FENWICK SOLAR FARM

Fenwick Solar Farm
EN010152

Environmental Statement

Volume I Chapter 6: Climate Change

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6. Climate Change

6.1 Introduction

6.1.1 This chapter of the Environment Statement (ES) presents the assessment of the likely significant effects on the climate as a result of the proposed Fenwick Solar Farm (hereafter referred to as the 'Scheme'). It also presents an assessment of the impacts of climate change on the Scheme and receptors in the surrounding environment.

6.1.2 This chapter should be read in conjunction with the Scheme description provided in **ES Volume I Chapter 2: The Scheme [EN010152/APP/6.1]**, where a description of the Scheme is provided. Additionally, elements of climate change interface with the water environment and as such should be considered alongside **ES Volume I Chapter 9: Water Environment**.

6.1.3 No figures or drawings have been produced in relation to this chapter.

6.1.4 This chapter is supported by the following appendices in **ES Volume III [EN010152/APP/6.3]**:

a. **Appendix 6-1: Legislation, Policy and Guidance (Climate Change)**;

b. **Appendix 6-2: Climate Change Risk Assessment**; and

c. **Appendix 6-3: In-Combination Climate Change Impact (ICCI) Environmental Technical Disciplinary Risk Assessment**.

6.1.5 A glossary and list of abbreviations are defined in **ES Volume I Chapter 0: Table of Contents, Glossary and Abbreviations [EN010152/APP/6.1]**.

6.1.6 A Non-Technical Summary is presented in **ES Volume IV Non-Technical Summary [EN010152/APP/6.4]**.

6.1.7 In line with the requirements of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (Ref. 6-1), consideration has been given to the following aspects of climate change assessment:

a. **Lifecycle greenhouse gas (GHG) impact assessment**: the impact of GHG emissions arising from the Scheme on the climate over its design life (Section 5(2)(c) and Schedule 4, clauses 4 and 5 of the EIA Regulations);

b. **In-combination climate change impact (ICCI) assessment**: an in-combination climate change impact (ICCI) assessment identifies how the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Scheme (Section 5(2) of the EIA Regulations). The receptors have been identified by the relevant technical disciplines and includes receptors such as soil resources; and

c. **Climate change risk assessment (CCRA)**: the resilience of the Scheme to future climate change impacts, including damage to the Scheme as a result of climate change (Section 5(2) of the EIA Regulations).

6.2 Legislation, Policy and Guidance

6.2.1 The legislation, policy, and guidance related to climate change, as detailed in **ES Volume III Appendix 6-1 Legislation Policy and Guidance (Climate Change) [EN010152/APP/6.3]**, and pertinent to the Scheme, are outlined below.

Legislation

6.2.2 Legislation that has been considered includes:

a. The Infrastructure Planning (Environmental Impact Assessment (EIA)) Regulations 2017: Section 5(2) and Schedule 4, clauses 4 and 5 (Ref. 6-1);

b. Climate Change Act 2008 (Ref. 6-2);

c. UK Nationally Determined Contribution (2020) (Ref. 6-3);

d. UK Updated Nationally Determined Contribution (2022) (Ref. 6-4)

e. The Carbon Budgets Order 2009 (Ref. 6-5);

f. The Carbon Budget Order 2011 (Ref. 6-6);

g. The Carbon Budget Order 2016 (Ref. 6-7);

h. The Carbon Budget Order 2021 (Ref. 6-8); and

i. The Paris Agreement (2015) (Ref. 6-9).

National Policy

6.2.3 National policy that has been considered includes:

a. UK Climate Change Risk Assessment (2022) (Ref. 6-10);

b. Net Zero Strategy: Build Back Greener (2020) (Ref. 6-11);

c. Energy white paper: Powering our Net Zero future (2020) (Ref. 6-12);

d. National Infrastructure Strategy (2020) (Ref. 6-13);

e. National Policy Statement for Energy (NPS EN-1) (November 2023) (Ref. 6-14);

f. National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) (November 2023) (Ref. 6-15);

g. National Policy Statement for Electricity Networks Infrastructure (NPS EN-5) (November 2023) (Ref. 6-16);

h. National Planning Policy Framework (December 2023) (Ref. 6-17); and

i. Powering Up Britain: Net Zero Growth Plan (2023) (Ref. 6-18).

Local Policy

6.2.4 Local policies that have been considered include:

a. Doncaster Local Plan 2015–2035 adopted September 2021 (Ref. 6-19); and

b. Barnsley, Doncaster, and Rotherham Joint Waste Plan adopted 2012 (Ref. 6-20).

Guidance

6.2.5 Supporting guidance that has been considered includes:

a. World Business Council for Sustainable Development and World Resources Institute GHG Protocol guidelines (Ref. 6-21);

b. Planning Practice Guidance, Climate Change (Ref. 6-22);

c. Net Zero Strategy (2021) (Ref. 6-23);

d. Publicly Available Standard (PAS) 2080:2023 (Ref. 6-24);

e. Institute of Environmental Management and Assessment (IEMA) (2022) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref. 6-25); and

f. IEMA (2020) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation (Ref. 6-26).

6.2.6 More detailed information regarding the above legislation, policy and guidance can be found in **ES Volume III Appendix 6-1: Legislation, Policy and Guidance (Climate Change) [EN010152/APP/6.3]**.

6.3 Consultation

6.3.1 This section provides a summary of the consultation undertaken to date regarding the Scheme. Further detail on the consultation can also be found in **ES Volume I Chapter 4: Consultation [EN010152/APP/6.1]**.

Scoping Opinion

6.3.2 A scoping exercise was undertaken in spring 2023 to establish the content of the assessment and the approach and methods to be followed. The scoping exercise outcomes were presented in the Scoping Report (**ES Volume III Appendix 1-1: EIA Scoping Report [EN010152/APP/6.3]**) which was submitted to the Planning Inspectorate on 1 June 2023. The Scoping Report records the findings of the scoping exercise and details the technical guidance, standards, good practice, and criteria to be applied in the assessment to identify and evaluate the likely significant effects of the Scheme on climate change.

6.3.3 A Scoping Opinion was received from the Planning Inspectorate on 11 July 2023 (**ES Volume III Appendix 1-2: EIA Scoping Opinion [EN010152/APP/6.3]**).

6.3.4 A full review of all comments raised in the Scoping Opinion is provided in **ES Volume III Appendix 1-3: EIA Scoping Opinion Responses [EN010152/APP/6.3]**. This outlines how and where the Scoping Opinion comments have been addressed within this ES.

Statutory Consultation

6.3.5 In addition to the non-statutory consultation that was held in 2023, formal statutory consultation was held in Spring 2024 and included the issuing of the missing further consultation in response to formal pre-application engagement was undertaken through the Preliminary Environmental Information Report (PEIR) as an initial assessment of the Scheme for

comment. Responses to statutory consultation are presented in the **Consultation Report [EN010152/APP/5.1]**.

6.3.6 Statutory consultation responses relating to climate change are presented in the **Consultation Report [EN010152/APP/5.1]**. The key topics identified in these responses (which are provided in full within **Consultation Report Appendix O4: Section 47 Responses to Statutory Consultation and the Applicant's responses [EN010152/APP/5.2]**) and relevant to the assessment presented in this ES chapter are summarised below.

Scheme Sustainability

6.3.7 Responses flagged concerns that the Scheme was not sustainable or green. This ES chapter presents the findings of an assessment of the likely significant effects of the proposed Scheme on climate change. This assessment has been informed by a climate change risk assessment, lifecycle greenhouse gas impact assessment, and in-combination climate change impact assessment. This chapter identifies and proposes measures to address the potential impacts and likely significant effects of the Scheme on climate change, during the construction, operation, and decommissioning phases of the Scheme. The assessment also highlights the Scheme's contribution towards Net Zero through carbon emissions savings. In addition, wider sustainability issues such as Biodiversity Net Gain is discussed in **ES Volume I Chapter 8: Ecology [EN010152/APP/6.1]**.

Sustainable Transport

6.3.8 Responses also raised questions regarding employees' use of sustainable transport. **Framework Construction Environmental Management Plan [EN010152/APP/7.7]** and **Framework Construction Traffic Management Plan [EN010152/APP/7.17]** include measures to enhance employee awareness of sustainable transport and facilitate its use. These are detailed in **ES Volume I Chapter 13: Transport and Access [EN010152/APP/6.1]**. Additionally, the GHG emissions associated with employee transport have been considered as part of the GHG Assessment.

Scheme's Carbon Emissions

6.3.9 Responses also stated that carbon emissions from the construction phase are too high to offset. This ES chapter analyses the Scheme's lifecycle GHG emissions (including both construction and operational emissions) and demonstrates that will result in savings of approximately 3.5 million tCO_2e compared with the equivalent quantity of electricity being produced by a gas-fired Combined Cycle Gas Turbine (CCGT).

6.4 Assessment Methodology

6.4.1 This section sets out the scope and methodology for the assessment of the impacts of the Scheme on climate change.

Study Area

Lifecycle GHG Impact Assessment

6.4.2 The Study Area for the GHG impact assessment covers all direct GHG emissions arising from activities undertaken within the Order limits during the

construction, operation and maintenance, and decommissioning phases of the Scheme. It also includes indirect emissions arising outside the Order limits, for example emissions embedded within the construction materials arising as a result of the energy used for their production, as well as emissions arising from the transportation of materials, waste, and construction workers.

6.4.3 The Study Area also includes activities that may be avoided or displaced as a result of the Scheme, such as other grid electricity production activities.

In-Combination Climate Change Impact Assessment

6.4.4 The Study Area for the ICCI assessment has been defined taking into account the environmental assessments reported within the ES. This includes all the identified environmental receptors identified within the assessments undertaken and reported within the ES. The sensitive receptors for the ICCI assessment are those identified by each discipline in their assessment. The Study Area for the ICCI assessment is therefore as identified by each discipline for their individual assessments.

6.4.5 The methodology used by the environmental disciplines to identify ICCIs is described in Paragraph 6.4.26, and the ICCIs identified by other environmental disciplines are summarised in **ES Volume III Appendix 6-3: In-Combination Climate Change Impact Environmental Technical Disciplinary Risk Assessment [EN010152/APP/6.3].**

Climate Change Risk Assessment

6.4.6 The Study Area for the CCRA (**ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**) is the area within the Order limits, i.e. it covers the construction, operation and maintenance, and decommissioning of all assets and infrastructure which constitute the Scheme.

Sources of Information

6.4.7 In preparation of this chapter, the following sources of published information have been referenced:

Lifecycle GHG Impact Assessment

6.4.8 Where available, the project team provided data required to undertake the lifecycle GHG impact assessment and analysed using the methodology outlined below from Paragraph 6.4.14. Where data was unavailable, reasonable assumptions have been made based on professional judgement.

Climate Change Risk Assessment and In-combination Climate Change Impact Assessment

6.4.9 Historical climate data obtained from the Met Office website (Ref. 6-27) has been used to determine the current baseline conditions for the Doncaster region.

6.4.10 In line with updated NPS EN-1 (which came into force in January 2024) (Ref. 6-14) requirements in Paragraphs 4.10.13 and 4.10.17 to use the latest UK Climate Projections 2018 (UKCP18) (Ref. 6-28), data was obtained from those Projections to determine the future baseline conditions.

