However, at this stage, it is unknown what these potential savings would be and whether such consolidation is practicable, and the cumulative effect is based on both schemes operating in isolation.

7.11.4 The Gate Burton Energy Park has also been considered as part of the cumulative assessment. The cumulative effect of the construction phases of the scheme is not likely to be >1% of the 4^{th} Carbon Budget. While there may be some cumulative effects from combined GHG emissions during the construction phase, it is considered that, as with the Scheme, the offset from reduced emissions over the operational phase of the development would ultimately result in a beneficial cumulative effect with regards to Climate Change.

7.11.5 The GHG assessment has included for the cumulative effect of emissions. There are potential savings for joint working practices with the West Burton and Gate Burton project ducts and cables being constructed at the same time. The specific embodied emissions for cables associated with Cottam are separated out in the GHG assessment above. Sharing a joint cable corridor would result in a net saving of GHG emissions compared to approaching each project separately.

7.11.6 While the Tillbridge Solar Project will not directly lead to any efficiencies in the construction phase emissions, in the same way that Gate Burton and West Burton are predicted to, the overall increase in renewables offered by the inclusion of this scheme would lead to further reduced Greenhouse Gas Emissions and would have a net cumulative positive effect.

7.11.7 In summary, there are not anticipated to be any significant cumulative effects as a result of all three developments with regards to Climate Change in either the construction or operational scenarios.

7.11.8 The cumulative effect of the solar developments will be major beneficial in terms of Climate Change Resilience given that the combined effect of the renewable energy will serve to counter the effects of Climate Change.

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