Fosse Green Energy

EN010154

6.1 Environmental Statement

Chapter 6: Climate Change (Tracked)

VOLUME

6

Planning Act 2008 (as amended)

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

20 March 2026

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The Infrastructure Planning

(Applications: Prescribed Forms and Procedure) Regulations

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Fosse Green Energy

Development Consent Order 202[ ]

6.1 Environmental Statement

Chapter 6: Climate Change

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6. Climate Change

6.1 Introduction

6.1.1 This chapter of the Environmental Statement (ES) presents the findings of an assessment of the likely significant effects on climate change as a result of the proposed construction, operation, maintenance and decommissioning of Fosse Green Energy (hereafter referred to as the 'Proposed Development').

6.1.2 A description of the Proposed Development is presented in **Chapter 3: The Proposed Development** of this ES **[EN010154/APP/6.1]**. This chapter of the ES identifies measures to address the likely effects of the Proposed Development on climate change, as well as the impact of climate change on the Proposed Development and the combined impact of future climate conditions on the surrounding environment.

6.1.3 In accordance 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 over the lifetime of the Proposed Development on the climate;

b. **Climate change risk (CCR) assessment** – the resilience of the Proposed Development to the impacts of future climate change; and

c. **In-combination climate change impact (ICCI) assessment** – the resilience of receptors in the surrounding environment to the combined impact of future climate conditions and the Proposed Development.

6.1.4 The three assessments follow the stages of assessment methodology set out in Section 5.9 of **Chapter 5: EIA Methodology** of this ES **[EN010154/APP/6.3]**. For purposes of clarity for the reader, each individual assessment is presented separately following the stages of determining sensitivity of receptor, determining magnitude and attributes of impacts, and classifying significance of effects.

6.1.5 This chapter is supported by a **Flood Risk Assessment (FRA)**, included in **Appendix 9-C** of this ES **[EN010154/APP/6.3]**, which is considered for the CCR and ICCI assessments. Additional details of legislation and policy pertinent to this chapter are presented in **Appendix 6-A**: **Climate Change Policy and Legislation** of this ES **[EN010154/APP/6.3]**. The results of the CCR assessment are presented in **Appendix 6-B: Climate Change Risk Assessment,** while the ICCI assessment results are summarised in **Appendix 6-C: In-combination Climate Change Impact Assessment.**

6.2 Legislation and Planning Policy

6.2.1 Legislation, planning policy and guidance relating to the assessment of climate change effects and pertinent to the Proposed Development comprises the documents listed below. More detail regarding these policies can be found in **Appendix 6-A: Climate Change Policy and Legislation** of this ES **[EN010154/APP/6.1]**.

Legislation

a. United Nations (2015): The Paris Agreement (Ref 6-2) and Department for Energy Security and Net Zero (DESNZ) (2025): UK Nationally Determined Contribution (Ref 6-3);
b. HM Government (2017): The Infrastructure Planning (Environmental Impact Assessment (EIA)) Regulations 2017: Section 5(2) and Schedule 4, paragraphs 4 and 5 (Ref 6-1);
c. HMSO (2008, 2019): The Climate Change Act (2008) (Ref 6-4) and Climate Change Act (2050) Target Amendment Order 2019 (Ref 6-5);
d. HMSO (2009): The Carbon Budgets Order 2009 (Ref 6-6);
e. HMSO (2011): Carbon Budget Order 2011 (Ref 6-7);
f. HMSO (2016): Carbon Budget Order 2016 (Ref 6-8);
g. HMSO (2021): The Carbon Budget Order 2021 (Ref 6-9);
h. HM Government (2021): Environment Act 2021 (Ref 6-10); and.
i. HM Government (2016): Energy Act 2016 (Ref 6-11).

National Planning Policy

a. DESNZ (2024): The Overarching National Policy Statement for energy (NPS EN-1) (Ref 6-12);
b. DESNZ (formerly Department for Business, Energy, & Industrial Strategy (BEIS)) (2024): The National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) (Ref 6-13);
c. DESNZ (formerly BEIS) (2024): The National Policy Statement for Electricity Networks Infrastructure (EN-5) (Ref 6-14);
d. Ministry of Housing, Communities, and Local Government (MHCLG) (2024): The National Planning Policy Framework (NPPF) (Ref 6-15).
e. HM Government (2022): UK Climate Change Risk Assessment 2022 (Ref 6-16);
f. HM Treasury (2020): National Infrastructure Strategy (Ref 6-17);
g. DESNZ (2023): Powering Up Britain: Net Zero Growth Plan (Ref 6-18);
h. HM Government (2024): Clean Power 2030 Action Plan: A new era of electricity (Ref 6-19)

National Guidance

a. MHCLG (2014): Planning Practice Guidance, Climate Change (Ref 6-20).

b. DESNZ (formerly BEIS) (2021): Net Zero Strategy (Ref 6-21);

c. Institute of Environmental Management and Assessment (IEMA) (2022): Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref 6-22);

d. IEMA (2020): Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (Ref 6-23).

Local Planning Policy

a. North Kesteven District Council (NKDC) (2023): Climate Emergency Strategy (Ref 6-24) and NKDC (2023): Climate Emergency Action Plan (Ref 6-25).

b. Bassingham Parish Council (2017): Bassingham Neighbourhood Plan 2016-2036 (Ref 6-26);

c. Central Lincolnshire Joint Strategic Planning Committee (2023): Central Lincolnshire Local Plan (Ref 6-27);

d. Lincolnshire County Council (2019): Carbon Management Plan (Ref 6-28);

e. Lincolnshire County Council (2020): Green Masterplan 2020-2025 (Ref 6-29);

6.2.2 Where required, relevant Neighbourhood Plans and Supplementary Planning Documents (SPDs)/Guidance (SPGs) will be considered.

6.3 Consultation

6.3.1 A scoping exercise was undertaken in June 2023 to establish the content, approach and method of the EIA. A request for an EIA Scoping Opinion was issued to the Secretary of State through the Planning Inspectorate in June 2023. Comments received in the EIA Scoping Opinion (**Appendix 1-B [EN010154/APP/6.3]**), and Applicant responses in relation to the climate change assessment are summarised in **Table 6-1**.

6.3.2 Further consultation in response to formal pre-application engagement was undertaken through the Preliminary Environmental Information (PEI) Report, issued in October 2024. **Table 6-2** outlines the statutory consultation responses relating to the climate change assessment and how these have been addressed through the ES. The **Potential Main Issues for Examination [EN010154/APP/7.11]**, **Consultation Report [EN010154/APP/5.1]** and **Consultation Report Appendices [EN010154/APP/5.2]** provide further detailed responses, as relevant, to the feedback received during statutory consultation.

Table 6-1 Matters from the Scoping Opinion addressed in ES (Climate Change)

Consultee	Summary of Opinion/Consultation	Response and location of where this is addressed in the ES
Planning Inspectorate	The Scoping Report proposes to scope out an assessment of the combined impact of the Proposed Development and future climate change on the receiving environment. The Inspectorate agrees that the Proposed Development is not likely result in significant in-combination impacts relating to changes in wind patterns and this matter can therefore be scoped out of the assessment. However, the Inspectorate considers there is insufficient evidence in relation to temperature, precipitation change and sea level rise to scope these matters out of the assessment at this stage. Given part of the Proposed Development lies within the Witham Washlands Flood Storage Area, the Inspectorate considers there is potential for in-combination effects with the Proposed Development and likely future changes in precipitation. These matters should be assessed in the ES.	Noted. An FRA (presented in **Appendix 9-C** of this ES **[EN010154/APP/6.3]** and **Framework Drainage Strategy** (presented in **Appendix 9-D** of this ES **[EN010154/APP/6.3]**) has been submitted with the DCO application which considers climate change in relation to precipitation change, future flood risk and flood defences, in line with the requirements of the NPPF – this has been raised by the Environment Agency (EA) in their response. An ICCI assessment has been undertaken (presented in **Appendix 6-C** of this ES **[EN010154/APP/6.2]**) alongside the further development of the Proposed Development design as it progresses, and the outputs are presented in the ES. It considers the combined impacts of temperature, precipitation change and sea level rise on the Proposed Development.
Planning Inspectorate	The Scoping Report states that the Proposed Development is not located in an area susceptible to sea level rise. The Planning Inspectorate considers that in the absence of tidal flood modelling through the lifetime of the Proposed Development to demonstrate that the Proposed Development would not be affected, this matter cannot be scoped out of the assessment at this stage. Subject to the provision of an evidence-based justification that considers the whole lifetime of the Proposed Development, however, this matter could be scoped out of the assessment.	Noted, this is presented in the FRA **(Appendix 9-C** of this ES **[EN010154/APP/6.3]**). The impact of sea level rise on the Proposed Development as a result of climate change has been assessed. The outputs of this assessment are summarised in **Appendix 6-B** of this ES **[EN010154/AP/6.3]**.
Planning Inspectorate	The Scoping Report sets out the criteria that will be used in the GHG Emissions assessment to determine the significance of effect. Table 7-4 sets out the significance criteria and refers to guidance from the Institute of Environmental Management and Assessment (2022). The Inspectorate notes that Table 7-4 does not	The GHG assessment has been undertaken in line with the IEMA Guidance and the assessment results are presented in this ES Chapter. The significance criteria used within the GHG assessment has also been amended within **Section 6.4** of this ES Chapter in line with the request in the Scoping Opinion.

