Cottam Solar Project

Preliminary Environmental Information Report:
Chapter 7: Climate Change

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Cottam
SOLAR PROJECT

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Issue Sheet

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Preliminary Environmental Information Report:

Chapter 7: Climate Change

Prepared by:

Name: Hannah Smith

Title: Principal Consultant

Approved by:

Signature: 

Name: Daniel Clampin

Title: Senior Environmental Consultant

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7 Climate Change

7.1 Introduction

7.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the findings of the Environmental Impact Assessment (EIA) work undertaken to date 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 will also be considered.

7.1.2 The following aspects will be considered 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.

7.2 Planning Policy Context and Guidance

7.2.1 Legislation, planning policy and guidance relating to climate change relevant to the Scheme:

Legislation and Planning policy

- 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 Planning Policy

- 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 CO2 emissions through design and reduced energy consumption; and paragraphs 155 to 165 in relation to climate projections, associated flood risk and adaptation.

National Guidance

- Planning Practice Guidance, Climate Change (March 2019) (Ref 7.13)

Local Planning Policy

- 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 7.16)
- Central Lincolnshire draft Local Plan- in relation to Climate Change (Ref 7.17)
- Bassetlaw District Council Renewable and Low carbon study (2010) (Ref 7.18)
- Bassetlaw draft Local Plan (Ref 7.19), specifically policy ST45: Climate Change Mitigation and Adaptation and Policy ST46: Renewable Energy Generation

7.3 Assessment Methodology

7.3.1 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 7.20) and considering climate change resilience and adaptation (Ref 7.21) in EIA.

7.3.2 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 IEMA guidance.

GHG Impact Assessment

7.3.3 All GHG emissions arising over the Scheme will be assessed through the Lifecycle GHG impact Assessment. Direct emissions from activities within the Sites, indirect emissions from activities outside the Site and embodied carbon within construction materials are considered the study area for the GHG impact assessment.

7.3.4 The applicant and design team will provide data and information that will underpin the lifecycle GHG impact assessment, which will then be evaluated using the methodology set out below.

7.3.5 In line with the GHG Protocol, the potential effects of the Scheme on the climate during the construction phase will be assessed (Ref 7.22). 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. As set out by the Institute of Environmental Management and Assessment (IEMA) document 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance'; the approach is consistent with the guidance provided by the succeeding document provided by IEMA (Ref 7.20).

7.3.6 The approach to assessing emissions will follow the different stages of the scheme including construction, operation and maintenance and decommissioning.

7.3.7 The BEIS 2021 emissions factors guidance (as shown below) will be 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 7.23):

Activity data x GHG emissions factor = GHG emissions value

7.3.8 The seven Kyoto Protocol GHGs have been considered in this assessment, which are in-line with the 'GHG protocol' (Ref 7.22):

- 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).

7.3.9 It should be noted that within this assessment, 'GHG emissions' broadly represent all seven Kyoto Protocol GHGs and will be given the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (Megatonnes of CO_2 equivalent).

Significance criteria

7.3.10 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 and the climate science community.

7.3.11 Standard GHG accounting and reporting practices have been followed to assess the magnitude of impact caused by 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.

7.3.12 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.

7.3.13 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 7.24)

7.3.14 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.

7.3.15 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).

7.3.16 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 7.1: 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

7.3.17 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 7.25). At the time of writing, the UK is in the 3rd carbon budget period with the 4th carbon budget commencing in 2023.

7.3.18 It is expected that the construction stage of the Scheme will occur during the 4th national carbon budget (2023 – 2027). Additionally, the operational stages of the Scheme will occur during the 4th (2023 – 2027), 5th (2028 – 2032) and 6th (2033 – 2037) carbon budgets. However, as the current carbon budgets are only available up to 2037 and the Scheme is expected to be operational past this; a qualitative approach can be applied to resolve this issue. Using professional judgement; the significance of the impacts associated with GHG emissions produced by the Scheme will be determined.