6.4.11 The IPCC AR6 Sea Level Projection Tool (Ref. 6-29) and Thinkhazard (Ref. 6-30) were also used for other projected trends/impacts, and the UK Climate Change Risk Assessment analysed (per the direction in Paragraph 4.10.17 of NPS EN-1 (January 2024)) for the current state of nationwide climate change risks (Ref. 6-14).

6.4.12 Climate change resilience measures that have been built into the Scheme design were determined in liaison with the Applicant's design team and relevant environmental discipline leads and are set out in (**ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**).

Methodology

6.4.13 This section sets out the scope and methodology for the assessment of the impacts of the Scheme on climate change.

Lifecycle GHG Impact Assessment

6.4.14 The GHG assessment followed a project lifecycle approach to calculate estimated GHG emissions arising from the construction, operation and maintenance, and decommissioning phases of the Scheme and to identify GHG 'hot spots' (i.e. emissions sources likely to generate the largest amount of GHG emissions). This enabled the identification of priority areas for mitigation in line with the principles set out in IEMA guidance (Ref. 6-25).

6.4.15 In line with the World Business Council for Sustainable Development and World Resources Institute GHG Protocol guidelines (Ref. 6-21), the GHG assessment was reported as tonnes of carbon dioxide equivalent (tCO_2e) and considered the seven Kyoto Protocol gases:

a. Carbon dioxide (CO_2);
b. Methane (CH_4);
c. Nitrous oxide (N_2O);
d. Sulphur hexafluoride (SF_6);
e. Hydrofluorocarbons (HFCs);
f. Perfluorocarbons (PFCs); and
g. Nitrogen trifluoride (NF_3).

6.4.16 These GHGs are broadly referred to in this chapter under an encompassing definition of 'GHG emissions', with the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (Mega tonnes of CO_2 equivalent).

6.4.17 Table 6-1 summarises the key anticipated GHG emissions sources associated to the Scheme by lifecycle stage, in line with Publicly Available Standard (PAS) 2080:2023 – Carbon Management in Infrastructure and Built Environment (Ref. 6-24).

Table 6-1: Potential Sources of GHG Emissions

Lifecycle Stage	Activity	Primary Emission Sources
Production phase	Raw material extraction and manufacturing of products	Embodied GHG emissions from energy use in the extraction of materials and

Lifecycle Stage	Activity	Primary Emission Sources
	required to build the equipment for the Scheme.	manufacture of components and equipment. Emission of potent GHGs during manufacture, such as sulphur hexafluoride (SF_6).
	Transportation of materials for processes/manufacturing (where available).	GHG emissions from transportation of products and materials during their processing and manufacture. Due to the nature of the equipment, this could require shipment of certain aspects over significant distances. Transport of materials to the Site is included under construction phase where it is not included in embodied GHG emissions.
Construction phase	On-site construction activity including emissions from construction compounds.	Energy (electricity, fuel, etc.) consumption from plant and vehicles, generators on-site, and construction worker commuting.
	Transportation of construction materials to the Site. Due to the nature of the equipment required, this could require shipment of certain aspects over significant distances.	GHG emissions from transportation of materials to and from the Site.
	Transportation of construction workers to and from the Site.	GHG emissions from transportation of workers to and from the Site.
	Disposal of any waste generated by the construction phase.	GHG emissions from disposal and transportation of waste.
	Land use change.	GHG emissions from net loss/gain of carbon sink. Given the nature of the Scheme it is likely that the carbon capture potential of soils will increase.
	Water use.	GHG emissions associated with the provision of potable water, and treatment of wastewater.

Lifecycle Stage	Activity	Primary Emission Sources
Operation and Maintenance phase	Operation and maintenance phase of the Scheme.	GHG emissions from energy consumption, provision of potable water, treatment of wastewater, and transportation effects for worker travel. These operational aspects are expected to be negligible in the context of overall GHG emissions of the Scheme's lifecycle. Leakage of potent GHGs during the operation and maintenance phase, such as SF_6 (derived from certain electric items such as gas-insulated switchgear and gas-insulated transformers during the production and operation and maintenance phases through leakage, and dismantling).
	Maintenance of the Scheme.	GHG emissions from energy consumption, transportation of maintenance workers and materials, material use and waste generation as a result of site maintenance.
Decommissioning phase	On-site decommissioning activities.	Energy (electricity, fuel, etc.) consumption from plant, vehicles and generators within the Order limits.
	Transportation and disposal of waste materials.	GHG emissions from disposal and transportation of waste.
	Transportation of workers.	GHG emissions from transportation of workers to and from the Site.

6.4.18 Expected GHG emissions arising from construction and decommissioning phases, embodied carbon in materials and operation and maintenance emissions of the Scheme, as well as baseline emissions, have been quantified using a calculation-based methodology as per the following equation, and aligned with the GHG Protocol (Ref. 6-21):

Activity data x GHG emissions factor = GHG emissions

6.4.19 Department for Energy Security and Net Zero (DESNZ) 2024 emissions factors (Ref. 6-36) and embodied carbon data from the University of Bath

Inventory of Carbon and Energy (ICE) (Ref. 6-37) have been used as the primary data sources for calculating GHG emissions.

6.4.20 The sensitivity of the receptor (i.e. the 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. Also, the extreme importance of limiting global warming to below 2°C this century is broadly asserted by the International Paris Agreement (Ref. 6-9) and the climate science community.

Significance Criteria

6.4.21 When evaluating the significance of the GHG emissions, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its design life, which may be positive, negative or negligible. The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050.

6.4.22 For the GHG impact assessment, the magnitude of impact considers the output of the GHG quantification process, i.e. the Scheme's GHG lifecycle footprint, in the context of its contribution to the UK's carbon budgets and the possible impact of the Scheme on the UK meeting its net-zero target. Emissions from the Scheme will be presented as a percentage of the carbon budget period under which they fall.

6.4.23 According to the IEMA guidance on assessing GHG emissions in EIA (Ref. 6-25), "*GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant*".

6.4.24 IEMA guidance describes five distinct levels of significance, which consider not only whether a project emits GHG emissions, but also how the project contributes towards a science-based transition to Net Zero, aligned with the goal of limiting global temperature rise to 1.5°C.

6.4.25 A 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily indicate that GHG emissions are carbon neutral (i.e., zero on balance). Instead, it reflects the alignment of project emissions with a science-based trajectory compatible with limiting global temperature rise to 1.5°C, while also contributing towards achieving Net Zero by 2050.

6.4.26 A project's impact can shift from significant adverse to non-significant adverse effects by incorporating mitigation measures that substantially improve on business-as-usual and meet or exceed the science-based emissions trajectory of ongoing but declining emissions towards Net Zero.

6.4.27 Table 6-2 presents the different significance levels as per the latest version of the IEMA guidance, which emphasises that "…*a project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area-based transition targets, results in a significant adverse effect. It is down to the*

practitioner to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects."

Table 6-2: Definition of Levels of Significance

Significance Level	Effects	Description in the IEMA Guidance	Example in the IEMA Guidance
Significant adverse	Major adverse	A project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area-based transition targets, results in a significant adverse effect. It is down to the practitioner to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects.	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.
	Moderate adverse	As above	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.
Not significant	Minor adverse	A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that has a minor adverse effect that is not significant. It may have residual emissions but is doing enough to align with and contribute to the relevant	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.

Significance Level	Effects	Description in the IEMA Guidance	Example in the IEMA Guidance
		transition scenario, keeping the UK on track towards net zero by 2050 with at least a 78% reduction by 2035[1] and thereby potentially avoiding significant adverse effects.	
	Negligible	A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a negligible effect that is not significant. This project is playing a part in achieving the rate of transition required by nationally set policy commitments.	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.
Significant	Beneficial	A project that causes GHG emissions to be avoided or removed from the atmosphere. Only projects that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

6.4.28 IEMA guidance (Ref. 6-25) also states it is down to the professional judgement of the practitioner to determine how best to contextualise a project's GHG impact and assign the level of significance. It is suggested that sectoral, local, or national carbon budgets can be used, as available and appropriate, to contextualise a project's GHG impact and determine the level of significance. The approach adopted for the purposes of this assessment is outlined below.

6.4.29 Where available, UK national carbon budgets (Ref. 6-8) have been used for the purposes of this assessment to represent future emissions inventory scenarios for the UK. These legally binding targets, which outline the total amount of GHGs that the UK can emit over a 5-year period, are currently

[1] Or other science-based 1.5°C compatible trajectory as may be defined for a specific sector or local area, as applicable.

available up to the 6th Carbon Budget period (2033–2037). The UK is currently in the 4th Carbon Budget period, which runs from 2023 to 2027. The 3rd, 4th and 5th Carbon Budgets reflect the previous 80% reduction target by 2050. The 6th Carbon Budget aligns with the legislated 2050 net zero target.

6.4.30 The annual average GHG impact of the Scheme has been compared against the annualised carbon budget for the period in which the emissions arise to allow separate assessment of each lifecycle stage. The construction programme of the Scheme (anticipated to be 2028 to 2030) spans the 5th Carbon Budget period (2028 to 2032).

6.4.31 Operation and maintenance GHG emissions as a result of the Scheme (assumed to be fully operational by 2030 at the earliest) have been compared to all the appropriate and available carbon budgets within the design life of the Scheme: the 4th, 5th and 6th Carbon Budgets (2023 to 2027, 2028 to 2032 and 2033 to 2037, respectively).

6.4.32 In order to illustrate the Scheme trajectory towards net-zero by 2050, the Climate Change Committee's (CCC) balanced net zero pathway is utilised post-2037, in the absence of any nationally legally binding Carbon Budgets after the 6th Carbon Budget. The CCC is expected to advise the UK Government on the level of its 7th Carbon Budget in early 2025. Beyond 2050, it is implied that the UK will remain at net zero.

6.4.33 The CCC balanced net-zero pathway has been divided into 5-year periods between 2037 and 2050 to match the time period of the legally binding UK carbon budgets, and the proposed budgets up to 2050 are in line with the UK's 1.5-degree trajectory (as detailed in Table 6-3).

6.4.34 However, it should be noted that the CCC's proposed carbon budgets beyond 2037 have not been formally adopted by the government or ratified by parliament and can therefore only be used as an indicative measure to contextualise the Scheme's progress toward the national net-zero trajectory.

6.4.35 It is noted that the contribution of most individual projects to national-level budgets will be small and so the UK context will have limited value. This GHG assessment therefore uses the IEMA guidance to assess the significance of effects (Ref. 6-25), with the UK carbon Budgets being used to provide context to the GHG emissions (Ref. 6-8).

Table 6-3: UK carbon budgets and indicative carbon budgets based upon the CCC's Balanced Net Zero Pathway

Carbon Budget	Cumulative UK Carbon Budget ($MtCO_2e$)	Cumulative Indicative Carbon Budget Totals Based Upon the CCC's Balanced Net-Zero Pathway ($MtCO_2e$)
4th (2023–2027)	1,950	—
5th (2028–2032)	1,725	—
6th (2033–2037)	965	—
7th (2038–2042)	—	*526*
8th (2043–2047)	—	*195*
9th (2048–2050)	—	*17*

6.4.36 In addition to providing advice that underpins setting UK carbon budgets, the CCC also provides sector-specific decarbonisation pathways (Ref. 6-38). Table 6-4 presents the electricity generation sector-specific carbon budgets as further context to the GHG emissions assessment. However, it should be noted that these are not legislated like the national-level budgets.