Consultee	Summary of Opinion/Consultation	Response and location of where this is addressed in the ES
	completely align with the stated guidance in relation to the significance of 'minor adverse' effects. The ES should ensure that where guidance is used to inform the assessment methodology, that it is clear how it has been applied and, where differences occur in the approach, that reasons are given for any proposed change.	
Planning Inspectorate	Where flexibility is being sought on the types of panels or batteries within the Proposed Development, the ES should present a worst-case assessment for the options under consideration.	The GHG assessment represents a 'worst-case scenario' based on the parameters defined in **Chapter 3: The Proposed Development [EN010154/APP/6.1]**, and has been undertaken in line with the IEMA Guidance as outlined in **Section 6.4** of this ES Chapter. Fixed south facing panels have been selected as a worst-case scenario due to the higher number of panels, potential lower annual yield, and higher embodied carbon in comparison to tracking panels. Both battery options yield the same GHG estimate because the functional unit for emissions calculations is $kgCO_2e/MWh$ capacity as the closest proxy for available information. This is considered in line with best practice and IEMA guidance on assessing GHGs.
Planning Inspectorate	The ES should seek to agree the approach to the climate change assessment with relevant consultation bodies.	Consultation responses received in relation to climate change have been considered and included in this ES.

Table 6-2 Matters from the Statutory Consultation Addressed in the ES (Climate Change)

Consultee	Summary of Opinion/Consultation	Response and location of where this is addressed in the ES
North Kesteven District Council	Consideration should be given to impact on climate change of waste panels due to intermediate component replacements.	Replacement and disposal of panels are included within the GHG assessment, **Section 6.4**. Embodied emissions and waste disposal due to replacements are presented in the operational assessment of effects in **Section 6.4.49** onwards (in line with the **Chapter 14: Other Environmental Topics, Section 14.5 Materials and Waste**), assuming a full replacement after 30 years and 10% for ad hoc replacements.
North Kesteven District Council	Latest carbon factors to be used in the ES.	The latest emission factors from the Inventory of Carbon and Energy (ICE) V4.0 database and the UK Department of Energy Security and Net Zero (DESNZ) greenhouse gas reporting 2024 are used in calculations. A review of Environmental Product Declarations (EPDs) and best available data for electronic components has formed part of the GHG assessment.
North Kesteven District Council	Request recognition of NKDC 2030 ambition compared to the national target and how the proposal impacts the District's strategic ambition	North Kesteven District Council's (NKDC) 2030 ambition is considered in **Section 6.2** and the Proposed Development aligns with District's ambition on renewable energy. National policies and net zero trajectories have been selected as the appropriate test of significance for the Proposed Development's contribution to net zero as operation is expected to commence post-2030.
North Kesteven District Council	No inclusion in the PEIR of GHG associated with replacement parts, components, plant and equipment during the operation lifetime of the development, with Table 6-1 lacking clarity. 60-year lifespan given rather than 40.	We have provided further detail on the GHG assessment and methodology here, with replacement and maintenance emissions presented throughout **Section 6.4**. A 60-year operating life span has been selected in line with the project description set out in **Chapter 3: The Proposed Development [EN010154/APP/6.1]**.
North Kesteven District Council	Encourage developer to consider planting high carbon sequestering species.	This will be considered by the Applicant. The **Framework Landscape and Ecological Management Plan (LEMP) [EN010154/APP/7.15]** will include indicative species mixes which are typically defined using species characteristic of the local landscape. Consideration has been given in the LEMP to the inclusion of high carbon sequestering species. This is however

Consultee	Summary of Opinion/Consultation	Response and location of where this is addressed in the ES
		not considered within the GHG assessment chapter, which therefore presents a worst-case scenario in terms of overall emissions impact.
Anglian Water	No reference to embedded carbon from manufacture and construction of the solar farm and supporting infrastructure- other net zero transition NSIP projects have set this out and the duration for the project to payback its embedded carbon in replacing more carbon intensive electricity generation.	We have provided further detail on the GHG assessment and methodology here, with embodied material, replacement, and maintenance emissions presented throughout **Section 6.4**. The payback and benefits of the Proposed Development from replacing more carbon intensive electricity generation are set out in **Paragraph 6.4.73**.

6.4 Lifecycle GHG Impact Assessment

Study Area

6.4.1 The study area for the lifecycle GHG impact assessment covers all direct GHG emissions arising from activities undertaken at the DCO Site during the construction, operation (including maintenance), and decommissioning of the Proposed Development. It also includes indirect emissions embedded within the construction products (e.g. Solar Photovoltaic (PV) Panels, Battery Energy Storage System (BESS) and cables) and construction materials (e.g. the steel required to construct the PV mounting structures) arising from their production, as well as emissions arising from the transportation of products and materials, waste and construction workers.

6.4.2 The environmental impact associated with GHG emissions is a national and global issue. Consequently, the significance of the Proposed Development's lifecycle GHG emissions is assessed by comparing the estimated GHG emissions from the Proposed Development against the reduction targets defined in the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (Ref 6-5), associated five year, legally-binding carbon budgets (Ref 6-6 to Ref 6-9) and the UK's forecast trajectory towards net zero.

Methodology

Sources of Information

6.4.3 Where available, data required to undertake the lifecycle GHG impact assessment was informed by the project design team and **Chapter 3: The Proposed Development [EN010154/APP/6.1]** and analysed using the methodology outlined below in this section. Where data was unavailable, reasonable assumptions have been made based on professional judgement, the details of which are outlined in the Assumptions and Limitations in **Paragraph 6.4.23.**

Scope of the Assessment

6.4.4 The GHG impact assessment followed a project lifecycle approach to calculate estimated GHG emissions arising from the construction, operation (including maintenance) and decommissioning of the Proposed Development. It further identifies 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 the IEMA guidance (Ref 6-22).

6.4.5 In line with the World Business Council for Sustainable Development and World Resources Institute GHG Protocol guidelines (Ref 6-30), the GHG assessment will be reported as tonnes of carbon dioxide equivalent (tCO_2e) and will consider 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).

6.4.6 Expected GHG emissions arising as a result of the Proposed Development, as well as baseline emissions, were quantified using a calculation-based methodology as per the following equation, and aligned with the GHG Protocol:

Activity data x GHG emissions factor = GHG emissions

6.4.7 Where data was not available, benchmarks from similar schemes assessed previously have been utilised, or a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-22).

6.4.8 **Table 6-3** summarises the key anticipated GHG emissions sources associated with the Proposed Development, in line with the Publicly Available Specification (PAS) 2080:2023 modules outlined in British Standard (BS) EN 17472 (Ref 6-31).

Table 6-3: Potential sources of GHG emissions

Lifecycle Stage	Activity	Primary emission sources
A1-3 Product stage	Raw material extraction and manufacturing of products required to build the equipment for the Proposed Development.	Embodied GHG emissions from energy use in extraction of materials and 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.
A4-5 Construction process stage	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 DCO Site.	GHG emissions from transportation of materials to the DCO Site.

Lifecycle Stage	Activity	Primary emission sources
	Transportation of construction workers to and from the DCO Site.	GHG emissions from transportation of workers to the DCO Site.
	Disposal of any waste generated by the construction processes.	GHG emissions from disposal and transportation of waste.
	Land use change.	GHG emissions from net loss of carbon sink.
	Water use.	Provision of potable water, and treatment of wastewater.
B1-7 Operation and Maintenance stage	Operation of the Proposed Development.	GHG emissions from energy consumption, provision of potable water, and treatment of wastewater.
		Leakage of potent GHGs during operation, such as SF_6 (derived from certain electric items such as gas-insulated switchgear and gas-insulated transformers during production, operation through leakage, and dismantling). The Onsite Substation will consist of air insulated switchgear (AIS).
	Maintenance of the Proposed Development.	GHG emissions from energy consumption, material use and waste generation as a result of site maintenance.
C1-4 Decommissioning stage	On-site decommissioning activity.	Energy (electricity, fuel, etc.) consumption from plant, vehicles and generators within the DCO Site.
	Transportation and disposal of waste materials.	GHG emissions from disposal and transportation of waste.
	Transportation of workers.	GHG emissions from transportation of workers to the DCO Site.

Impact Assessment Methodology

Sensitivity

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

Magnitude of Impacts

6.4.10 For the lifecycle GHG impact assessment the magnitude of impact considers the output of the GHG quantification process i.e. the Proposed Development's GHG lifecycle footprint, in the context of its contribution to the UK's carbon budgets and the possible impact of the Proposed Development on meeting the net zero targets. GHG emissions are also contextualised against sectoral budgets as defined by the Carbon Budget Delivery Plan (Ref 6-35).

6.4.11 According to the IEMA guidance on assessing GHG emissions in EIA (Ref 6-22), *"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"*.

6.4.12 The IEMA guidance 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 magnitude. The approach adopted for the purposes of this assessment is outlined below.