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

Table 7.2: 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

7.3.20 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 deemed as a suitable method for climate change mitigation, as highlighted by IEMA guidance on Assessing GHG emissions and Evaluating their Significance (Ref 7.20). Therefore, for this assessment, the following criteria (Table 7.3) will be used to determine the magnitude of significance.

Table 7.3: 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

7.3.21 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

7.3.22 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 7.25).

7.3.23 UKCP18 data and historic climate data from the Met Office have been acquired to establish the future and historic baseline climate conditions (Ref 7.26)

7.3.24 The Scheme's design has been adapted to include CCR measures.

7.3.25 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 7.20), which assesses the Scheme's resilience to potential impacts caused by climate change.

7.3.26 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.

7.3.27 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.

7.3.28 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).

7.3.29 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.

7.3.30 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.

7.3.31 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.

7.3.32 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 7.4: 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.

Level of Likelihood	Definition of Likelihood
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.

7.3.33 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.

7.3.34 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

7.3.35 The ICCI assessment methodology has been developed in line with the Institute of Environmental Management and Assessment (IEMA) – 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation' (Ref 7.21).

7.3.36 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.'

7.4 Assessment Assumptions and Limitations

7.4.1 The baseline and scheme design at the time of writing this PEIR Report will inform the preliminary assessment of the Scheme. As part of the EIA, a full assessment is being undertaken, which will be stated in the ES and put forward with the DCO application.

Assumptions for Construction Plant

7.4.2 At this stage, 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 CEMP (Ref 7.33) to limit emissions during the construction phase.

Assumptions for Construction Worker Vehicle Movements

7.4.3 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 well-to-tank (WTT) emissions[1], have been applied to this distance and total worker numbers to calculate GHG emissions associated with worker transport.

7.4.4 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).**

Assumptions for Transport of Materials

7.4.5 As of writing, the manufacturer of solar photovoltaic PV panels has not yet been chosen and therefore the number and size of modules likely to be installed is not available. 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[2]. Therefore, the manufacture and transport of PV panels will likely be the largest sources of GHG emissions from the Scheme.

7.4.6 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);

[1] 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.
[2] A supply chain statement will form part of the DCO application and be in accordance with the statement made on Solar Energy UK (Ref 7.33)

- 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 DCO Site);
- 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);

7.4.7 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 WTT emissions. It has been assumed that HGVs are 50% laden;

7.4.8 For sea freight transportation, the UK Government GHG 2021 Conversion Factors for 'General Cargo –Average' has been applied, including WTT emissions.

Assumptions for Embodied Carbon within Products

7.4.9 At this stage, due to limited technical specifications available, a worst-case estimation of the embodied carbon has been calculated assuming an average solar panel and mounting weight of 20kg/m2 and a total coverage of approximately 1,035ha. The total coverage has been estimated based on the total area of each Site subtracted by the area designated for the substations and energy storage. The dominant materials associated to the manufacture of solar panels are metals and glass and therefore GHG emission estimates have been based on the production of these materials using emission rates from the Inventory of Carbon and Energy version 3 (ICE v3) database (Ref 7.32) for glass and UK Government GHG Conversion Factors for Company Reporting 2021 database (Ref 7.23) for metals.

7.4.10 Within the ES a more in-depth assessment will be used to calculate the embodied carbon for the Scheme using the Environmental Product Declaration (EPD) of a widely used PV panel from China or the specific EPD associated with the chosen panel type, in conjunction with the known information about the size and number on panels.

7.4.11 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 7.28) was used as a benchmark to estimate material quantities associated with the transformers required for the Scheme. This breakdown assumes 77% metal, 19% oil and 4% 'other'. It has been assumed for the purposes of this assessment that 'other' relates to plastics. Embodied carbon factors for each of these materials from the UK

Government GHG Conversion Factors for Company Reporting 2021 database (Ref 7.23) have been applied.

7.4.12 At the stage of writing the PEIR, there was not enough technical data available to estimate the embodied carbon of the PV inverters, switchgear, batteries, cabling and structures. The worst-case scenario assessed for the embodied carbon emissions generated from the production of the solar panels is expected to compensate for the missing information. A more detailed analysis of the individual products will be provided within the ES.