Table 6-4: Sector-Specific Electricity Generation carbon budgets based upon the CCC's Balanced Net Zero Pathway

Carbon Budget Period	Recommended Carbon Budget ($MtCO_2e$)
2023–2027	189.16
2028–2032	92.56
2033–2037	35.74
2038–2042	23.22
2043–2047	12.36
2048–2050	4.03

Climate Change Risk Assessment

6.4.37 The EIA Regulations require the inclusion of information on the vulnerability of the Scheme to climate change. Consequently, the CCRA for the Scheme has been conducted which identifies potential climate change impacts. In the Scoping Report (**ES Volume III Appendix 1-1 [EN010152/APP/6.3]**) this was referred to as the Climate Change Resilience Review, but terminology has been updated to reflect the recent update to the IEMA guidance (Ref. 6-26).

6.4.38 The CCRA has included all infrastructure and assets associated with the Scheme. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UKCP18 projections.

6.4.39 The review of potential impacts and the Scheme's vulnerability considers the embedded mitigation measures that have been designed into the Scheme, discussed in Section 6.6.

6.4.40 The assessment has considered Climate Projections over a 40-year period from the Scheme's commissioning, assumed to be 2030.

6.4.41 Climate parameters considered in the CCRA during the construction, operation and maintenance, and decommissioning phases of the Scheme include the following:

a. Extreme weather events;

b. Flood risk;

c. Sea level rise;

d. Temperature change; and

e. Precipitation change.

6.4.42 The CCRA has been undertaken for the Scheme to identify potential climate change impacts on the Scheme and associated receptors, and to consider their potential consequence and likelihood of occurrence, taking account of the adaption measures embedded into the design of the Scheme (Section 6.6).

6.4.43 Climate change projections for the Scheme during the enabling works and construction phase have been examined against receptors. Construction phase receptors of the Scheme include the workforce, plant, machinery, and materials.

6.4.44 Heatwaves and other extreme weather events could present a risk to site workers. Climate change impacts during construction (expected to be approximately two years from 2028 to 2030) were therefore considered in the CCRA, covering effects like heat exhaustion and exposure to dangerous weather conditions.

6.4.45 For the operation and maintenance phase of the Scheme, potential climate change impacts on the Scheme have been identified using relevant projections from UKCP18 and the CCRA considers their potential consequence to receptors and likelihood of occurrence, taking account of the measures incorporated into the design of the Scheme where available. The CCRA therefore considers the impact of climate change on the Scheme itself including the Scheme's infrastructure (for example the Solar PV Panels and other equipment, the workers on Site, during operation and maintenance, and refurbishment and any landscaping, and habitat creation being undertaken as part of the Scheme.

6.4.46 The following key terms and definitions relating to the CCRA have been used:

a. Climate risk – a weather or climate related event, which has potential to do harm to environmental or community receptors or assets, for example, increased winter precipitation;

b. Climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and

c. Consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

6.4.47 A stepped approach is used to assess the impacts of climate change on the Scheme:

a. Identify potential climate hazards;

b. Identify likelihood of climate impact occurring;

c. Identify consequence of impact on the Scheme; and

d. Identify significance of impact (likelihood of impact occurring x consequence of impact).

6.4.48 Once potential climate impacts have been identified (e.g. heatwaves), the likelihood of their occurrence during the construction, operation and maintenance, and decommissioning phases is categorised.

6.4.49 The criteria which have been used to determine the likelihood of a climate change impact occurring are detailed in Table 6-5. For example, a climate hazard could be a heatwave, while the climate impact is the impact on the Scheme, e.g. overheated electrical equipment.

Table 6-5: Level of Likelihood of a Climate Change Risk Occurring

Likelihood Category	Qualitative description (frequency of occurrence)	Quantitative description (probability of occurrence)
Rare	Highly likely to occur	5%
Unlikely	Unlikely to occur	20%
Moderate	As likely to occur as not	50%
Likely	Likely to occur	80%
Almost certain	Very likely to occur	95%

6.4.50 After identifying climate hazards, the consequences of climate impacts have been evaluated in accordance with the criteria outlined in Table 6-6. For instance, the permanent damage to electrical equipment caused by heatwaves may lead to a complete loss of operation. The categories and descriptions provided below are based on the EU Technical Guidance on the climate proofing of infrastructure in the period 2021-2027 (Ref. 6-31).

Table 6-6: Level of Consequence of a Climate Change Impact Occurring

Risk areas	Insignificant	Minor	Moderate	Major	Catastrophic
Asset damage/Engineering/ Operational	Impact can be absorbed through	An adverse event that can be absorbed by taking	A serious event that requires additional	A critical event that requires extraordinary	Disaster with the potential to lead to shut down or

Risk areas	Insignificant	Minor	Moderate	Major	Catastrophic
	normal activity	business continuity actions	emergency business continuity actions	/emergency business continuity actions	collapse or loss of the asset/network
Safety and Health	First aid case	Minor injury, medical treatment	Serious injury or lost work	Major or multiple injuries, permanent injury, or disability	Single or multiple fatalities
Environment	No impact on baseline environment. Localised in the source area. No recovery required	Localised within site boundaries. Recovery measurable within one month of impact	Moderate harm with possible wider effect. Recovery in one year	Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations/consent	Significant harm with widespread effect. Recovery longer than one year. Limited prospect of full recovery
Social	No negative social impact	Localised, temporary social impacts	Localised, long-term social impacts	Failure to protect poor or vulnerable groups (1). National, long-term social impacts	Loss of social licence to operate. Community protests
Financial (for single extreme event or annual average impact) (**)	x % IRR (***) < 2 % of turnover	x % IRR 2 – 10% of turnover	x % IRR 10 – 25% of turnover	X % IRR 25 – 50% of turnover	x % IRR >50% of turnover
Reputation	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short- term impact on public opinion; negative national media coverage	National, long-term impact with potential to affect the stability of the Government
Cultural heritage and cultural premises	Insignificant impact	Short term impact. Recovery or repair.	Serious damage with wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society

(1) Including groups that depend on natural resources for their income/livelihoods and cultural heritage (even if not considered poor) and groups considered poor and vulnerable

Risk areas	Insignificant	Minor	Moderate	Major	Catastrophic

(and often that have less capacity to adapt) as well as persons with disabilities and older persons.

(*) The ratings and values suggested here are illustrative. The project promoter and climate-proofing manager may choose to modify them.

(**) Example indicators – other indicators that may be used including costs of immediate/long-term emergency measures; restoration of assets; environmental restoration; indirect costs on the economy, indirect social costs.

(***) Internal Rate of Return (IRR).

Significance Criteria

6.4.51 The significance of the CCRA is determined as a function of the likelihood of a climate change hazard occurring (Table 6-5) and the consequence to the receptor if the hazard occurs (Table 6-6). This is detailed in Table 6-6, where N = negligible, L = Low, M = Moderate, and H = High. The significance is then detailed in Table 6-7. The assessment takes into account confirmed design and mitigation measures (referred to as embedded mitigation as set out in Section 6.9).

Table 6-7: Significance of Effect Matric for Climate Change Risk Assessment

		Likelihood of Climate-Related Impact Occurring				
		Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Level of consequence of a climate risk occurring	Rare	Low (NS)	Low (NS)	Medium (NS)	Medium (NS)	Medium (NS)
	Unlikely	Low (NS)	Low (NS)	Medium (NS)	High (S)	High (S)
	Moderate	Low (NS)	Medium (NS)	High (S)	High (S)	Extreme (S)
	Likely	Medium (NS)	High (S)	High (S)	Extreme (S)	Extreme (S)
	Almost certain	Medium (NS)	High (S)	Extreme (S)	Extreme (S)	Extreme (S)

Note: S = significant; NS = not significant

6.4.52 The Scheme's resilience to climate change was considered qualitatively during construction, operation and maintenance, and decommissioning phases. This was completed in liaison with the Scheme's design team and the other technical specialists by considering the climate projections for the geographical location and timeframe of the Scheme. The assessment has been undertaken in line with IEMA guidance (Ref. 6-26) on climate change resilience.

6.4.53 In line with standard methodology, the significance of climate resilience was not assessed. Instead, a statement was provided to describe how the Scheme has been designed to be as resilient as reasonably practicable to future climate change.

In-combination Climate Change Impact Assessment

6.4.54 The ICCI assessment has considered the ways in which projected climate change will influence the significance of the impact of the Scheme on receptors in the surrounding environment.

6.4.55 The ICCI assessment has considered the existing and projected future climate conditions for the geographical location and assessment timeframe. It identifies the extent to which identified receptors in the surrounding environment are potentially vulnerable to and affected by these factors. The receptors for the ICCI assessment are those that will be impacted by the Scheme. These impacts have been assessed in liaison with the technical specialists responsible for preparing the applicable technical chapters in **ES Volume I [EN010152/APP/6.1]**, listed below:

a. **Chapter 7: Cultural Heritage**;
b. **Chapter 8: Ecology**;
c. **Chapter 9: Water Environment**;
d. **Chapter 10: Landscape and Visual Amenity**;
e. **Chapter 11: Noise and Vibration**;
f. **Chapter 12: Socio-economics and Land Use**;
g. **Chapter 13: Transport and Access**; and
h. **Chapter 14: Other Environmental Topics** (Air Quality, Glint and Glare, Ground Conditions and Waste and Materials).

6.4.56 Additionally, the Arboricultural specialists who prepared the **Arboricultural Impact Assessment** (**ES Volume III Appendix 10-7 [EN010152/APP/6.3]**) also provided input.

6.4.57 Once potential ICCIs were identified in relation to the Scheme, the likelihood of their occurrence during construction, operation and maintenance, and decommissioning phases was categorised. This is the same process as is undertaken for the CCRA, as detailed in Table 6-5.

6.4.58 In consideration of the likelihood of the climate risk occurring, and the sensitivity of the receptor, the likelihood of an impact occurring to the receptor is then defined. This includes consideration of any embedded mitigation measures and good practice. These classifications are defined in Table 6-8.

6.4.59 Once the likelihood of an ICCI has been identified the assessment then considers how this will affect the significance of the identified effects.

6.4.60 The ICCI consequence criteria are defined in Table 6-8 and are based on the change to the significance of the impact already identified by the environmental discipline. To assess the consequence of an ICCI each discipline has assigned a level of consequence to an impact based on the criteria description and their discipline assessment methodology.

Table 6-8: Consequence criteria for ICCI assessment

Consequence	Consequence criteria
High	The climate change parameter in-combination with the effect of the Scheme causes the significance of the impact of the Scheme on the resource/receptor, as defined by the topic, to increase from negligible, low, or moderate to major.
Moderate	The climate change parameter in-combination with the effect of the Scheme causes the effect defined by the topic to increase from negligible or low, to moderate.
Low	The climate change parameter in-combination with the effect of the Scheme, causes the significance of effect defined by the topic, to increase from negligible to low.
Negligible	The climate change parameter in-combination with the effect of the Scheme does not alter the significance of the effect defined by the topic.

Significance Criteria

The significance of potential effects is determined using the matrix in Table 6-9**.** Where an effect has been identified as moderate or high, against the matrix in Table 6-9, these will be classed as a significant ICCI effect. If significant ICCI effects are assessed, then appropriate additional mitigation measures (secondary mitigation) are identified.