6.4.13 The UK carbon budgets are in place to restrict the amount of GHG emissions the UK can legally emit in a five-year period. The UK is currently in the 4th Carbon Budget period, which runs from 2023 to 2027, as detailed in **Table 6-4**. The 3rd, 4th, and 5th Carbon Budgets reflect the previous 80% reduction target by 2050. The 6th Carbon Budget is the first to align with the legislated 2050 net zero commitment.

6.4.14 The appropriate UK national Carbon Budgets that span the construction programme of the Proposed Development (2031 to 2033), are the 5th and 6th Carbon Budgets (2028 to 2032 and 2033 to 2037). The annual average GHG impact of the Proposed Development has been compared against the annualised Carbon Budget for the period in which the emissions arise to allow separate assessment of each lifecycle stage.

Table 6-4: UK national and indicative carbon budgets based upon the Climate Change Committee's (CCC) Balanced Net-Zero Pathway (2025)

Carbon budget	UK Carbon Budget ($MtCO_2e$)	Indicative Carbon Budgets based upon the CCC's balanced net-zero pathway ($MtCO_2e$)
3rd (2018-2022)	2,544	-
4th (2023-2027)	1,950	-
5th (2028-2032)	1,725	-
6th (2033-2037)	965	-

Carbon budget	UK Carbon Budget ($MtCO_2e$)	Indicative Carbon Budgets based upon the CCC's balanced net-zero pathway ($MtCO_2e$)
7th (2038-2042)	-	535
8th (2043-2047)	-	220
9th (2048-2050)	-	23

6.4.15 In order to illustrate the Proposed Development's trajectory towards net zero by 2050, it is recommended that 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 using the 6th Carbon Budget. The CCC published its advice to the UK Government on the level of its 7th Carbon Budget in early 2025, but this has not yet been secured (Ref 6-32). Beyond 2050, it is implied that the UK will remain at net zero.

6.4.16 The CCC Balanced Net-Zero Pathway has been divided into 5-year periods post-2037 to match the previous six legally binding UK national carbon budgets. The proposed carbon budget periods derived from the net-zero pathway encompass the 7th, 8th, and 9th indicative budget periods up to 2050 in line with the UK's 1.5-degree trajectory as detailed in **Table 6-4**.

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

6.4.18 In addition to providing advice that underpins setting national carbon budgets, the CCC also provides sector-specific decarbonisation pathways. **Table 6-5** presents the electricity generation sector-specific carbon budgets as further context to the GHG emissions, however, it should be noted that these are not statutory like the national-level budgets. The sector-specific carbon budget periods began in 2020 and have been amended in 2025 (Ref 6-33).

Table 6-5: Sector-specific electricity generation carbon budgets based upon the CCC's Balanced Net Zero Pathway

Carbon budget period	Recommended Carbon Budget ($MtCO_2e$)
2025 - 2027	89.51
2028 - 2032	67.57
2033 - 2037	29.17
2038 - 2042	21.89
2043 - 2047	10.18
2048 - 2050	3.48

Significance of Effects

6.4.19 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 lifetime, which may be positive, negative, or negligible. IEMA guidance emphasises that "*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*". To align with the national policy environment and best practice design, emissions, including any potential savings, are compared against a "without-project" baseline to assess the Proposed Development's contribution to the UK's net zero trajectory.

6.4.20 **Table 6-6** presents the different significance levels as per the latest version of the IEMA guidance, which states 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"*. The position taken in paragraph 150 of the Supreme Court Judgement in the case of *Finch (on behalf of the Weald Action Group) (Appellant) vs Surrey County Council and others (Respondents)* reiterates 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*".

6.4.21 Without low-carbon energy generation projects such as the Proposed Development, 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 (Ref 6-33).

6.4.22 Major or moderate adverse effects and beneficial effects are considered to be significant. Minor adverse and negligible effects are not considered to be significant.

Table 6-6: IEMA definition of levels of significance for the lifecycle GHG impact assessment

Significance level	Effect	Description in the IEMA guidance
Significant adverse	Major adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.
	Moderate adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.
Not significant adverse	Minor adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.
	Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or Net Zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.
Significant beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

Limitations and Assumptions

6.4.23 This section outlines the limitations of the data used to inform, and any key assumptions made within the lifecycle GHG impact assessment. The assessment has been based on the information available at the time of preparing this ES and the parameters outlined in **Chapter 3: The Proposed Development** of this ES **[EN010154/APP/6.1]**.

6.4.24 The GHG impact assessment presented in this chapter has relied on available information in the form of project-specific data, and relevant data from comparable schemes being brought forward in the UK. Quantities of products for minor components like switchgear, cabling, and inverters have been scaled based on other solar Nationally Significant Infrastructure Projects (NSIP) accepted for examination by the Planning Inspectorate which have been assessed by AECOM[1] and include BESS (Tillbridge solar farm Ref 6-36 and Gate Burton solar farm Ref 6-37). Information has also been gathered in collaboration with the Materials and Waste Assessment presented in Section 14.5 of **Chapter 14: Other Environmental Topics** of this ES **[EN010154/APP/6.1]**.

6.4.25 Since the ‘centralised’ and ‘distributed’ options for the BESS both have the same power capacity of 480MWh (and this was used as the functional unit for emissions calculations in line with best practice and IEMA guidance (Ref 6-22)), the embodied and operational emissions from both options are assumed to be the same, so have been referred to as simply ‘BESS’ throughout this chapter.

6.4.26 To estimate energy generation over the lifetime of the Proposed Development, a degradation rate of 2% has been assumed for the first year, and a rate of 0.45% has been applied for each year thereafter, up to year 30. To account for the PV modules being replaced after 30 years (which is halfway through the Proposed Development's lifetime – noting that not all components will be replaced at the same time), to provide a worst-case assumption for calculating embedded carbon, the same degradation rates for energy generation were applied from years 31 to 60. However, assuming the same energy generation as the current modules beyond year 31 is considered to be conservative, as the panels of the future are expected to be more efficient as a result of continued technological improvement over time.

6.4.27 Other replacement assumptions are applied based on the indicative design life of each component, with an additional 10% of components added for ad hoc replacements, e.g. materials replaced at a lifetime rate of 110% if one full replacement was required. Batteries are assumed to be replaced every 10 years and inverters every 15 years, while cabling and transformers are assumed to be replaced every 30 years. These assumptions align with assumptions applied in the Materials and Waste assessment (presented in Section 14.5 of **Chapter 14: Other Environmental Topics** of this ES **[EN010154/APP/6.1]**). It is possible that the batteries could be replaced at 15-year intervals, but a 10-year anticipated lifespan has been selected as a reasonable worst-case, conservative assumption.

[1] Noting that the Applicant is taking forward the Mallard Pass development, but AECOM did not produce the ES assessment for climate.

6.4.28 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, approaches, and carbon intensities of activities in the future. It has been assumed that the resources and effort required for decommissioning will be equivalent to those required for construction regarding elements like water and fuel use and worker transport. Waste emissions have been calculated as a "realistic worst-case scenario" from 70% of all materials going to recycling and the remaining 30% to landfill, as detailed in **Chapter 14: Other Environmental Topics** (Section 14.5 Materials and Waste) of this ES **[EN010154/APP/6.1]**. This is considered to be a worst-case scenario, as future developments in methodologies and technological advances are likely to reduce the carbon impact, particularly of decommissioning due to the 95% recovery rate of PV panels and semiconductors, which will take place after the date by when the UK must achieve net zero emissions.

6.4.29 It is assumed that the land will be returned to its original state following decommissioning of the Proposed Development. Net impact of GHG emissions associated with land use change (e.g. agricultural activity and carbon sequestration from vegetation) are expected to be minor.

6.4.30 Transportation emissions were calculated under the assumption that materials and waste would be transported by Heavy Goods Vehicles (HGVs), with distances based on RICS transport assumptions per material type where required (Ref 6-38). Inverters were assumed to be sourced from Europe under the assumption that procurement of this component is comparable to other solar farm projects. Distances used in the calculations for worker transportation emissions were based on assumptions applied in similar solar schemes.

6.4.31 The generating capacity of the fixed south facing panels option is estimated as 385MW DC and single axis trackers option as 368MW DC (i.e., an overplanting ratio of 1.6). The storage capacity of battery is assumed to be 480MWh. Where other 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 were made based on industry approximations and professional best practice. For example, to derive the embodied carbon emissions for Solar PV panels, an estimation of 286 kgCO_2e/kWp was taken as an average of published EPD data from manufacturers Jinko and SunPower (Ref 6-39 and Ref 6-40). This is inclusive of the associated accessory equipment (i.e. support, wiring, inverters and optimisers). The estimation is associated with Monocrystalline PV modules, which would meet the requirements of the project.

6.4.32 The latest IEMA guidance on assessing GHG emissions (Ref 6-22) states that where there are no physical developments or activity taking place directly on the identified site, it may not be possible to report on current baseline emissions. As this is the case for the DCO Site, a baseline of zero GHG emissions is reported, again in line with IEMA guidance.