Assumptions for Climate Change Resilience

7.4.13 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.

7.4.14 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.

Limitations – Operational Phase

7.4.15 Due to the limited information currently available, the calculation of operational GHG emissions has been isolated to GHG emissions associated with worker transportation to and from the site during the life span of the Scheme. It is acknowledged that consideration of maintenance activities as well as fuel and water use on site are still required. However, in comparison to the overall GHG emissions expected from the construction phase, the operational activities are likely to be significantly lower.

7.5 Stakeholder Engagement

7.5.1 For this Scheme, the stakeholders that have been involved are statutory consultees, landowners, local communities, land managers, heritage groups. Additionally, continuing engagement and communication with statutory and non-statutory consultees will help include climate considerations that will be later addressed in the ES.

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

7.5.3 The following table (Table 7.5) outlines the consultation to date.

Table 7.5: Main Matters Highlighted During Consultation

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Planning Inspectorate	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 PEIR and will be addressed within the ES. In particular, the two other nearby major Solar Projects have been taken into consideration (West Burton and Gate Burton Solar Projects)	Cumulative Assessment
Planning inspectorate	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	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 PEIR	n/a
Lincolnshire County Council	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	What is the energy consumption and associated carbon emissions of the battery system?	The total emissions are unknown at this stage as specifications for the energy	n/a

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
		storage system have not yet been defined. However, as stated in the assumptions and limitations, conservative estimation has been applied to account for additional products.	
Lincolnshire County Council	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
Lincolnshire County Council	Power losses and associated carbon footprint of connecting cables to the grid need estimating	The total emissions are unknown at this stage as specifications for the cabling have not yet been defined. However, as stated in the assumptions and limitations, conservative estimation has been applied to account for additional products.	n/a
Lincolnshire County Council	With regard to greenhouse Gas Emissions this should be directly compared to the number of years it will take for development to be	Assessed as part of GHG assessment	GHG assessment

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
	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.		
Natural England	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
Natural England	Consideration of net zero by 2050.	Calculation of Carbon Neutrality included	Referenced throughout

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, 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.

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 within the Sites from the existing activities on-site.

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 7.26). 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

7.6.6 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

7.6.7 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.

7.6.8 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.

7.6.9 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 7.25). 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.

7.6.10 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)

7.6.11 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 draft Outline CEMP and the Outline CTMP. A Schedule of Environmental Mitigation will be produced for the ES, which outlines how this mitigation will be secured.

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 A Decommissioning Statement **(Appendix 4.4)** has been set out. 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, Floor Risk and Drainage 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, cabling, inverters and transformer stations) 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, the bottoms of the majority of the panels are likely to be between 0.45 and 0.6m off the ground. For areas of flooding higher panels may be considered as a mitigation strategy.

- Critical infrastructure within the Scheme (the substations and battery 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%); and

7.7.6 Health and safety plans developed for construction and decommissioning activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves.

7.8 Assessment of Likely Impacts and Effects

GHG Impact Assessment

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

7.8.2 A summary of the anticipated GHG emissions arising from the Scheme can be showed below:

Table 7.11: Possible sources of GHG emissions

Lifecycle Stage	Activity	Primary emission sources
Production 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. Materials that are transported for manufacturing.	GHG emissions that are embodied within the product. GHGs that are produced during manufacturing Vehicle GHG emissions
Construction Stage	Construction activity on-site, which includes construction compound emissions. Construction materials that are transported and not integrated in embodied GHG emission. Equipment required is likely to require shipment, due to overseas origin. Construction worker that would need transportation to the site.	Energy consumption of on-site vehicles and generations and 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.
	Waste produced during the construction process that need to be disposed. Water use	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	GHG emissions from energy consumption from operation and maintenance, supply of potable water and wastewater treatment from staff facilities. These operational aspects are expected to be negligible in the context of overall GHG emissions.