Table 6-9: ICCI significance criteria

		Likelihood of climate-related impact occurring			
		Negligible	**Low**	**Moderate**	**High**
Level of consequence	**Negligible**	NS	NS	NS	NS
	Low	NS	NS	NS	S
	Moderate	NS	NS	S	S
	High	NS	S	S	S

Note: S = significant; and NS = not significant

Matters Scoped In and Scoped Out

6.4.61 A summary of the elements scoped into the and out of the assessment of climate change is presented in Table 6-10. This was informed by the Scoping Opinion received from the Planning Inspectorate on 11 July 2023 (**ES Volume III Appendix 1-2: EIA Scoping Opinion [EN010152/APP/6.3]**).

Table 6-10: Elements scoped in and out of the assessment of climate change

Element	Scoped In/ Scoped Out
GHG impact assessment (construction, operation and decommissioning).	Scoped in and will cover all aspects of the Scheme's development (direct and indirect) from raw products

Element	Scoped In/ Scoped Out
	and manufacture of materials, through to construction, operation and decommissioning.
In-combination climate impact assessment (construction, operation and decommissioning).	The impacts of temperature change, precipitation change and changing wind patterns on receptors in the surrounding environment including biodiversity, are scoped in. They are predicted to have a potential impact upon receptors identified by other environmental disciplines. Assessment of changes in sea level has been scoped out as the Scheme is not located in an area that is susceptible to sea level rise.
Climate change resilience review (construction, operation and decommissioning).	Scoped in. This will consider the vulnerability of the Scheme to extreme weather events and changes in temperature, precipitation and wind patterns. Assessment of changes in sea level has been scoped out as the Scheme is not located in an area that is susceptible to sea level rise.

Assumptions, Limitations and Uncertainties

GHG Assessment

6.4.62 The climate change assessment has been based on the parameters outlined in **ES Volume I Chapter 2: The Scheme [EN010152/APP/6.1].** The entire Site has been considered together when considering the effects of the Scheme on climate (and the impacts of climate change on the Scheme), and the effects are presented for the Scheme as a whole.

6.4.63 This chapter forms an assessment which has been based on available information at the time of preparing the ES. The technology for solar photovoltaic (PV) continues to evolve. The 'Rochdale Envelope' approach (**ES Volume I Chapter 5: Environmental Impact Assessment Methodology [EN010152/APP/6.1]**) has been applied within the EIA to ensure a robust assessment of the likely significant environmental effects of the Scheme while maintaining commercial flexibility to meet the changing demands of the UK market. This approach assesses maximum parameters for the Scheme, however, any adverse impacts are expected to be lower as a result of developing technology.

6.4.64 Where detailed information is not available regarding energy use, types and quantities of materials used, or the embodied carbon of key features of the assets, precautionary assumptions have been made based on industry approximations and professional good practice.

6.4.65 The largest single source of GHG emissions from the Scheme is likely to result from the manufacture and transport of Solar PV Panels and Battery Energy Storage System (BESS) Area components. The infrastructure manufacturer has not been confirmed and therefore for the purposes of estimating the GHG impact of the Scheme, a conservative estimate is to

assume that the Solar PV Panels will be sourced from China (or a country of similar distance from the UK). This will increase the embodied and transport emissions compared to the Solar PV Panels being sourced from Europe. This assumption is consistent with assessments undertaken for other large scale UK solar schemes.

6.4.66 The GHG Assessment assumes the BESS Area will be constructed and operated. The DCO Application also has the flexibility to install additional solar PV instead of the proposed BESS Area. If additional solar PV is installed, it will likely reduce the Scheme's net GHG emissions.

6.4.67 There is limited data available from Environmental Product Declarations (EPDs) for PV panels, an estimation of 286 kgCO_2e/kWp was taken as an average of published EPD data from manufacturers Jinko and SunPower (see Ref. 6-42 and Ref. 6-43). This is inclusive of the associated accessory equipment (i.e. support wiring, inverters and optimisers). The estimation is associated with Monocrystallline PV modules, which would meet the requirements of the project.

6.4.68 Minimum yields for the Scheme are assumed to be 1018 kilowatt hours per kilowatt peak per year (kWh/kWp/yr), with the output of the Solar PV Panels assumed to degrade by 2% in the first year and by 0.45% per year. For an installation rated at 353.6 MWp (megawatt peak), an oversized AC peak operating for 40 years of lifetime generation is estimated at 12,940 gigawatt hours (GWh) of electricity.

6.4.69 In areas of archaeological mitigation of the Solar PV Site (as defined within the **Archaeological Mitigation Strategy [EN010152/APP/7.19]**) the Solar PV Panels may be fixed using pre-cast concrete blocks. Total weight of concrete blocks for the solar PV panes has been assumed to be 4000 tonnes.

6.4.70 For transportation distances of construction materials to the Scheme, the default scenarios from the Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment were used (Ref. 6-33).

6.4.71 The BESS Area is assumed to have a 950 MWh storage capacity, with a carbon intensity of 78 kg CO_2e per kWh (Ref. 6-34). This emission factor also considers projected Chinese grid decarbonisation, providing a more realistic estimate of the carbon emissions from manufacturing the BESS Area. It was assumed the BESS Container was replaced every 15 years over a 40 year period.

6.4.72 Concrete foundation requirements for the BESS Area, On-Site Substation, and Field Stations were derived from GIS data.

6.4.73 Based on EPD ranges, the aggregate to be used at the Scheme was assumed to have a density of 2.4 tonnes/m^3.

6.4.74 For construction workers' transportation to the Scheme, it was assumed that 250 workers would commute during the first 18 months of construction, reducing to 225 workers for the final 6 months. Each worker was assumed to travel an average of approximately 39 km per day. It is also assumed that minibuses will be used to transport construction workers to and from the site.

6.4.75 It was assumed that 5% of all construction materials would go to waste, with 70% being recycled and 30% sent to landfill. The waste was split by material type using the latest 2024 emission factors from DESNZ. In addition, for

materials such as paperboard, wood, plastic, and construction energy use, these were prorated based on a similar type of Scheme, using MW intensity as the basis for comparison.

6.4.76 It is assumed that 10% of the panels will need to be replaced on an ad hoc basis for repairs/failures. The embodied emissions from these replacement panels are included in the operational emissions calculations.

6.4.77 It was assumed that during operation, a backup 350 kW diesel generator would need to operate for 8 hours per year over a span of 40 years, using 100% mineral diesel. Emission calculations were based on the 2024 emission factors from DESNZ, including well-to-tank emissions.

6.4.78 When data was unavailable for life cycle stages, such as energy and fuel use during construction and operational energy use, emission data from the Sunnica Solar DCO was utilised (Ref. 6-35). This is because the Sunnica Solar DCO is of a similar scale and is therefore considered representative.

6.4.79 Sulphur hexafluoride (SF_6) is an extremely powerful GHG with a global warming potential (GWP) of 23,900. Fugitive emissions of SF_6 from certain electrical items, such as gas insulated switchgear, have historically been a significant source of emissions. Manufacturers of such equipment are now increasingly able to offer SF_6-free components, and those that do continue to use SF_6 are sealed-for-life with extremely low leakage rates (Ref. 6-39). The Applicant has confirmed that although there will most likely be SF_6 within the switchgear located at the Field Stations, these will be 'sealed for life' solutions with no leakage expected. Given the minimal expected emissions of SF_6 from the Scheme, they are not considered material to this GHG assessment. However, they are included for completeness and have been assessed qualitatively. Therefore, further detailed consideration of SF_6 emissions is not necessary, as they are not projected to have a significant impact on the overall GHG emissions associated with the Scheme (Ref. 6-39).

6.4.80 The IEMA 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance' (Ref. 6-25) states that a comparable baseline must be used as a reference point against which the impact of a new project can be assessed, which may be *"GHG emissions arising from an alternative project design for a project of this type"*.

6.4.81 Currently, marginal load-following generation capacity[2] is generally provided by gas-fired CCGT (Ref. 6-40). The benefit of any renewable electricity scheme is to displace the use of fossil fuelled power sources. It is reasonable to assume that as additional renewable energy generation capacity becomes available, such as from developments like the Scheme, it will reduce demand for the marginal generator, i.e., directly displace the use of CCGT. On this basis, the GHG assessment has used the operational emissions of an existing, unabated CCGT as the future baseline.

6.4.82 As described in **Chapter 2: The Scheme, ES Volume 1**, subject to being granted consent and following a final investment decision, the earliest construction could start is in 2028. Construction of the Grid Connection Cables is anticipated to require an estimated 12 months; construction of the solar farm is anticipated to require an estimated 24 months, with operation

[2] A power source that adjusts its power output as demand for electricity fluctuates throughout the day, as opposed to the base load (continuously running over extended periods of time) or peaking plant (running in periods of high demand).

therefore anticipated to commence in 2030. The GHG assessment has used a two-year construction phase, with the two elements of construction running in parallel.

6.4.83 As described in **Chapter 2: The Scheme, ES Volume 1,** the design life of the Scheme is 40 years, with decommissioning to commence 40 years after final commissioning (currently anticipated to be 2030). The climate change assessments presented in this chapter, therefore, consider that that the entire Scheme is decommissioned at the end of the 40 years (2070).

6.4.84 Emissions from the decommissioning process at the end of the design life are very difficult to estimate due to the substantial uncertainty surrounding decommissioning methodologies and approaches so far into the future. It has been assumed that on-site fuel use and employee commuting during the decommissioning phase will be equivalent to those required for construction. This is considered to be a worst-case scenario, as future developments in methodologies and technological advances are likely to reduce the carbon impact of decommissioning. It is assumed that the land will be returned to its original state following decommissioning of the Scheme. It was assumed that 70% of waste would be recycled, with the remaining 30% being sent to landfill. This is considered a worst-case scenario as it is anticipated that decommissioning methodologies and approaches will evolve to become less carbon-intensive.

6.5 Baseline Conditions

6.5.1 This section describes the baseline environmental characteristics for the Scheme and surrounding areas with specific reference to GHG emissions and climatic conditions.

Data Sources

6.5.2 In preparation of this chapter, the following sources of published information have been used to establish the baseline conditions:

a. Historic climate data obtained from the Met Office website at the closest meteorological station to the Scheme (Finningley, approximately 16 miles south of the Scheme) (Ref. 6-27) to determine the existing baseline conditions;

b. UKCP (Ref. 6-28) to determine the future baseline conditions; and

c. The IPCC AR6 Sea Level Protection Tool (Ref. 6-29) and ThinkHazard (Ref. 6-30) were also used for the other projected trends/impacts, and the UK Climate Change Risk Assessment (Ref. 6-10) analysed for the current state of nationwide climate change risks.

Current Baseline – GHG Impact Assessment

6.5.3 For the GHG assessment, the current baseline is a ‘no-development’ scenario whereby the Scheme is not implemented. The baseline comprises existing carbon stock and sources of GHG emissions within the boundary of the existing activities on-site. A full assessment of the baseline ‘no-development’ scenario has been undertaken within the ES.