6.4.33 The IEMA 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance' 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"*. The benefit of any renewable electricity scheme is to provide low-carbon electricity to the grid, displacing fossil fuelled sources to bring down the national grid average carbon intensity. On this basis, the production of electricity from the Proposed Development and associated carbon savings is compared against the future baseline of the production of electricity at the average grid intensity without decarbonisation. This is discussed in **Paragraph 6.5.27** onwards - **Assessment of Effects**.

Baseline Environment

6.4.34 This section describes the existing and anticipated future baseline conditions for the lifecycle GHG impact assessment.

Current Baseline

6.4.35 The current baseline is a 'no-development' scenario whereby the Proposed Development is not implemented. The baseline comprises existing carbon stock and sources of GHG emissions resulting from the existing activities within the DCO Site.

6.4.36 The current land use within the DCO Site consists of arable land, interspersed with individual trees along field boundaries, hedgerows and linear tree belts. The abundance of vegetation within the DCO Site suggests limited carbon sink potential. Also, current land use within the DCO Site has minor levels of associated GHG emissions as the land use is largely agricultural. Baseline agricultural GHG emissions are dependent on soil and vegetation present, fuel use for the operation of vehicles and machinery, and other inputs such as fertiliser and pesticide use. Due to the minimal use of the land and as a worst-case scenario, current baseline emissions are considered zero.

Future Baseline

6.4.37 The future baseline for the GHG assessment is a business-as-usual position whereby the Proposed Development is not implemented. This includes the operational emissions from the generation of electricity that would occur elsewhere should the Proposed Development not go ahead but which will be displaced in the case of the Proposed Development being delivered. As mentioned in **Paragraph 6.4.33**, this involves the generation of electricity from the national grid without a decarbonisation trajectory applied.

6.4.38 The current land use within the DCO Site 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.

Embedded Mitigation

6.4.39 The Proposed Development is being developed through an iterative Environmental Impact Assessment (EIA) and design process which involves seeking to avoid or reduce and, if possible, offset potential environmental effects. Where possible, these measures are incorporated into the form or design of the Proposed Development, for example through the appropriate routing and placement of infrastructure.

6.4.40 Once these measures are incorporated into the design, they are termed 'embedded mitigation measures'. Embedded mitigation relevant to the construction phase are described within each technical chapter of this ES. For the operational phase, such embedded mitigation will be represented primarily in the design, for example through the choice of infrastructure components. Embedded mitigation measures are therefore either incorporated into the design from the outset or identified through the assessment process.

6.4.41 Along with any measures required for legislative compliance, the Proposed Development will also incorporate industry standard control measures, which are common practice on construction sites, into the embedded measures. These are described in each technical chapter of this ES.

6.4.42 A range of embedded mitigation has been considered for incorporation into the design to mitigate the impact of the Proposed Development on the climate. Measures including, but not limited to, the following are secured through the **Framework CEMP [EN010154/APP/7.7], Framework OEMP [EN010154/APP/7.8] and Framework DEMP [EN010154/APP/7.9]** submitted as part of the DCO application and include:

a. Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable;

b. Designing, constructing and implementing the Proposed Development in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content where feasible;

c. Reusing suitable infrastructure and resources where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements);

d. Liaising with construction personnel for the potential to implement staff minibuses and car sharing options;

e. Implementing a Travel Plan in the Construction Traffic Management Plan (CTMP) to reduce the volume of construction staff and employee trips to the Proposed Development, while encouraging the use of lower carbon modes of transport by identifying and communicating local bus connections and pedestrian/cycle access routes to/from the Proposed Development to all construction staff, and providing appropriate facilities for the safe storage of bicycles;

f. Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and

g. Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.

Assessment of Effects

6.4.43 The impacts and effects (both beneficial and adverse) associated with the construction, operation (including maintenance), and decommissioning of the Proposed Development (as described in **Chapter 3: The Proposed Development** of this ES **[EN010154/APP/6.1]**) are outlined in the sections below. The assessment has been completed using a combination of project specific data and scaling based on other similar capacity UK solar farm schemes assessed by AECOM (Tillbridge and Gate Burton solar farms).

6.4.44 Within this section, GHG emissions arising as a result of the Proposed Development are first identified and assessed for each lifecycle stage individually (construction, operation (including maintenance) and decommissioning). While it is important to understand the GHG impacts at each individual lifecycle stage, it is also important to understand the net lifecycle GHG impact of the Proposed Development due to the long-term, cumulative nature of GHG emissions over the lifetime of the Proposed Development.

6.4.45 Therefore, the net impact of the Proposed Development is identified and assessed, taking into account the renewable energy generation and the benefit of this in the context of the wider electricity sector and the national grid average GHG intensity. The overall assessment, which accounts for all GHG emissions over the lifetime of the Proposed Development, compares the GHG intensity of the Proposed Development with the GHG intensity of other predicted grid energy generation sources.

Construction (estimated 2031 – 2033)

6.4.46 The GHG effects of construction are taken to be those for which the source begins and ends during the construction stage, and the effects do not endure beyond the completion of the construction phase. The construction phase is expected to run from 2031-2033, but may commence earlier, as outlined in **Chapter 3: The Proposed Development** of this ES **[EN010154/APP/6.1]**. The embodied carbon associated with the manufacture of the materials and their components, particularly the manufacturing of the BESS and Solar PV Panels, will have the greatest carbon impact during construction. Transportation of these products is the second greatest contributor, while the remaining impacts will come from worker commuting, waste, and fuel and water use. Other GHG impacts during construction of the Proposed Development include:

a. Transportation and disposal of waste arising from construction processes and packaging of materials;

b. Water use in concrete production and the end of construction cleaning cycle. Additional water consumption that contributes to GHG emissions includes water consumption by the workers; and

c. 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 DCO Site, and transportation of construction workers to and from the DCO Site.

6.4.47 Land use change is anticipated to have a beneficial impact during the lifetime of the Proposed Development as grassland that can be grown under the panels has a higher carbon sink value than agricultural land. However, as this beneficial impact is largely reversed during decommissioning, 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 planted during construction are expected to be retained beyond the decommissioning phase.

6.4.48 The manufacturing of the PV panels is estimated to account for 110,110 tCO_2e, with the BESS (both centralised and distributed options) providing a further contribution of 37,220 tCO_2e. **Table 6-7** summarises the emissions resulting from the manufacture of components required for construction.

Table 6-7. Material Embodied Emissions

Emissions Source	Embodied emission (tCO_2e)	Proportion of total embodied emissions (%)
PV Panels	110,110	43.41
Combiner Boxes	23,851	9.40
Inverters	23,851	9.40
Switchgears	166	0.07
Transformers	3,287	1.30
BESS	37,220	14.67
Cabling	200	0.09%
Concrete	4,104	1.62
Steel	43,208	17.04
CCTV	109	0.04%
Fencing	253	0.10
Aggregate/Tracks	7,274	2.06
Total Products	**253,630**	**100%**

6.4.49 Based on the assumptions listed in **Paragraphs 6.4.20 – 6.4.30**, total GHG emissions from the construction phase are estimated to equate to 229,637

tCO_2e. **Table 6-8** below summarises the overall construction emissions and their source.

6.4.50 **Table 6-9** shows the construction emissions as a proportion of the relevant carbon budget, assuming that construction ends on 31st December 2032. It is possible that the construction phase could commence earlier than 2031, so there is a low likelihood of this phase carrying into 2033 and the next carbon budget period. Furthermore, the associated impact against the next carbon budget would have no effect on the assessment of significance.

Table 6-8. Construction GHG emissions

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total embodied emissions (%)
Product and Materials	253,630	90.4
Transportation of products and materials	22,094	7.9
Worker Commuting	1,674	0.6
Fuel use	911	0.3
Water use	0.70	<0.01%
Waste	2,370	0.85
Total Construction	**280,682**	**100**

Table 6-9: UK carbon budgets relevant to construction period

Relevant UK Carbon Budget	UK Carbon Budget (tCO_2e)	Construction Emissions During Carbon Budget Period (tCO_2e)	Construction Emissions as a Proportion of Carbon Budget (%)
5th Carbon Budget (2028 to 2032)	1,725,000,000	280,682	0.016

Operation (and maintenance) (estimated 2033 – 2093)

6.4.51 Operational GHG Impacts 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, and its operation, use and maintenance.

6.4.52 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 Proposed Development 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 DCO Site; and

e. Waste management activities.

6.4.53 Operational emissions predominantly arise from the replacement of panels and the associated embodied carbon in the materials (occurring after 30 years), and therefore occur at regular intervals, rather than being ongoing, constant emissions. **Section 14.5: Materials and Waste** of **Chapter 14: Other Environmental Topics** of this ES **[EN010154/APP/6.1]**, provide a review of expected design life and replacement frequency for key components of the Proposed Development. As a summary for other components, batteries are assumed to be replaced every 10 years, inverters every 15 years, while cabling and transformers are assumed to be replaced every 30 years.