Lifecycle Stage	Activity	Primary emission sources
		Emissions from routine maintenance are expected to be negligible. However, the periodic replacement of components has the potential to have significant impacts given the complexity of the equipment involved.
Decommissioning Stage	Decommissioning activity occurring on-site Removal and transportation of any waste materials Workers that would need to be transported to the site	Energy consumption of on-site vehicles and generators. 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. 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 7.20), 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 18 -24 months. Construction activities will be carried out Monday to Friday 08:00-18:00 and between 08:00 and 13:30 on Saturdays.

7.8.7 The construction phase for the solar element of the Scheme includes the preparation of the Sites, installing the access tracks, erection of security fencing, assembly and erection of the 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 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 and therefore, the manufacture and supply of PV panels will likely be the largest source of GHG emissions. A worst-case estimate has been carried out in the absence of additional technical data for all products to be provided on site.

Table 7.12: Construction GHG Emissions

Emissions Source	Emissions (tCO2e)	% Construction Emissions
Products (PV arrays)	748,209	88.7
Products (Transformers)	12	<1
Transportation of Materials by land	21,906	2.6
Transportation of Materials by sea	71,777	8.5
Worker Transportation	1,229	<1
Total	**843,133**	**100**

7.8.10 In the ES, estimates of GHGs from other sources of emissions during the construction stage will be included. These include and are not limited to; GHG emissions from energy and fuel use during construction activities, disposal of waste

materials from the Sites, water use and further details with regards to the embodied carbon of products to be installed on site. In the interim, the estimated GHG emissions associated with the PV arrays has been calculated as worst case to compensate for the missing data.

7.8.11 It is assumed that with the conversion of arable land to grassland required for the installation of Solar PV panels; there will be an increase in sequestrated carbon. Although this figure has not been estimated yet, it will be discussed in the ES.

Significance of Effect (Construction)

7.8.12 Total GHG emissions from the construction phase are estimated to equate to around 843,133 tCO2e as a worst-case assumption.

7.8.13 GHG emissions from construction activities will be limited to the duration of the construction programme (2 years). When annualised, the total annual construction emissions equate to around 421,566 tCO2e.

7.8.14 Table 7.13 presents the estimated construction emissions against the carbon budget period during which they arise. Construction emissions will fall under the 4th UK carbon budget.

7.8.15 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 7.13: 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	421,566	0.1080%

7.8.16 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 therefore considered to have a minor adverse likely significant effect on the climate. A negligible likely significant effect is not possible where any GHG emissions are released to the atmosphere.

Operation (2026–2066)

7.8.17 During the operational stage, GHG emissions will likely arise from the generation of consumed mains electricity to heat and power any proposed buildings on site, i.e. the substations, control room and energy storage areas. Within the ES, an annual energy demand for the buildings will be obtained from benchmark data to estimate a worst case in terms of emission scenario.

7.8.18 GHG emissions will also be generated as a result of additional operational activities such as the transportation of operational workers to and from the Site and some minor emissions from mains water consumption, wastewater treatment and the transport and treatment of waste from staff facilities.

7.8.19 At the time of writing this chapter only the transportation data for the operational workers to and from the Sites was available. Assuming a 30km distance of travel, the operational phase of the project would generate approximately 10 tCO2e as a result of operational workers travelling to and from the Sites twice a month for maintenance.

7.8.20 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.

7.8.21 The operational GHG emissions to be calculated will reflect a robust 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.

7.8.22 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 7.22) due to its high Global Warming Potential (GWP) of 23,900.

7.8.23 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 7.29) 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.

7.8.24 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 7.23). Any overall positive or negative effect is not anticipated to have a material impact on the outcome of the assessment.

7.8.25 Energy generation from the Scheme during the first year of operation is estimated to be 778,500 MWh. A standard assumed 0.55% degradation factor has been assumed for each subsequent year, resulting in an estimated energy generation figure of 624,382 MWh in the final year of operation, and a total energy generation figure of around 28,645,904 MWh over the estimated 40-year assessed lifetime.