6.5.4 The current land use within the Site and the local area consists predominately of agricultural fields mainly under arable production, with

some areas of pasture, interspersed with individual trees, hedgerows, linear tree belts, small woodland blocks, and farm access tracks. The abundance of vegetation within the Scheme suggests carbon sink potential. Current land use within the Scheme has relatively low levels of land use GHG emissions in the context of the overall emissions in the wider area as it is largely arable land. Baseline agricultural GHG emissions are dependent on types of soil and vegetation present, fuel use for the operation of vehicles and machinery, and other inputs such as fertiliser and pesticide use.

Future Baseline – GHG Impact Assessment

6.5.5 This section considers those changes to the baseline conditions, described above, that might occur in the absence of the Scheme and during the time period over which the Scheme would have been in place.

6.5.6 The future baseline scenarios are set out in **ES Volume I Chapter 5: Environmental Impact Assessment Methodology [EN010152/APP/6.1]** and described for climate change below.

6.5.7 The future baseline for the GHG assessment is a business-as-usual position whereby the Scheme is not implemented. This includes the operation and maintenance emissions from the generation of grid electricity that would occur should the Scheme not go ahead but which will be displaced in the case of the Scheme being delivered.

6.5.8 The current land use within the Scheme will have minor levels of associated GHG emissions from agricultural activities and minor carbon sequestration from vegetation. Therefore, for the purpose of the GHG assessment, embodied GHG emissions are considered zero in the future baseline.

Current Baseline – CCRA and ICCI Assessments

6.5.9 The baseline for the CCRA and ICCI assessments is the climate in the location of the Scheme for the 30-year historical period of 1981 to 2010 (the standard baseline for climate data (Ref. 6-28). Historical climate data recorded by the closest meteorological station to the Scheme (Finningley, approximately 16 miles south of the Scheme) for the 30-year period of 1981 to 2010 was obtained from the Met Office website (Ref. 6-27) and is summarised in Table 6-11 below.

Future Baseline – CCRA and ICCI Assessments

6.5.10 The future baseline is expected to differ from the present-day baseline described above. UKCP18 (Ref. 6-28) provides probabilistic climate change projections for pre-defined 30-year periods for annual, seasonal and monthly changes to mean climatic conditions over land areas. For the purpose of the assessments, UKCP18 probabilistic projections for pre-defined 30-year periods for the following average climate variables have been obtained:

a. Mean annual temperature;

b. Mean summer temperature;

c. Mean winter temperature;

d. Maximum summer temperature;

e. Minimum winter temperature;

f. Mean annual precipitation;

g. Mean summer precipitation;

h. Mean winter precipitation;

i. Sea level rise; and

j. Extreme weather events e.g. heat waves, storm surges etc.

6.5.11 Projected temperature and precipitation variables presented in UKCP18 probabilistic projections have been analysed for the 25 km^2 grid square within which the Scheme is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981 to 2010 baseline.

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

6.5.13 As the design life of the Scheme is 40 years (around 2 years for construction and 40 years for operation and maintenance), the CCRA has considered a scenario that reflects a high level of GHG emissions at the 10%, 50%, and 90% probability levels up to 2079 to assess the impact of climate change over the assessed design life of the Scheme.

6.5.14 Climate variables impacting the construction, operation and maintenance, and decommissioning phases of the Scheme have been assessed in Table 6-11 below against RCP8.5 2020-2049 and 2050-2079 projection data.

Table 6-11: Climate Change Baseline and Projection Data

Climate Variable	Baseline (1981–2020)	Climate change projection RCP8.5 (2020–2049)	Climate change projection RCP8.5 (2050–2079)	Projected Trend	Climate Projection Source
Temperature					
Mean annual maximum temperature (°C)	14.07°C	+1.1 (+0.5 to +1.8)	+2.5 (+1.3 to +3.8)	↑	UKCP RCP8.5
Mean summer maximum daily temperature (°C)	20.73°C	+1.4 (+0.2 to +2.5)	+3.2 (+1.2 to +5.3)	↑	UKCP18 RCP8.5
Mean winter minimum daily temperature (°C)	1.52°C	+0.9 (+0.2 to +1.7)	+2 (+0.8 to +3.4)	↑	UKCP18 RCP8.5
Increase in highest temperature for baseline period (°C)	July 22.30°C	—	—		UKCP18 RCP8.5
Increase in lowest temperature for baseline period (based on average temperatures increasing) (°C)	January 1.43°C	—	—		UKCP18 RCP8.5
Rainfall					
Mean annual rainfall (mm)	48.52 mm	+0.8% (-5.3 % to +6.8%)	-1.2% (-8.7% to +6.1%)	↓	UKCP18 RCP8.5

Climate Variable	Baseline (1981–2020)	Climate change projection RCP8.5 (2020–2049)	Climate change projection RCP8.5 (2050–2079)	Projected Trend	Climate Projection Source
Mean summer rainfall (mm)	56.57 mm	-6.6% (-25.1% to +13%)	-18.6% (-44% to +8.4%)	↓	UKCP18 RCP8.5
Mean winter rainfall (mm)	42.47 mm	+3.8% (-4.1% to +12.6%)	+10% (-2.6% to 25%)	↑	UKCP18 RCP8.5
Wettest month on average (mm)	June 64.62 mm	—	—		UKCP18 RCP8.5
Driest month on average (mm)	March 32 mm	—	—		UKCP18 RCP8.5
Other					
Sea Level rise (m)		0.12	0.34	↑	IPCC AR6 Sea Level Projection Tool SSP8.5
Storm surges		The UKCP18 model suggest a small contribution from storm surges, however it is unclear if the frequency and severity of future storm surges is going to change.			UKCP18 RCP8.5
Heatwaves		Under a high emissions scenario, it is estimated that by the end of the 21st Century, all areas of the UK are projected to be warmer with hotter, drier summers and			UKCP18 RCP8.5

Climate Variable	Baseline (1981–2020)	Climate change projection RCP8.5 (2020–2049)	Climate change projection RCP8.5 (2050–2079)	Projected Trend	Climate Projection Source
		heatwaves likely to become more common and intense.			
Wildfires		Think Hazard has classified the wildfire hazard in South Yorkshire as medium, according to currently available information. This means that there is between a 10% and 50% chance of experiencing weather that could support a hazardous wildfire that may pose risk to life and property loss in any given year.			Think Hazard
Drought		The Met Office has projected a trend towards drier summers on average, with the trend being stronger under a high GHG emission scenario compared to a low one. However, it is the distribution of rainfall throughout the seasons that will determine UK drought risk.			UKCP18 RCP8.5

6.6 Embedded Mitigation

6.6.1 The Scheme has been designed, as far as practicable, to avoid and reduce impacts and effects on climate change through the process of design development, and by embedding measures into the Scheme design. In addition, how the Scheme is constructed, operated and maintained, and decommissioned would be appropriately controlled in order to manage and minimise potential environmental effects (required as a result of legislative requirements and/or standard sectoral practices).

6.6.2 The delivery of these embedded mitigation measures will be secured through the detailed Construction Environmental Management Plan (CEMP), detailed Operational Environmental Management Plan (OEMP) and detailed Decommissioning Environmental Management Plan (DEMP) via Requirements in the DCO. A **Framework CEMP [EN010152/APP/7.7]**, **Framework OEMP [EN010152/APP/7.8]** and **Framework DEMP [EN010152/APP/7.9]** have been prepared and submitted as part of the DCO Application.

6.6.3 Embedded measures are taken into account prior to the assessment of effects in order to avoid considering assessment scenarios that are unrealistic in practice i.e. effects do not take account of measures even though they are likely to be standard practice and/or form part of the Scheme design. These have been followed through into the assessment to ensure that realistic likely environmental effects have been identified.

GHG Mitigation Measures

6.6.4 Mitigation measures in relation to GHG emissions arising from the Scheme have been embedded within the design and material choices. The following good practice GHG mitigation measures will be included within the Scheme design:

a. Where practicable, the use of alternative materials with lower embodied GHG emissions such as locally sourced products and materials with a higher recycled content;

b. Low carbon design specifications, such as energy-efficient lighting and durable construction materials to reduce maintenance and replacement cycles;

c. The **Framework CEMP [EN010152/APP/7.7]** identifies various mitigation measures, including:

   i. Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Scheme by employing good industry practice measures which go beyond statutory compliance;

   ii. Liaising with personnel on the potential to implement staff minibuses and car sharing options;

   iii. Switching vehicles and plant off when not in use and ensuring construction vehicles conform to European Union (EU) vehicle emissions standards for the types of plant vehicles to be used;

iv. Increasing recyclability by segregating construction waste to be reused and recycled where reasonably practicable; and

v. Designing, constructing and implementing the Scheme in such a way as to minimise the creation of waste.

CCRA Mitigation Measures

6.6.5 A number of climate change risks have been identified. Mitigation measures have been incorporated into the early design stages of the Scheme and have been further developed at the ES stage. Mitigation measures embedded within the Scheme include:

a. Measures specified in the **Framework CEMP [EN010152/APP/7.7]**, including but not limited to:

i. Conducting regular planned maintenance of the plant and machinery to operate efficiently;

ii. Storing topsoil and other construction materials outside of the 1 in 100-year floodplain extent within the Solar PV Site, as far as reasonably practicable;

iii. Named person(s) – likely Safety, Health and Environment Manager/ Clerk of Works – to monitor weather forecasts and receive Environment Agency flood alerts to allow works to be planned and carried out accordingly to manage extreme weather conditions such as storms and flooding; and

iv. Health and safety plans developed for construction activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves. To include measures such as toolbox talks on training on dangers of extreme weather conditions.

b. The implementation of the Drainage Strategy (**ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]**), including attenuation of surface water runoff to minimise flood risk at the Scheme components;

c. Flood risk consideration and mitigation measures are outlined in the Flood Risk Assessment (**ES Volume III Appendix 9-3: Flood Risk Assessment [EN010152/APP/6.3]**). Infrastructure flood resilience methods have been set, including the requirement for Solar PV Panels to be set back by 10 m from all water features.

6.7 Assessment of Likely Impacts and Effects

6.7.1 The Scheme has the potential to affect, and be affected by, climate change (positively or negatively), during construction, operation and during decommissioning, in the following ways:

a. Impact of GHG emissions arising over the lifetime of the Scheme on the climate;

b. Resilience of the Scheme to projected future climate change impacts, including damage to the Scheme resulting from climate change; and

c. How the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Scheme.

6.7.2 The assessments have been undertaken following consideration of the embedded mitigation measures as described in Section 6.6.

Lifecycle GHG impact assessment

6.7.3 Within this section, GHG emissions arising as a result of the Scheme are first identified and assessed individually for each lifecycle stage (construction, operation and decommissioning).

6.7.4 It is important to understand the GHG impacts at each individual lifecycle stage, but 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 their lifetime.

6.7.5 Therefore, the net impact of the Scheme is also identified and assessed, taking into account renewable energy generation and its benefits in the context of the wider energy generation sector and the National Grid average GHG intensity. The overall assessment, which will account for all GHG emissions over the lifetime of the Scheme, will compare the GHG intensity of the Scheme with the GHG intensity of other predicted grid energy generation sources.

GHG Assessment – Construction

6.7.6 The greatest GHG impacts of the Scheme would occur during the construction phase (which is expected to last 24 months from 2028–2030) as a result of the manufacture of the materials and components required. The manufacture of Solar PV Panels is estimated to account for 266,278 tCO_2e. Table 6-12 summarises the emissions resulting from the manufacture of materials required for the construction of the Scheme.