6.4.54 It is assumed that the annual grid energy requirement for operations at the Proposed Development will equate to 3.53 GWh per year. The UK Government published projections of grid carbon intensity for each year to 2100 (Ref 6-42), with the emissions per kWh of electricity generated set to decline over the period to 2050. Operational energy emissions will therefore be highest in year one of operation and decrease thereafter. Applying these projected grid factors, emissions in the first year of operations are estimated to be 179 tCO_2e, falling to 22 tCO_2e/year by 2050, by which time the national grid is assumed to be substantially decarbonised. Lifetime emissions from grid power consumption total 1,763 tCO_2e. This is assuming a worst-case scenario where the energy required will not be drawn directly from the Proposed Development's own solar PV array or BESS.

6.4.55 Based on the proposed maintenance rate for the required components (PV panels, inverters, cabling, transformers, and BESS) as described in **Paragraph 6.4.20 – 6.4.30**, and applying the same embodied and transportation emissions used for the construction phase, the replacement of these components is estimated to result in embodied emissions of 477,829 tCO_2e (including transport of the replacement materials to the DCO Site, any wastage, and the transport and disposal of replaced components).

6.4.56 The operational and replacement emissions have been annualised against the UK Carbon Budgets. The budget periods only go out to 2050, and it is likely that replacement emissions will arise beyond this period, but in order to capture the impacts of replacement, these emissions have also been captured in the annualised operational emissions rather than spiking at a future date.

6.4.57 With the exception of the emissions data for PV panels, which have been derived from the Jinko and SunPower EPDs, the embodied carbon factors on which these figures are based are subject to considerable uncertainty as the Proposed Development's specific products have not been confirmed and there are no industry-standard emissions factors for many of the parts. The most recent UK government conversion factors (Ref 6-41) have been selected based on professional judgement.

6.4.58 The battery modules are required to be replaced on average every 10 years which are associated with high embodied carbon. However, replacements that occur later in the design life of the Proposed Development are likely to have a substantially lower carbon impact due to increased efficiency of manufacturing, ongoing decarbonisation of electricity consumed during the manufacturing process, and the availability of more reliable and accurate data.

6.4.59 As discussed in **Paragraph 6.4.20– 6.4.30** Assumptions and Limitations and the assessment of construction effects, land use change is anticipated to have a beneficial impact during the lifetime of the Proposed Development. However, as this beneficial impact is largely reversed during decommissioning, the GHG impact associated with land use change has been excluded from the lifecycle GHG impact assessment. This is assumed to represent a robust worst-case scenario as some areas of ecological mitigation and grasslands may remain after decommissioning.

6.4.60 Total operational emissions over the design life of the Proposed Development are estimated at 477,466 tCO_2e. Almost 99% of these emissions are associated with the materials and transport of the replacement components required throughout operation. The largest proportion of this (262,599 tCO_2e) relates to five full replacements of the battery modules (plus 10% for ad hoc replacements) over the Proposed Development's lifecycle. **Table 6-10** below summaries operational emissions and their sources.

Table 6-10. Operational GHG emissions

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total operational emissions (%)
Maintenance (Replacement Components)	472,234	98.9%
Staff Transport	3,457	0.72%
Energy Use	1,763	0.37%
Water Use	11	<0.05%
Operations Total	**477,466**	**100%**

6.4.61 The Proposed Development is anticipated to be operational by the start of 2033, therefore operational emissions up to 2037 (the end of the 6th Carbon Budget) will fall under the 6th UK Carbon Budget, beyond which point no Carbon Budgets have yet been legislated for, although indicative carbon budgets have been summarised. **Table 6-11** presents the estimated operational emissions against the Carbon Budget periods during which they arise. The overall significance of GHG emissions in the context of the UK Carbon Budgets and the national policy environment has been assessed from **Paragraph 6.4.78**.

Table 6-11: UK Carbon Budgets relevant to operational period (up to 2037)

Relevant UK Carbon Budget	UK Carbon Budget (tCO_2e)	Operational Emissions During Carbon Budget Period (tCO_2e)	Proportion of Carbon Budget (%)
6th Carbon Budget (2033 - 2037)	965,000,000	39,789	0.004%
7th Carbon Budget (2038 - 2042)	535,000,000	39,789	0.007%
8th Carbon Budget (2043 – 2047)	220,000,000	39,789	0.018%
9th Carbon Budget (2048 – 2050)	22,000,000	23,873	0.109%

Decommissioning (estimated 2093 – 2095)

6.4.62 GHG emissions from the decommissioning phase are subject to a high degree of uncertainty, as the conditions that will apply in 2095 cannot be described with any confidence. For the purposes of this assessment, it is assumed that decommissioning emissions from the use of plant, worker travel and waste replicate the emissions produced during the construction phase. This is likely to be a conservative estimate as the emissions associated with these activities are anticipated to decrease in the future.

6.4.63 Emissions from the disposal and recovery of materials and components at the end of the Proposed Development's design life have been estimated based on a worst-case scenario that all materials and components will go to waste – 70% to recycling and 30% to landfill. This calculation is also likely to be a conservative estimate as it is anticipated that recycling rates will increase by the time of decommissioning. Emissions from the end-of-life disposal of all material and products is estimated at 282 tCO_2e.

6.4.64 Land use change has been excluded from the GHG assessment as discussed previously, due to the beneficial GHG impacts of conversion of arable land to grassland during operation being returned to cropland following the decommissioning of the Proposed Development, with any carbon stored in soil or vegetation re-released to the atmosphere. This is considered to be a robust worst-case approach and is likely to underestimate the beneficial effect of the Proposed Development as some vegetation may be retained after decommissioning.

6.4.65 **Table 6-12** summarises the emissions resulting from the decommissioning phase.

Table 6-12: Decommissioning GHG emissions

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total operational emissions (%)
Fuel Use	911	31.8%
Staff Transport	1,674	58.4%
Water Use	0.70	0.02%
Waste	282	9.8%
Operations Total	**2,869**	**100%**

6.4.66 As above for the operational 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 the date of decommissioning, 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 net zero carbon emissions target for 2050.

Carbon Intensity of the Proposed Development

6.4.67 Renewable energy generation from the Proposed Development during the first full year of operation is estimated to be 345,607 MWh based on the Proposed Development description provided within **Chapter 3: The Proposed Development** of this ES **[EN010154/APP/6.1]** and applying a worst-case scenario of using south-facing PV panels**.** Taking into consideration a 2% reduction in PV Panel performance during the first year of operation and applying a 0.45% degradation factor for each subsequent year to year 30, then the same assumptions again from year 31 to year 60, this gives a total energy generation figure of 19,438,499 MWh over the assessed 60-year Proposed Development lifetime.

6.4.68 A carbon intensity value represents how many grams of CO_2e are released to produce a kilowatt hour (kWh) of electricity. Dividing the lifetime total energy generation figure into the lifetime emissions total of 715,924 tCO_2e gives a total carbon intensity value for a worst-case scenario of the Proposed Development of 37 gCO_2e/kWh.

6.4.69 The 2024 grid average carbon intensity is 207 gCO_2e/kWh (Ref 6-41), however these figures cannot be directly compared as the published UK grid carbon intensity figure only takes into account operational emissions from the generation of electricity, overwhelmingly from the fossil fuels used to power gas-fired power stations. For a meaningful comparison to be made between the Proposed Development and the UK grid, the operational carbon intensity of the Proposed Development must only include emissions from the ongoing operations of the Proposed Development and exclude emissions from construction and decommissioning.

6.4.70 Over the 60-year lifetime of the Proposed Development, the lifetime operational carbon intensity is a value of 25 gCO_2e/kWh, which is overwhelmingly due to emissions from replacement components rather than the operation of the Proposed Development.

6.4.71 Over the last decade, there has been significant decarbonisation of the grid. This trend is set to continue into the future, but only if projects such as the Proposed Development are brought forward. Therefore, comparing a low-carbon electricity project such as the Proposed Development against projections of future grid carbon intensity with decarbonisation fails to recognise that the grid can only decarbonise if additional renewable generation projects are consented.

6.4.72 On this basis, the GHG assessment assumes a do-nothing counterfactual scenario of the operation of the UK grid with no projected decarbonisation. The operational intensity of the Proposed Development is therefore 88% lower than that of the grid average which sits at 207 gCO_2e/kWh in 2025. Each kilowatt hour of electricity generated by the Proposed Development will emit 182 gCO_2e less than if it was generated by the national grid.

6.4.73 Combining this figure with the estimated lifetime output from the Proposed Development indicates an overall lifetime carbon saving, relative to the counterfactual grid average of the current (2025) energy mix, of 3,302,906 tCO_2e. The carbon payback period for construction emissions is approximately 4 years of operation. Considering that the initial role of solar and other renewable energy generation is to displace fossil fuels such as gas from the grid, a payback period can be calculated when considering displacement of unabated CCGT. This would be two years for the emissions in the construction phase of the Proposed Development. This will help the UK meet its national and international binding targets including the UK's Carbon Budget and the Nationally Determined Contributions in line with the Paris Agreement.

Additional Carbon Savings from the use of Battery Energy Storage

6.4.74 Use of battery energy storage 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 fast response but high carbon intensity power sources such as open cycle gas turbines (OCGT). The use of a battery charged from solar PV generation can deliver a substantial carbon saving relative to an OCGT.

6.4.75 The current estimated BESS capacity is 480 MWh, for either the centralised (AC-coupled arrangement located as a single BESS compound) or distributed (DC-coupled arrangement located alongside solar stations) BESS options.