7.8.26 At this stage only the construction phase GHG emissions can be used to estimate the GHG intensity of the scheme as a benchmark. Based on the total energy generation of the Scheme and the worst-case assumption for construction GHG emissions of 843,133 tCO_2e, the intensity of the Scheme is estimated to be 29.4 gCO_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 7.31).

Table 7.14: 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	29.4

7.8.27 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. The calculation has used the UK Government Conversion factor for UK Electricity from 2021 to calculate the tCO2e generated by the scheme year on year with a 0.55% reduction in efficiency per year. 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. Table 7.15 shows the expected year for the operation of the scheme to offset the construction emissions.

Table 7.15: Calculation of Savings to Offset Construction GHG Emissions

Year of Operation	GHG Savings as a Result of Scheme ($kgCO_2e$)	Offset from Construction Emissions (kgCO2e)
Year 1	165299	677,834
Year 2	164390	513,444
Year 3	163486	349,959
Year 4	162586	187,372
Year 5	161692	25,680
Year 6	160803	-135,123

7.8.28 As shown above, it is expected that the savings from the scheme would result in offsetting the construction emissions within 5-6 years of operation based on worst case assumptions used for the PEIR.

Significance of Effect (Operation)

7.8.29 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.

7.8.30 Compared to other types of electricity generation; the Scheme is expected to have a major beneficial impact on the climate.

7.8.31 The ES chapter will outline the complete estimated operational GHG emissions expected during the lifespan of the Scheme.

Decommissioning (2066 - 2067)

7.8.32 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.

7.8.33 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.

Significance of Effect (Decommissioning)

7.8.34 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 scale of the development, it is expected that the magnitude of effect will be low.

Overall GHG Impact

7.8.35 It is anticipated that the construction and decommissioning stages of the Scheme will result in a minor adverse impact on the climate. However, the overall operation stage will likely have a major beneficial impact.

Climate Change Resilience Review

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

7.8.37 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 7.16: 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)

7.8.38 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 7.17: 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

7.8.39 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.

Operation (2026 - 2065)

7.8.40 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 7.18: 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

Climate Risk	Receptor	Impact	Likelihood of Impact	Magnitude of Effect
Increased summer temperatures	Human Health	Health and safety risk due to increased risk of fire	As likely as not	High
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)

7.8.41 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

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

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

7.8.44 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.

In Combination Assessment

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

7.8.46 The risk of flooding 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 PEIR.

Table 7.19: 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 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	Very Low to High

Area	Flood Risk Summary	Likelihood of Impact
	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
Cottam Substation	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

7.8.47 While there is potential for some of Cottam to have increased chance of flooding as a result of the effects of Climate Change, the layout of the scheme can be 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. While this is to be finalised in the ES following completion of the EPD, the final product selection should seek to use products with the lowest embodied carbon wherever possible.

7.9.2 While worse 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 UKs Carbon Target of Net Zero by 2050.

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 that fall within the zone of influence around the location of the Scheme. With two of these planned developments being Nationally Significant Infrastructure Projects (NSIPs); it is anticipated that a cumulative effects assessment on GHG emissions will need to be undertaken and included in the ES.

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 would allow for consolidation of vehicle trips which would lead to less GHG emissions than if the construction periods were staggered. At this stage, it is unknown what these potential savings would be, and the cumulative effect is based on both schemes operating in isolation.

7.11.4 The cumulative effect of Construction emissions from the construction phase of West Burton Solar Project and the Cottam scheme has been calculated as part of this PEIR. The combined tCO_2e shown below.

Table 7.20: Cumulative Construction GHG Emissions

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Cumulative Annual Construction Emissions During Carbon Budget Period from Cottam and West Burton(tCO_2e)	Cumulative Construction Emissions as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	781,304	0.2003%

7.11.5 The cumulative effect of both construction periods concurrently would not result in an exceedance of 1% of the Carbon budget. The cumulative effect is not considered significant.

7.11.6 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 4th Carbon Budget but this will be confirmed following publication and review of the ES for that scheme. 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.

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