Table 6-12: Embodied emissions from the manufacture of materials and components

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Solar PV Panels	101,130	38%
Solar PV inverters (BESS Area)	14,701	6%
Solar PV framework	12,601	9%
BESS Area	73,664	28%
On-Site Substation	33,161	12%
Transformers	5,695	2%
Cables	3,577	1%
Concrete	10,125	4%

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Aggregate	625	<1%
Total products	**266,278**[3]	**100%**

6.7.7 Other sources of emissions during construction within the scope of the Lifecycle GHG impact assessment include water, energy and fuel use for construction activities (including fuel consumed by construction plant and machinery, fuel use for the transportation of construction materials to the Solar PV Site, transportation of construction workers to and from the Site, and the transportation and disposal of waste).

6.7.8 As with other solar farm schemes, land use change is anticipated to have a beneficial impact in terms of GHG emissions during the lifetime of the Scheme with the **Framework Soils Resource Management Plan [EN010152/APP/7.10]** and **Framework Landscape and Ecological Management Plan (LEMP) [EN010152/APP/7.14]** securing mitigation measures to protect species, reinstate soil resources and manage Biodiversity Net Gain (BNG). However, as this beneficial impact has been assumed to reverse during decommissioning provided the Site is utilised for farming again, the GHG impact associated with land use change has therefore been excluded from the lifecycle GHG impact assessment. This is assumed to represent a robust worst-case scenario as trees and hedges planted prior to or during construction will be retained throughout decommissioning.

6.7.9 Based on the scheme details and assumptions included in Section 6.4, total GHG emissions from the construction phase are estimated to equate to around 303,740 tCO_2e. Table 6-13 summarises the overall construction emissions from various emissions sources.

Table 6-13: Emissions resulting from the construction phase

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Products and materials	266,278	88%
Transportation of products and materials	33,859	11%
Worker commuting	3	<1%
Waste (including transport)	2,467	<1%
Fuel use	525	<1%
Water use	0.3	<1%
Construction total	**303,740**[4]	**100%**

[3]Decimals not used in the table so it may not round to the total.
[4]Decimals not used in the Table so it may not round to the total.

6.7.10 The annual emissions of the construction phase have been compared to the 5th Carbon Budget (2028 to 2032) in Table 6-14, as this carbon budget falls within the anticipated construction phase for the Scheme.

Table 6-14: UK carbon budgets Relevant to the Construction Phase

Relevant UK Carbon Budget	Cumulative UK Carbon Budget (tCO_2e)	Construction emissions during Carbon Budget period (tCO_2e)	Construction emissions as a proportion of Carbon Budget
5th (2028–2032)	1,725,000,000	303,740	0.0172%

6.7.11 The overall significance of GHG emissions in the context of the UK carbon budgets and the national policy environment is assessed below from Paragraph 6.7.43.

GHG Assessment – Operation

6.7.12 The operation and maintenance phase of the Scheme is assumed to be 2030–2070 (40 years).

6.7.13 For the assessment, these are the effects that are either permanent, endure for a substantial period beyond construction, or represent an extended cumulative effect of construction or decommissioning activity. This includes the effects of the physical presence of the energy infrastructure, as well as its operation, use, and maintenance.

6.7.14 GHG emissions sources within the scope of the operational emissions include operational energy use (i.e., for auxiliary services and standby power) and fuel used for the transportation of workers to the Scheme and maintenance activities. Maintenance and transportation cover the following:

a. Embodied carbon in replacement parts;
b. Plant and machinery requirements;
c. Fuel and water use during maintenance activities;
d. Transportation of materials and waste to and from the Solar PV site; and
e. Waste management activities include the landfill or recycling of replaced parts.

6.7.15 With the exception of the emissions data for Solar PV Panels, derived from an EPD, the embodied carbon factors for many components are subject to considerable uncertainty, particularly due to the lack of industry-standard emissions factors. This is especially relevant for components with shorter replacement lifespans, such as the presumed 2-3x replacement of the BESS Container and other design elements. These components are expected to account for the majority of operational emissions, yet they remain less thoroughly analysed, highlighting a disproportionate gap in the data.

6.7.16 It is anticipated there would be up to two permanent staff on-site at any one time with additional ad hoc visitors, such as maintenance workers and deliveries (**ES Volume I Chapter 2 [EN010152/APP/6.1]**). For the purposes of this assessment emissions from the transportation of workers assume three workers on the Site each day, with each worker driving to Site in their

own vehicle an estimate of 75 km each way. This is assumed to be a conservative assumption that is likely to overestimate the distance travelled. The emissions factor applied is for an average van of unknown fuel, from the most recent conversion factors for company reporting (Ref. 6-36). Based on these assumptions, emissions from commuting are estimated at to be c.48 tCO_2e per year, for a total of 1,933 tCO_2e over the 40-year design life of the Scheme. This figure is a highly conservative worst-case scenario, with the actual operational transport emissions likely to be much lower with the policy-driven transition to electric vehicles (EV) combined with the ongoing decarbonisation of UK grid electricity.

6.7.17 Emissions from the supply of water and treatment of wastewater have been estimated by applying the same emissions factors as for construction emissions. Based on three workers each consuming 90 litres per day, annual emissions from water and wastewater are estimated at 0.04 tCO_2e per year or 1.7 tCO_2e over the 40-year design life of the Scheme. This is also a conservative assumption, as the carbon intensity of water supply and wastewater treatment are expected to fall over time due to improving technologies.

6.7.18 While SF_6 is a potential source of GHG emissions over the lifetime of the Scheme (from its use in certain electric components such as gas-insulated switchgears and transformers during production, operation through leakage, and dismantling), it is not likely to be possible to accurately quantify the small level of fugitive emissions from the leakage of SF_6 due to insufficient data. Manufacturers of electrical switchgear and transformers are increasingly able to provide equipment that either does not contain any SF_6 or is sealed for life with extremely low leakage rates. The Applicant has confirmed that although there will most likely be SF_6 within the switchgear located at the Field Stations, these will be ‘sealed for life’ solutions with no leakage expected. This will therefore not be considered further in the assessment and is not expected to have a material impact on the predicted effects on GHG emissions associated with the Scheme (Ref. 6-39).

6.7.19 As presented in Table 6-15 the operational emissions over the design life of the Scheme are estimated at 237,905 tCO_2e. A total of 97% of this figure results from the manufacture, transport and installation of replacement components, with the remaining 3% the result of ongoing operational emissions.

Table 6-15: Emissions resulting from the Operation and Maintenance Phase

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Materials (replacement components)	231,309	97%
Transportation of materials	4,605	2%
Worker transport	1,933	<1%
Grid electricity	56	<1%
Water/wastewater	2	<1%
Operations total	**237,905**	**100%**

6.7.20 The Scheme is expected to be operational by or earlier than 2030, therefore operational emissions up to 2037 (the end of the 6th UK Carbon Budget) will fall under the 5th and 6th UK Carbon Budgets, beyond which point no carbon budgets have yet been formally approved or ratified. Beyond 2037, indicative carbon budgets based on the CCC's Balanced net-zero pathway have been used to contextualise the Scheme against the UK's 2050 net-zero target.

6.7.21 Table 6-16 presents the estimated operational emissions against the carbon budget periods during which they arise.

Table 6-16: UK carbon budgets relevant to the Operation and Maintenance Phase

Carbon Budget	UK Carbon Budget (tCO_2e)	Operation emissions during Carbon Budget period (tCO_2e)	Operation emissions as a proportion of Carbon Budget
5th (2028–2032)	1,725,000,000	17,843	0.0010%
6th (2033–2037)	965,000,000	29,738	0.0031%
7th (2038–2042)	526,000,000	29,738	0.0057%
8th (2043–2047)	195,000,000	29,738	0.0153%
9th (2048–2050)	17,000,000	11,895	0.0700%

6.7.22 To improve the robustness of the assessment and allow for temporal flexibility, the annual operational emissions have also been compared to the sector specific carbon budgets for electricity generation based on the CCC's Balanced Net Zero Pathway, these are detailed in Table 6-17.

Table 6-17: Sector specific electricity generation carbon budgets relevant to the Operation and Maintenance Phase of the Scheme

Carbon Budget	Sectoral Carbon Budget (tCO2e)	Estimated Total (tCO2e) Over the Carbon Budget Period	% of Sectoral Budget for Electricity Generation
5th (2028–2032)	92,560,000	17,843	0.01928%
6th (2033–2037)	35,740,000	29,738	0.08321%
7th (2038–2042)	23,330,000	29,738	0.12747%
8th (2043–2047)	12,360,000	29,738	0.24060%
9th (2048–2050)	4,030,000	11,895	0.29517%

6.7.23 The overall significance of GHG emissions in the context of the UK carbon budgets and the national policy environment has been assessed from paragraph 6.7.43.

GHG Assessment – Decommissioning

6.7.24 GHG emissions from the Scheme during decommissioning (Table 6-18) are subject to a very high degree of uncertainty, as the conditions that will apply over 40 years into the future (i.e. 2070) cannot be described with any confidence. Conservatively, for the purpose of this assessment it is assumed that decommissioning emissions from the use of plant, worker travel, water and wastewater consumption would be set at 100% of the corresponding emissions during the construction phase. As the economy decarbonises over the coming years in line with national policy, emissions from sources such as worker transport and waste disposal are anticipated to be much lower. Therefore, this is very likely to be a highly conservative estimate which overestimates decommissioning emissions.

6.7.25 Emissions from the disposal and recovery of materials and components at the end of the Scheme's design life have been estimated based on an assumption that 70% of materials and components will be recovered at the end of life, with 30% going to landfill, together with the most recent emissions factors for recycling published by the UK Government. This is also likely to be a highly conservative estimate as it is expected that a higher proportion of materials will be recycled. Emissions from end-of-life disposal of all materials and products are estimated at c.502 tCO_2e.

6.7.26 Emissions from the transportation of materials and products at end-of-life have been estimated on the assumption that concrete and aggregate will be disposed of within a 50 km radius of the Site, while all other products will be disposed of within 200 km. Applying the most recent DESNZ emissions factors (Ref. 6-36) for heavy goods vehicle (HGV) travel gives end-of-life transport emissions of 2 tCO_2e. This is very likely to be a highly conservative estimate as HGV transport decarbonises in the future.

6.7.27 Land use change has been excluded from the GHG assessment as discussed in paragraph 6.7.8, due to the beneficial GHG impacts of conversion of arable land to grassland during operation (increased carbon storage in soil and vegetation, being assumed to reverse following decommissioning to arable farming (carbon stored in soil or vegetation re-released to the atmosphere). This is considered to be a robust worst-case approach and likely to underestimate the beneficial effect of the Scheme, as tree and hedgerow planting may be retained after decommissioning. Any carbon sequestered in these areas would remain in soil and vegetation following decommissioning.

Table 6-18: Emissions resulting from the decommissioning phase

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Transportation of materials/waste	2	<1%
Worker commuting	4	<1%
Fuel use	525	51%
Waste recycling/disposal	502	49%

Emissions source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Water use	0.32	<1%
Decommissioning Total	**1,035**	**100%**

6.7.28 As above for the operational and maintenance phase, the decommissioning GHG footprint is considered to reflect a robust worst-case scenario as the calculations have been carried out using current emissions factors. By 2070, GHG emissions associated with energy generation, transportation, operation of plant, and waste disposal throughout the supply chain are anticipated to be much lower as a result of grid decarbonisation and machinery, and vehicle electrification in line with the UK's 2050 net-zero carbon target.