6.4.76 Should the BESS be charged from the Proposed Development, and discharged back into the grid once each day, at a typical round-trip efficiency of 85% and an overall lifetime degradation rate of 80% (accounting for replacements), it will be able to supply 7,985 GWh to the electricity grid over its 60-year operational lifetime. As the lifetime generation figure of the BESS is significantly less than that of the Proposed Development, it is reasonable to assume that the battery will only store and discharge energy generated by the Proposed Development.

6.4.77 Comparing the operational carbon intensity of the Proposed Development at 0.025 tCO_2e/MWh and OCGT at 0.460 tCO_2e/MWh (Ref 6-43); the use of battery energy storage for grid balancing purposes would deliver an additional saving of approximately 2,242,089 tCO_2e over its operational lifetime.

6.4.78 These figures are inevitably subject to a degree of uncertainty, but they illustrate the fact that the use of battery energy storage, when used for grid balancing purposes, is likely to result in significant additional carbon savings over its operational lifetime. These additional carbon savings from use of battery energy storage for grid balancing are not factored into the overall GHG assessment, which therefore represents a conservative, worst-case scenario.

Overall GHG Impact and Significance

6.4.79 In light of the UK's climate 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 Carbon Budgets have been used to contextualise emissions from the Proposed Development.

6.4.80 Annual emissions from the construction of the Proposed Development (and their magnitude) are compared to the significance definitions outlined in **Table 6-6**. In line with IEMA criteria for assessing the significance of GHG impacts, construction of the Proposed Development can be assumed to be consistent with applicable existing and emerging policy requirements. Emissions from construction are therefore determined to be 'minor adverse' and not significant.

6.4.81 The Proposed Development directly supports the UK policy of decarbonising electricity generation, as laid out primarily in NPS EN-1 and EN-3 (Ref 6-12, Ref 6-13). The pathways for net zero set in the CCC's Seventh Carbon Budget (Ref 6-32), and the legally-binding Sixth Carbon Budget Advice, Methodology and Policy reports (Ref 6-44), also make clear the need for renewable and solar energy to increase to deliver net zero. The National Grid cannot decarbonise without investments in low carbon electricity generation projects like the Proposed Development.

6.4.82 The Proposed Development results in some operational emissions associated with maintenance and worker travel. However, the benefits of generating renewable energy from the Proposed Development far outweigh the associated emissions as demonstrated in **Paragraph 6.4.67 to 6.4.73**. Annual emissions from the operation (including maintenance) of the Proposed Development (and their magnitude) are compared to the significance definitions outlined in **Table 6-6**. As stated in the IEMA guidance on assessing GHG emissions, "*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*".

6.4.83 The Proposed Development's operational 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 operational phase is therefore considered to be beneficial and significant when compared to the future baseline 'business-as-usual' scenario – as described above from **Paragraph 6.4.40**.

6.4.84 While there are expected to be GHG emissions associated with the construction and decommissioning phase of the Proposed Development, actual emissions are anticipated to be lower than the figures presented in **Table 6-8** and **Table 6-12**, which represent a robust worst-case scenario. Therefore, the magnitude of impact is considered to be low.

6.4.85 The GHG impact of construction and decommissioning are anticipated to result in minor adverse, non-significant effects on the climate. As noted in the significance definitions in **Table 6-6**, a negligible effect is not possible where any GHG emissions are released to the atmosphere. However, while there are residual emissions, the Proposed Development 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.

6.4.86 The impact of operations is considered to have a **beneficial, significant** effect due to the operational carbon intensity remaining below that of the UK grid without decarbonisation throughout its lifetime and 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 the national grid without decarbonisation would result in substantially higher GHG emissions. As stated in the latest IEMA guidance (Ref 6-22), "*a project that causes GHG emissions to be avoided or removed from the atmosphere has a beneficial effect that is significant*". This Proposed Development 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.

6.4.87 The GHG savings achieved throughout the lifetime of the Proposed Development 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 Proposed Development, 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.

6.4.88 **Table 6-13** summarises the overall GHG impact and significance.

Table 6-13: Assessment of effects – GHG assessment

Receptor	Description of impact	Significance of effect without mitigation	Embedded and additional mitigation measure	Residual effect after mitigation
Construction (estimated 2031–2033)	GHG emissions as a consequence of construction activities	Minor Adverse	The overall beneficial impact of the Proposed Development itself is considered to balance any GHG emissions during construction. Some measures for reducing construction GHG impacts are suggested in the **Framework CEMP [EN010154/APP/7.7]**.	Minor Adverse (not significant)
Operation (estimated 2033–2093)	GHG emissions as a consequence of operational activities	Beneficial (significant)	No mitigation required where a beneficial impact is assessed.	**Beneficial (significant)**
Decommissioning (estimated 2093–2094)	GHG emissions as a consequence of decommissioning activities	Minor Adverse	The overall beneficial impact of the Proposed Development itself is considered to balance any GHG emissions during decommissioning. Decommissioning plans may include measures for reducing GHG impacts.	Minor Adverse (not significant)
Overall	GHG emissions compared to business-as-usual scenario	Beneficial (significant)	No mitigation required where an overall beneficial impact is assessed.	**Beneficial (significant)**

6.5 Climate Change Risk Assessment

Study Area

6.5.1 The study area for the CCR assessment is the land within the DCO Site, including the Cable Corridor to the proposed National Grid substation near Navenby. It covers the construction, operation (including maintenance) and decommissioning of all assets (e.g. materials, workforce) and infrastructure which constitute the Proposed Development.

Methodology

Sources of Information

6.5.2 The following sources of information have been used to inform the baseline and assessment presented within this Chapter:

a. Historic climate data obtained from the Met Office website (Ref 6-45) has been used to determine the current baseline conditions;

b. In line with National Policy Statement (NPS) EN1 requirements to use the latest credible scientific evidence in relation to climate change (outlined in **Appendix 6-A: Climate Change Legislation and Policy** of this ES **[EN010154/APP/6.3]**), UK Climate Projections 2018 (UKCP18) (Ref 6-46) data was obtained to determine the future baseline conditions;

c. The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) Sea Level Projection Tool (Ref 6-47) and ThinkHazard (Ref 6-48) were also used for other projected trends/impacts, and the UK Climate Change Risk Assessment analysed for the current state of nationwide climate change risks (Ref 6-16); and

d. Climate change resilience measures that are embedded within the Proposed Development's design were determined through liaison between the project design team and relevant environmental discipline leads and are set out in **Appendix 6-B: Climate Change Risk Assessment** of this ES **[EN010154/APP/6.3].**

e. Information provided by the Applicant.

Scope of the Assessment

6.5.3 The Infrastructure Planning (EIA) Regulations 2017 (Ref 6-1) requires the inclusion of information on the vulnerability of the Proposed Development to climate change. Consequently, a CCRA for the Proposed Development has been conducted which identifies potential climate change impacts.

6.5.4 The CCRA presented in this Chapter includes consideration of all infrastructure and assets associated with the Proposed Development. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UK Climate Projections 2018 (UKCP18) projections.

6.5.5 The review of potential impacts and the Proposed Development's vulnerability considers the embedded mitigation measures that have been designed into the Proposed Development, discussed in **Paragraph 6.5.24**.

6.5.6 The assessment has considered climate projections over a 60-year period from the Proposed Development's completion, assumed to be 2033, with projections from 2070 – 2099 being used to assess effects for the decommissioning phase.

6.5.7 Climate parameters considered in the CCRA during the construction, operation (including maintenance) and decommissioning of the Proposed Development include the following:

a. Extreme weather events;
b. Flood risk;
c. Sea level rise (SLR);
d. Wind pattern;
e. Temperature change; and
f. Precipitation change.

Impact Assessment Methodology

Sensitivity

6.5.8 The receptor for the CCRA is the Proposed Development itself including its construction, operation (including maintenance) and decommissioning. The CCRA provides a description of how the Proposed Development has been designed to be more resilient to the climate change impacts identified during the review of the UKCP18 data (Ref 6-46).

6.5.9 The following key terms and definitions relating to the assessment 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 Impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and
c. Climate Consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

6.5.10 A staged approach has been used to assess the impacts of climate change on the Proposed Development:

a. Identify potential climate hazards and associated Climate Risks;
b. Identify likelihood of Climate Impact occurring;
c. Identify consequence of Climate Impact on the Proposed Development; and

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

Magnitude of Impacts

6.5.11 Once potential climate hazards have been identified (e.g. heatwaves), the likelihood of their occurrence during each project phase (construction, operation, and decommissioning) is categorised.

6.5.12 The criteria which have been used to determine the likelihood of a Climate Risk occurring are detailed in **Table 6-14**. This is in line with the definitions presented in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (Ref 6-49). For example, a climate hazard could be: increased summer temperatures, leading to the climate risk of a heatwave, while the climate change impact is the impact on the Proposed Development, e.g. overheated electrical equipment.