Carbon Intensity of the Operation and Maintenance of the Scheme

6.7.29 Renewable energy generation from the Scheme during the first full year of operation and maintenance is estimated to be 352,766 MWh. Taking into consideration a 2% reduction in solar PV panel performance during the first year and applying a 0.45% degradation factor for each subsequent year, this gives a total energy generation figure of 12,940,146 MWh over the assessed 40-year Scheme design life.

6.7.30 A carbon intensity value representing how many grams of CO_2 are released to produce a kilowatt hour (kWh) of electricity is presented. Dividing the lifetime total energy generation figure into the lifetime emissions total of 542,641 tCO_2e gives a total carbon intensity value for the Scheme of 41.94 gCO_2e /kWh.

6.7.31 The current carbon intensity of grid electricity generation is 207 gCO_2e /kWh (Ref. 6-36), however these figures cannot be directly compared as the published UK grid carbon intensity figure only takes into account operation and maintenance emissions from the generation of electricity, overwhelmingly from the fossil fuels used to power gas-fired and occasionally coal-fired power stations. For a meaningful comparison to be made between the Scheme and the UK grid, the operation and maintenance carbon intensity of the Scheme must only include emissions from the ongoing operation and maintenance of the Scheme and exclude emissions from the construction and decommissioning phases.

6.7.32 By combining the lifetime generation figures with operation and maintenance emissions, the Scheme achieves an operational and maintenance carbon intensity of 18.39 gCO2e/kWh. This is significantly lower than the current carbon intensity of the UK grid.

6.7.33 Contextualising the carbon intensity of a single electricity generating installation against an average for the entire UK grid, however, does not provide a particularly useful comparison for two main reasons. This context is provided to highlight the limitations of such a comparison and to underscore the importance of new renewable projects like the Scheme in the broader decarbonisation effort. Firstly, UK grid carbon intensity is not static, but changes from year to year as the generation mix changes over time. There has been significant decarbonisation of the grid over the last decade,

and this trend is set to continue into the future but only if projects such as the Scheme are brought forward. Therefore, comparing a low-carbon electricity project such as the Scheme against projections of future grid carbon intensity fails to recognise that the grid can only decarbonise if additional renewable generation projects are consented and able to contribute to this ongoing decarbonisation.

6.7.34 Secondly, it is not the average UK generation capacity that projects such as the Scheme seek to displace. Instead, the contribution from renewable electricity projects such as the Scheme can only support ongoing grid decarbonisation if they displace existing higher carbon generating capacity.

6.7.35 Currently, the marginal generating capacity (i.e. the generating technology that responds to changes in grid electricity demand) is provided by unabated, gas-fired combined cycle gas turbine (CCGT) power stations. As it is almost invariably CCGTs that provide the balance of generation capacity, it is reasonable to assume that every kWh of electrical energy provided by a new renewable installation such as the Scheme is a kWh that does not have to be generated by an existing CCGT.

6.7.36 It is recognised that NPS EN-1 (Ref. 6-14) requires all new commercial scale combustion power stations to be constructed Carbon Capture Ready, but the comparison is explicitly with existing, unabated CCGT technology and not with new installations. It is existing gas-fired power stations that low-carbon installations such as the Scheme must displace in support of the UK's net zero ambitions.

6.7.37 An existing gas fired CCGT, currently the most carbon-efficient fossil-fuelled technology available, can be assumed to operate with a representative carbon intensity of 354 gCO_2e/kWh (Ref. 6-44). The operational intensity of the Scheme is therefore 95% lower than that of the CCGT. Each kilowatt hour of electricity generated by the Scheme will emit 336 gCO_2e less than if it was generated by an existing gas fired CCGT generating facility.

6.7.38 Combining this figure with the estimated lifetime output from the Scheme indicates an overall lifetime carbon reduction, relative to the counterfactual existing CCGT, of over 4 million tCO_2e. Given that the construction and decommissioning phase emissions for the Scheme will be 542,681 tCO_2e, the breakeven period for emissions will be under 5 years of operation. Therefore, the total GHG savings for the remaining 35 years will be approximately 3.5 million tCO_2e.

Additional Carbon Savings from the Use of Battery Energy Storage Systems

6.7.39 The use of the BESS Area provides additional carbon saving opportunities. Relatively fast response power sources such as battery storage have an important role to play in helping to balance supply and demand within the electricity grid. This grid balancing function is often performed using high-carbon intensity power sources such as open cycle gas turbines (OCGT), so the use of a battery charged from solar PV generation can deliver an additional direct carbon saving relative to an OCGT.

6.7.40 It is currently estimated that the capacity of the Scheme's BESS Area will be 950 MWh.

6.7.41 Should the BESS Area be charged primarily from the Scheme and supplemented by grid charging, then discharged back into the grid once each day at a typical round-trip efficiency of 85% and an overall lifetime degradation rate of 80%, it is estimated to supply 13,870 GWh to the electricity grid over its 40-year design life. With the operation and maintenance carbon intensity of the Scheme at 18.39 gCO_2e/kWh (or 0.018 tCO_2e/MWh) compared to 0.460 tCO_2e/MWh for an OCGT, the use of the Scheme's BESS Area for grid balancing purposes could still deliver a significant carbon saving of approximately 4.1 million tonnes CO_2e over its design life. However, this figure may vary depending on the extent of grid charging.

6.7.42 These figures are inevitably subject to a degree of uncertainty until the detailed design stage, but they illustrate the fact that the use of the BESS Area, when used for grid balancing purposes, is likely to result in significant additional carbon savings over its design life. Given that the projected emissions figures for the BESS Area are subject to final design, a worst-case scenario approach has been applied, whereby these additional carbon savings from the use of the BESS Area for grid balancing are not factored into the overall GHG assessment.

Overall GHG Impact and Significance

6.7.43 In light of UK's climate policy objective to achieve net-zero carbon by 2050, and in line with IEMA guidance on Assessing Greenhouse Gas Emissions and Evaluating their Significance, the UK's Fourth, Fifth and Sixth Carbon Budgets have been used to contextualise emissions from the Scheme.

6.7.44 As outlined in paragraph 6.6.4, the Scheme incorporates embedded GHG mitigation measures that prioritise low-carbon design materials and construction practices. When evaluating the annual emissions from the construction phase of the Scheme, these emissions are compared against the significance definitions in Table 6-2. According to the IEMA criteria for assessing the significance of GHG impacts (Ref. 6-25), the construction of the Scheme aligns with both current and emerging policy requirements aimed at achieving net zero. Consequently, the emissions from the construction phase are considered to be **minor adverse** and **not significant**.

6.7.45 As the Scheme directly supports the UK policy environment of decarbonising electricity generation, as laid out in the CCC's Sixth Carbon Budget Advice, Methodology and Policy reports (Ref. 6-38), it can be considered to be aligned with the UK's overall trajectory to net zero. The National Grid cannot and will not decarbonise without investments in low carbon electricity generation projects like the Scheme.

6.7.46 The Scheme results in some operation and maintenance emissions associated with maintenance and worker travel. However, the benefits of generating renewable energy from the Scheme far outweigh the associated emissions as demonstrated in paragraph 6.7.38. Annual emissions from the operation and maintenance of the Scheme (and their magnitude) are compared to the significance definitions outlined in Table 6-2 . As stated in the IEMA guidance on assessing GHG emissions (Ref. 6-25) *"the crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to*

reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050". The Scheme's operation and maintenance phase indirectly causes a reduction in atmospheric GHG concentration compared to the without-project baseline and aligns with a trajectory towards net zero. The GHG impact of the operation and maintenance phase is therefore considered to be **beneficial** and **significant** when compared to the future baseline 'business-as-usual' scenario.

6.7.47 While there are expected to be GHG emissions associated with the decommissioning phase of the Scheme, actual emissions are anticipated to be lower than the figures presented in Table 6-18, which represents a robust worst-case scenario. Therefore, the magnitude of impact is considered to be low.

6.7.48 GHG emissions from the decommissioning phase are therefore considered to have a **minor adverse, non-significant** effect on climate change. As noted in the significance definitions in Table 6-2, a negligible effect is not possible where any GHG emissions are released to the atmosphere. However, while there are residual emissions, the Scheme is doing enough to align with and contribute to the relevant transition scenario, keeping the UK on track towards net zero by 2050 and thereby potentially avoiding significant adverse effects per the IEMA guidance (Ref. 6-25).

6.7.49 The impact of operation and maintenance is considered to have a **beneficial, significant** effect due to the operation and maintenance carbon intensity remaining substantially below that of a gas-fired CCGT generating facility throughout its design life, its role in achieving the rate of transition required by nationally set policy commitments and supporting the trajectory towards net zero. The without-project baseline alternative of a CCGT facility would result in substantially higher GHG emissions. As stated in the latest IEMA guidance (Ref. 6-25), "*a project that causes GHG emissions to be avoided or removed from the atmosphere has a **beneficial** effect that is **significant***".

6.7.50 Based on comparison with CCGT it is estimated that the solar power generation and the BESS Area will save over 4 million tCO_2e over the design life of the Scheme demonstrate the role solar energy generation has to play in the transition to, and longer-term maintenance of, a low carbon economy. Without low-carbon energy generation projects such as the Scheme, the average grid GHG intensity will not decrease as is projected, which would adversely affect the UK's ability to meet its carbon reduction targets.

6.7.51 The Scheme demonstrates an indirect reduction in atmospheric GHG concentration and avoidance of emissions; therefore, it is overall **beneficial** and has a positive impact on climate which is considered to be **significant.**

6.7.52 The GHG savings achieved throughout the lifetime of the Scheme demonstrate the role solar energy generation has to play in the transition to, and longer-term maintenance of, a low carbon economy. Without low-carbon energy generation projects such as the Scheme, the average grid GHG intensity will not decrease as is projected, which would adversely affect the UK's ability to meet its carbon reduction targets. This statement is consistent with the position taken in paragraph 150 of the Supreme Court Judgement in the case of Finch, on behalf of the Weald Action Group) (Appellant) v Surrey County Council and others (Respondents) (Ref. 6-41).

6.7.53 This case reiterated the need for the relevant planning authority to consider the beneficial indirect effects of a project on the climate, as well as adverse effects, as a material planning consideration: "*Just as beneficial indirect effects of a project on climate - for example, the "green" energy that would be generated by a project to develop a wind farm or solar farm - are clearly a relevant matter for the planning authority to consider, so corresponding adverse effects are also a material planning consideration*" (paragraph 150, Ref. 6-41).

In-Combination Climate Change Impact Assessment

6.7.54 Potential ICCIs, including the likelihood, consequence, and significance are detailed in **ES Volume III Appendix 6-3: ICCI Environmental Technical Disciplinary Risk Assessment [EN010152/APP/6.3]**.

6.7.55 Future climate projections have been reviewed and the sensitivity of receptors to both climate change and the Scheme have been examined, before commenting on the adequacy of the climate change resilience measures built into the Scheme. As a result of the embedded mitigation and good practice measures, no significant ICCIs during construction, operation and maintenance, or decommissioning phases have been identified.

Climate Change Risk Assessment

6.7.56 Potential climate risks, including the likelihood, consequence and significance are detailed in **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]** with the results summarised below.

6.7.57 Future climate change projections have been examined, before commenting on the adequacy of the embedded climate change mitigation measures built into the Scheme.

Construction Effects

6.7.58 The risks assessed as part of the CCRA are available in Table 6-11 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**.

6.7.59 The CCRA at the construction phase of the Scheme predominantly cover workforce exposure to dangerous working conditions and damage to physical structures.

6.7.60 Major climatic variables contributing to these risks include but are not limited to increased amount of extreme weather conditions (e.g., flooding and heatwaves) as well as increased temperatures due to climate change.

6.7.61 During the construction phase under the RCP8.5 scenario, there is likely to be an increase in daily temperatures. Furthermore, under the RCP8.5 it is likely that overall rainfall is likely to decrease and lead to more drought risk in summer. However, winter rainfall is likely to increase which could cause greater risks of flooding.

6.7.62 As a result of the embedded climate change mitigation measures highlighted in Section 6.6 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**, such as the **Framework CEMP [EN010152/APP/7.7]**, it is concluded that all climate change risks during the

construction phase have been identified to be **negligible to low** and **not significant**.

6.7.63 The drainage arrangements to attenuate surface water runoff and minimise flood risk to the Scheme location are detailed in **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]** and the **Framework CEMP [EN010152/APP/7.7]**. The **Framework CEMP [EN010152/APP/7.7]** also states that contracts with companies involved in the construction work will incorporate environmental control, health and safety regulations, and current guidance to ensure sustainable construction activities. A Safety, Health, and Environment Manager will advise construction managers, who will cascade this information to all workers. Additionally, flood resilience measures for infrastructure during construction are outlined in **ES Volume I Chapter 9: Water Environment [EN010152/APP/6.1]** and the **Framework CEMP [EN010152/APP/7.7]**. During construction, the contractor will monitor weather forecasts on a monthly, weekly, and daily basis and plan works accordingly.

Operation and Maintenance Effects

6.7.64 The risks assessed as part of the CCRA are available in Table 6-11 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**.

6.7.65 The CCRA at the operation and maintenance phase of the Scheme predominantly encapsulates asset damage from extreme weather conditions (e.g., flooding and heatwaves) and changes in annual precipitation and temperatures (decrease in overall rainfall and increase in temperature), as well as workforce exposure to dangerous working conditions (e.g. risks to worker health and safety).

6.7.66 During the operation and maintenance phase under the RCP8.5 scenario (Ref. 6-28), it is predicted that there will be an increase in average daily temperatures and an average decrease in the amount of rainfall the Scheme's location will receive.

6.7.67 Major climatic variables contributing to these risks are temperatures, precipitation and extreme weather conditions and changes in annual precipitation and temperatures, as well as workforce exposure to dangerous working conditions.

6.7.68 As a result of embedded climate change mitigation measures highlighted in Section 6.6 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**, such as the **ES Volume III Appendix 9-3: Flood Risk Assessment [EN010152/APP/6.3]**, **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3], Framework OEMP [EN010152/APP/7.8]** and **Framework Landscape and Ecological Management Plan [EN010152/APP/7.14]**, it has been concluded that all climate change risks during the operation and maintenance phase have been identified as **negligible to low** and **not significant**.

6.7.69 The Scheme has been designed considering flood risk modelling, which includes climate change projections as detailed in **ES Volume III Appendix 9-3: Flood Risk Assessment [EN010152/APP/6.3]**. Drainage arrangements to attenuate surface water runoff and minimise flood risk to the land within the Order limits and surrounding areas are discussed within **ES Volume III**

Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]. Measures to protect the health and safety of workers are detailed in the **Framework OEMP [EN010152/APP/7.8]**. Operational staff and contractors will monitor weather forecasts, and plan works accordingly. Infrastructure is designed to tolerate hot conditions, ensuring it will not be impacted.

Decommissioning Effects

6.7.70 The risks assessed as part of the CCRA are available in Table 6-11 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**.

6.7.71 The risks assessed in the CCRA at the decommissioning phase of the Scheme are mainly made up of risks to the workforce.

6.7.72 These risks are driven by climatic variables like increased temperatures, rainfall, and extreme weather events.

6.7.73 As a result of the embedded climate change mitigation measures highlighted in Section 6.6 and **ES Volume III Appendix 6-2: Climate Change Risk Assessment [EN010152/APP/6.3]**, such as the **Framework Decommissioning Environment Management Plan (DEMP) [EN010152/APP/7.9]** and **Framework Soil Management Plan (SMP) [EN010152/APP/7.10]**, it has been concluded that all climate change risks during the construction phase have been identified to be **negligible to low** and **not significant**.

6.7.74 However, it is important to recognise the inherent uncertainties in predicting climate change impacts, particularly over the long term associated with the decommissioning phase. These uncertainties encompass variability in climate model projections, potential shifts in regulatory and operational conditions, and unforeseen technological advancements that could influence the climate risks associated with the Proposed Development.

6.7.75 A Drainage Strategy for the decommissioning phase will be included in the **Framework DEMP [EN010152/APP/7.9]**. Additionally, the **Framework DEMP [EN010152/APP/7.9]** will outline health and safety measures for workers.

6.8 Additional Mitigation and Enhancement Measures

6.8.1 Additional mitigation measures are only required where significant effects are identified following the application of embedded mitigation measures. No significant adverse effects have been identified in this assessment therefore no additional mitigation or enhancement measures are proposed.

Monitoring

6.8.2 As no potential significant effects have been identified for climate change, no monitoring of significant effects is required and/or proposed.

6.9 Residual Effects

6.9.1 This section summarises the residual effects of the Scheme on climate change following the implementation of embedded and additional mitigation.

6.9.2 The residual effects are the same as presented in Section 6.7.

6.9.3 Table 6-19, Table 6-20 and Table 6-21 summarise the residual effects.

Table 6-19: Residual Effects – Climate Change (Construction Phase)

Receptor	Description of Impacts Including Duration	Embedded Mitigation	Significance of Effect with Embedded Mitigation	Additional Mitigation/Enhancement Measures	Residual Effect
Global atmosphere	Impact of GHG emissions arising during construction of the Scheme on the climate	Good practice measures in the Framework CEMP **[EN010152/APP/7.7]**.	Minor adverse – Not significant	Not required	Minor adverse – **Not significant**
The Scheme	Impact of projected future climate change on the Scheme	Good practice measures in the Framework CEMP **[EN010152/APP/7.7]**.	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**
Various identified by each discipline in their assessment	Combined impact of future climate conditions and the Scheme	As presented in **ES Volume I Chapters 7 to 14 [EN010152/APP/6.1].**	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**

Table 6-20: Residual Effects – Climate Change (Operation and Maintenance Phase)

Receptor	Description of Impacts Including Duration	Embedded Mitigation	Significance of Effect with Embedded Mitigation	Additional Mitigation/Enhancement Measures	Residual Effect
Global atmosphere	Impact of GHG emissions arising during operation	Good practice measures in the **Framework OEMP [EN010152/APP/7.8]**.	Beneficial – Significant	Not required	**Beneficial – Significant**

Receptor	Description of Impacts Including Duration	Embedded Mitigation	Significance of Effect with Embedded Mitigation	Additional Mitigation/Enhancement Measures	Residual Effect
	of the Scheme on the climate				
The Scheme	Impact of projected future climate change on the Scheme	To address the projected impacts of climate change (temperature increases and fluctuations in precipitation) and their impact on electrical equipment and the Scheme's mitigation and enhancement planting, comprehensive measures have been detailed in key documents including the **ES Volume III Appendix 9-3: Flood Risk Assessment [EN010152/APP/6.3]**, **ES Volume III Appendix 9-4: Framework Drainage Strategy [EN010152/APP/6.3]**, and **Framework Landscape and Ecological Management Plan [EN010152/APP/7.14]**. Consideration will also be given to the UKCP18 climate change projections, and the resilience of the Scheme's infrastructure to these, through the detailed design process.	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**
Various identified by each discipline in their assessment	Combined impact of future climate conditions and the Scheme	As presented in **ES Volume I Chapters 7 to 14 [EN010152/APP/6.1].**	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**

Table 6-21: Residual Effects – Climate Change (Decommissioning Phase)

Receptor	Description of Impacts Including Duration	Embedded Mitigation	Significance of Effect with Embedded Mitigation	Additional Mitigation/Enhancement Measures	Residual Effect
Global atmosphere	Impact of GHG emissions arising during decommissioning of the Scheme on the climate	Good practice measures in the Framework DEMP **[EN010152/APP/7.9]**.	Minor adverse – Not significant	Not required	Minor adverse – **Not significant**
The Scheme	Impact of projected future climate change on the Scheme	Good practice measures in the Framework DEMP **[EN010152/APP/7.9]**.	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**
Various identified by each discipline in their assessment	Combined impact of future climate conditions and the Scheme	As presented in **ES Volume I Chapters 7 to 14 [EN010152/APP/6.1].**	Negligible to Low – Not significant	Not required	Negligible to Low – **Not significant**

6.10 Cumulative Effects

6.10.1 This section addresses the potential effects of the Scheme in combination with the potential effects of other proposed and committed plans and projects including other developments (referred to as 'cumulative developments') within the surrounding area. These cumulative impacts are scoped out of this chapter, as outlined below.

6.10.2 The assessment has been made with reference to the methodology and guidance set out in **ES Volume I Chapter 5: Environmental Impact Assessment Methodology [EN010152/APP/6.1]**.

6.10.3 Climate change is the result of cumulative impacts as it is the result of innumerable minor activities. A single activity may itself result in a minor or insignificant impact, but when combined with many other activities, the cumulative impact could be significant. The nature of GHGs is such that their impact on receptors (the global climate) is not affected by the location of their source. The GHG emissions assessment by its nature is a cumulative assessment and considers whether the Scheme would contribute significantly to emissions on a national level.

6.10.4 The global atmosphere is the receptor for climate change impacts and has the ability to hold GHG emissions. As noted in the third principle of considering the aspect of significance in the IEMA guidance (Ref. 6-25), "*GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant*". While the impact of any individual Scheme may be limited, it is the cumulative impact of many Schemes over time that could have a significant impact on climate change.

6.10.5 As such it is not possible to define a Study Area for the assessment of cumulative effects of GHG emissions nor to undertake a cumulative effects assessment, as the identified receptor is the global climate, and effects are therefore not geographically constrained. Consequently, consideration of the effects of the Scheme together with other developments on GHG emissions is not considered to be applicable. It is on this basis that the ICCI assessment is considered, by nature, a cumulative assessment, and any effects are detailed in **ES Volume III Appendix 6-3: ICCI Environmental Technical Disciplinary Risk Assessment [EN010152/APP/6.3].**

6.10.6 It should also be noted that other Schemes falling under the EIA Regulations will also need to consider climate change assessment within their own planning application.

6.10.7 As the CCRA is focused solely on the assets of the Scheme and a broader consideration of existing interdependent infrastructure, a cumulative assessment is not required. The assessment has carefully considered the potential for combined effects with other developments in the area and has determined that these effects are negligible. Consequently, the Scheme operates independently with no significant interdependencies that would necessitate a cumulative climate impact assessment.

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