Table 6-14: Probability of climate risks occurring

Likelihood of event	Qualitative description	Description (probability of occurrence)
Almost certain	Likely that the event will occur many times (reoccurs frequently)	>90-100% probability that the impact will occur
Likely	Likely that the event will occur sometimes (reoccurs infrequently).	>66-90% probability that the impact will occur
Moderate	Possible that the event will occur (has occurred rarely)	>33-66% probability that the impact will occur
Unlikely	Unlikely that the event will occur (not known to have occurred).	>10-33% probability that the impact will occur
Rare	Almost inconceivable that the event will occur.	0-10% probability that the impact will occur

6.5.13 Following identification of climate hazards and risks, the likelihood of occurrence and consequences of Climate Impacts have been assessed according to **Table 6-15** and **Table 6-16**. For example, permanent damage to electrical equipment from heatwaves causing complete loss of operation. The categories and descriptions provided below are based on the IEMA Climate Change Resilience and Adaptation guidance (Ref 6-23).

Table 6-15: Likelihood of a climate impact occurring

Consequence of impact	Description
Almost certain	Likelihood of climate hazard occurring is high and impact is always/ almost always going to occur.
Likely	Likelihood of climate hazard occurring is high and impact often occurs.

Consequence of impact	Description
Moderate	Likelihood of climate hazard occurring is high and impact sometimes occurs or the likelihood of climate hazard occurring is moderate and impact is likely to occur always/ almost always.
Unlikely	Likelihood of climate hazard occurring is high but impact rarely occurs or the likelihood of climate hazard occurring is moderate and impact sometimes occurs or the likelihood of climate hazard occurring is low and impact is likely to occur always/ almost always.
Rare	All other eventualities - highly unlikely but theoretically possible.

Table 6-16: Level of consequence of a climate impact

Consequence of impact	Description
Catastrophic	Disaster with the potential to lead to shut down or collapse or loss of the asset/network; Single or multiple fatalities; Significant environmental harm with widespread effect and recovery longer than one year; Loss of social licence to operate; and/or Permanent financial impact.
Major	Permanent damage to structures/assets; Complete loss of operation/service; Complete/partial renewal of infrastructure; Exceptional environmental damage; and/or Extreme financial impact.
Moderate	Partial infrastructure damage and some loss of service; Some infrastructure renewal; Adverse impact on the environment; and/or Moderate financial impact.
Minor	Localised infrastructure disruption and minor loss of service; No permanent damage, minor restoration work required; Slight adverse environmental effects; and/or Small financial losses.
Insignificant	No damage to infrastructure; No impacts on the environment; No adverse financial impact.

Significance of Effects

6.5.14 The significance in the CCRA is determined as a function of the likelihood of a climate change risk occurring and the consequence to the receptor if the risk occurs. The significance is detailed in **Table 6-17**. Where a risk is determined as high or moderate, this has been deemed significant. Low and negligible risks are classified as not significant. The assessment takes into account confirmed design and mitigation measures (referred to as embedded mitigation).

Table 6-17: CCRA significance of effect matrix

		Consequence of a Climate Impact				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood of climate impact occurring	Rare	Low (NS)	Low (NS)	Medium (NS)	High (S)	Extreme (S)
	Unlikely	Low (NS)	Low (NS)	Medium (NS)	High (S)	Extreme (S)
	Moderate	Low (NS)	Medium (NS)	High (S)	Extreme (S)	Extreme (S)
	Likely	Medium (NS)	High (S)	High (S)	Extreme (S)	Extreme (S)
	Almost certain	High (S)	High (S)	Extreme (S)	Extreme (S)	Extreme (S)

**NS= Not Significant; S=Significant*

Limitations and Assumptions

6.5.15 This Chapter forms the Climate Change assessments which have been based on information available at the time of preparing this ES **[EN010154/APP/6.1]**. Information has been gathered from the UK Met Office for historical climate averages and UKCP18 for future climate projections. Construction phase risks have been assessed against the 2020 – 2039 projections, operational risks against 2020 - 2039, 2040 – 2069 and 2070 – 2099, and decommissioning risks against the 2070 – 2099 period.

6.5.16 Uncertainty in climate models arises from two sources. The first is uncertainty regarding how volumes of GHG emissions may change over time due to variable factors like changes in energy use, land use, and technology associated with economic developments, population growth, and lifestyle and behavioural changes, and the impacts associated with political drivers. The second source of uncertainty is variable confidence levels in how well the climate models can capture different climatic variables. For example, climate model performance tends to wane when simulating large-scale precipitation patterns in comparison to modelling surface temperature. Caution should ultimately be used when utilising climate projection data, hence why the worst-case scenario is selected under EIA Regulations.

6.5.17 UKCP18 uses a wide range of possible scenarios, classified as Representative Concentration Pathways (RCP), 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.

Baseline Environment

6.5.18 This section describes the existing baseline conditions and anticipated future baseline conditions for the CCRA.

Current Baseline

6.5.19 The baseline for the CCRA is the climate in the location of the Proposed Development for the 30-year period of 1981 to 2010 (the standard baseline for climate data). Historic climate data recorded by the closest meteorological station to the Proposed Development (Waddington) for the 30-year period of 1981 to 2010 was obtained from the Met Office website (Ref 6-45) and is summarised in **Table 6-18** below.

Future Baseline

6.5.20 The future baseline is expected to differ from the present-day baseline described above. UKCP18 (Ref 6-46) 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. Wind pattern;

j. Sea level rise; and

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

6.5.21 Projected temperature and precipitation variables are presented in **Table 6-18**. UKCP18 probabilistic projections have been analysed for the 25 km^2 grid square within which the DCO Site is located. These figures are expressed as temperature/ precipitation anomalies in relation to the UKCP18 1981 to 2010 baseline, which is used for consistency in estimating climate projections.

6.5.22 As the design life of the Proposed Development is 60 years, the CCRA has considered a scenario that reflects a high level of GHG emissions at the 10th, 50th, and 90th percentile levels for the pre-defined 30-year periods up to 2099 to assess the impact of climate change over the assessed lifetime of the Proposed Development.

6.5.23 Construction risks are assessed against the 2020 to 2039 projection data. Operational risks are assessed across 2020-39, 2040-69 and 2070-2099 projections, and decommissioning are assessed against 2070 to 2099 projection data, respectively, using the RCP8.5 pathway as a conservative worst-case scenario. The selected time periods have been used in order to assess the full anticipated period of the associated lifecycle phase.

Table 6-18: Historic and future climate data

Variable	Baseline data	Climate change projection (change)			Projected Trend	Climate projection source
	1981-2010	2020-2049	2040-2069	2070-2099		
Temperature						
Mean annual maximum daily temperature (°C)	13.5	+1.1 (+0.5 to +1.7)	+1.9 (+1.0 to +2.8)	+3.8 (+2.2 to +5.6)	↑	UKCP18 RCP8.5
Mean summer maximum daily temperature (°C)	20.4	+1.3 (+0.44 to +2.13)	+2.3 (+1.0 to +3.6)	+5.2 (+2.3 to +8.2)	↑	UKCP18 RCP8.5
Mean winter minimum daily temperature (°C)	1.4	+0.90 (+0.2 to +1.7)	+1.6 (+0.5 to +6.0)	+3.1 (+1.0 to +5.5)	↑	UKCP18 RCP8.5
Warmest month for baseline period and average temperature (°C)	July 21.3	-	-	-	-	Met Office
Coldest month for baseline period and average temperature (°C)	February 1.2	-	-	-	-	Met Office
Rainfall						

Variable	Baseline data	Climate change projection (change)			Projected Trend	Climate projection source
	1981-2010	2020-2049	2040-2069	2070-2099		
Mean annual rainfall (mm)	614.5	+0.1% (-6.7% to +6.7%)	-2.9% (-11.7% to +6.0%)	-2.1% (-13.1 to +9.0%)	↓	UKCP18 RCP8.5
Mean summer rainfall (mm)	58.9	-4.1% (-22.0% to +13.3%)	-15.9% (-38.9% to +7.6%)	-30.1% (-57.9 to +0.8%)	↓	UKCP18 RCP8.5
Mean winter rainfall (mm)	45.5	+3.7% (-4.2% to +12.4%)	+7.0% (-4.3% to +19.5%)	+17.4% (-0.6 to +39.0%)	↑	UKCP18 RCP8.5
Wettest month on average (mm)	55.5 (November)	-	-	-	-	Met Office
Driest month on average (mm)	38.3 (February)	-	-	-	-	Met Office
Other						
Sea Level Rise (m)[2]	-	0.12	0.27	0.43	↑	IPCC AR6 Sea Level Projection Tool SSP8.5
Mean monthly wind speed at 10m (knots)	7.3	The Met Office has projected an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind are experienced. However, the increase in wind speeds is modest compared to natural variability from month to month and season to season, so confidence is low.			-	UKCP18 RCP8.5
Storm surges	The UKCP18 model suggests a small contribution from storm surges, however it is unclear if the frequency and severity of future storm surges is going to change. Although, rising sea levels due to				↑	UKCP18 RCP8.5

[2] Note: The sea level rise projection differs from the other variables in that it is given for the decade, rather than the 30-year period that centres around the decade, i.e. the 2040s for the projection period 2020-2049. The scenarios used for sea level rise are the IPCC's latest 6th Assessment Report scenario SSP8.5 (very high GHGs). https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool

Variable	Baseline data	Climate change projection (change)			Projected Trend	Climate projection source
	1981-2010	2020-2049	2040-2069	2070-2099		
	climate change are expected to worsen the impacts of storm surges.					
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 heatwaves likely to become more common and intense.				↑	UKCP18 RCP8.5
Wildfires	ThinkHazard has classified the wildfire hazard in Lincolnshire as High, according to currently available information.				↑	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

Embedded Mitigation

6.5.24 A range of embedded mitigation has been incorporated to mitigate the impacts of climate change:

a. **Chapter 9: Water Environment** of this ES **[EN010154/APP/6.1]** presents a series of measures to mitigate flood risk. Within the design of the Proposed Development, development is restricted for Flood Zone 3. The CEMP will consider the management of activities within floodplain areas (i.e. kept to a minimum and with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable).

b. The **Framework CEMP, Framework OEMP** and **Framework DEMP** will incorporate measures to prevent an increase in flood risk during the construction, operation and decommissioning works, including the provision of temporary settlement and drainage measures. The **Framework CEMP [EN010154/APP/7.7], Framework OEMP [EN010154/APP/7.8]** and **Framework DEMP [EN010154/APP/7.9]** are submitted as part of the DCO application. Measures that could be implemented include:

i. Storing topsoil and other construction materials outside of the 1 in 100-year floodplain extent where feasible. If areas located within Flood Zone 2 (or 3) are to be utilised for the storage of construction materials, this would be done in accordance with the applicable flood risk activity regulations, if required;

ii. Conducting regular planned maintenance of the plant and machinery;

iii. Appointing named person(s) to monitor weather forecasts on a monthly, weekly and daily basis, and plan works accordingly. For example, works in the channel of any watercourse will be avoided or halted were there to be a significant risk of high flows or flooding;

iv. The construction laydown area site office and supervisor will be notified of any potential flood occurring by use of the Flood line Warnings Direct or equivalent service;

v. Connectivity will be maintained between the floodplain and the adjacent watercourses, with no changes in ground levels within the floodplain as far as practicable; and

vi. Developing health and safety plans for construction activities 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.

c. To manage flood risk during construction and operation, the **Framework Surface Water Drainage Strategy** (presented in **Appendix 9-D** of this ES **[EN010154/APP/6.3]**) will be submitted with the DCO application which will provide for the attenuation of surface water runoff from the Proposed Development. The following measures have been developed, as set out in the **Framework CEMP [EN010154/APP/7.7], Framework OEMP [EN010154/APP/7.8]** and **Framework DEMP [EN010154/APP/7.9]**, to further minimise flood risk to the DCO Site and surrounding areas:

i. All temporary construction compounds will be located outside of areas of fluvial Flood Zone 2 and 3; and

ii. Additional attenuation in the form of SuDS will be incorporated to control any increase in the rate of flow towards receiving watercourses including allowances for climate change.

d. Infrastructure flood resilience methods have been set, including the requirement for Solar PV Panels to be set back by 10m from all water features.

6.5.25 The design of the Proposed Development will incorporate climate change projections required by the Environment Agency to ensure flood risk from all sources, including a sea level rise assessment, is accounted for and managed across the lifetime of the Proposed Development so it will remain operational in times of flood.

6.5.26 Mitigation measures to protect against the adverse effects of climate change on the natural environment within the DCO Site can also be found in **Chapter 12: Socio-Economics and Land Use** of this ES **[EN010154/APP/6.1]**,the **Framework Landscape and Ecology Management Plan (LEMP)**

[EN010154/APP/7.15] and the **Framework CEMP [EN010154/APP/7.7]**. These measures include:

a. Consideration of future climate conditions when selecting species for use in green infrastructure; and

b. Protecting against increased soil erosion and degradation due to increased precipitation by covering exposed soil with grass, reducing permeability.

Assessment of Effects

6.5.27 The potential impacts and effects of the Proposed Development have been assessed using the methodology as detailed earlier in **Section 6.5** of this chapter.

6.5.28 Potential climate risks, including the likelihood, consequence, and significance are detailed in **Appendix 6-B: Climate Change Risk Assessment** of this ES **[EN010154/APP/6.1]**, with the results summarised below.

6.5.29 Future climate projections have been reviewed, and the sensitivity of assets have been examined, before commenting on the adequacy of the embedded climate change mitigation measures built into the Proposed Development.

Construction (estimated 2031 – 2033)

6.5.30 The risks assessed in the CCRA at the construction phase of the Proposed Development predominantly cover workforce exposure to dangerous working conditions and damage to physical structures/asset damage.

6.5.31 Major climatic variables contributing to these risks include, but are not limited to, increased temperatures, flooding, and storms.

6.5.32 As a result of the embedded climate change mitigation measures, no significant climate change risks during the construction phase have been identified. 12 risks with a rating of low were identified. However, some adaptation measures have been considered, such as a water pump for areas with critical infrastructure, and tree pruning to mitigate against storm damage.

Operation (and maintenance) (estimated 2033 – 2093)

6.5.33 The risks assessed in the CCRA at the operational phase of the Proposed Development predominantly encapsulate asset damage from extreme weather conditions and changes in annual precipitation and temperatures, as well as workforce exposure to dangerous working conditions.

6.5.34 Major climatic variables contributing to these risks are temperatures, precipitation, and extreme weather events. England as a whole has experienced higher average annual land temperatures, with the 21st Century so far being warmer overall than any of the previous three centuries (Ref 6-16). Most notable is the greater incidence of hot summer maximum temperatures in England. Coningsby in Lincolnshire now holds the UK's highest recorded temperature at 40.3°C, set in July 2022 (Ref 6-50).

6.5.35 As a result of the embedded climate change mitigation measures (as detailed in the **Framework CEMP [EN010154/APP/7.7]**) three significant adverse climate change risks during the operation phase have been identified (all of which arise in the 2070 – 2099 period), summarised in **Appendix 6-B: Climate Change Risk Assessment** of this ES **[EN010154/APP/6.3].**

6.5.36 These risks relate to increases in summer and annual temperatures, which are classified as likely impacts. Embedded mitigation includes monitoring weather forecasts, regular maintenance to monitor asset performance and damage from heat exposure, as well as ensuring access to indoor facilities, scheduled breaks, and appropriate Personal Protective Equipment (PPE). These planned controls mitigate the majority of risk to workforce and assets, meaning the consequence rating is either minor or moderate, but the likelihood of the climate hazard occurring cannot be reduced, leading to the significant adverse rating. These risks are further discussed in the Residual Effects and Conclusions section (**Section 6.8**).

6.5.37 Nine medium and four low (not significant) risks have been identified and discussed in **Appendix 6-B: Climate Change Risk Assessment [EN010154/APP/6.3].**

6.5.38 The Energy Sector summary of the UK Climate Change Risk Assessment (Ref 6-16) has assessed that all energy-related infrastructure is at risk from the impacts of climate change. Both high and low temperatures can cause disruption to the energy network, such as an increased risk of substation fires, leading to cascading effects across interconnected networks. These disruptions may interrupt critical services, including water supply, IT systems, and transportation, with rural areas being particularly vulnerable due to limited backup infrastructure and alternative resources.

Decommissioning (estimated 2093 – 2095)

6.5.39 The risks assessed in the CCRA at the decommissioning phase of the Proposed Development are mainly made up of risks to the workforce.

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

6.5.41 As a result of the embedded mitigation measures, no significant adverse climate change risk during the decommissioning phase have been identified. A detailed Health and Safety Plan ensuring all workers have access to indoor facilities and adequate PPE and committing to cease outdoor and non-essential work if temperatures are too high will protect the workforce from high temperature risks.

6.5.42 Seven medium and three low risks were identified.

6.5.43 **Table 6-19** summarises the total number of risks for each rating and assessed time period (spanning construction, operation and decommissioning risks).

Table 6-19: Climate change risk profile for the Proposed Development

Risk Rating	Initial risk rating RCP 8.5 (2020-2049)	Initial rating RCP 8.5 (2040-2069)	Initial risk rating RCP 8.5 (2070-2099)
Negligible	0	0	0
Low	28	9	7
Medium	0	7	16
High	0	0	3

6.6 In-combination Climate Change Impact Assessment

Study Area

6.6.1 The Study Areas used for the ICCI assessment comprises the Study Areas defined in each of the relevant topic chapters in this ES. This assessment aims to determine the influence of climate change and related impacts to the identified environmental receptors in each of the assessments in those chapters.

6.6.2 ICCI assessments are undertaken in liaison with the technical specialists responsible for preparing the applicable technical chapters.

Methodology

Sources of Information

6.6.3 The climate baseline of the area shown in **Section 6.5** informed the assessment by other technical disciplines.

Scope of the Assessment

6.6.4 The ICCI assessment considers the ways in which projected climate change will influence the significance of the impact of the Proposed Development on receptors in the surrounding environment. The assessment considers the existing and projected future climate conditions for the geographical location and assessment timeframe. It also identifies the extent to which identified receptors in the surrounding environment are potentially vulnerable to and affected by these factors.

6.6.5 The methodology for the ICCI assessment follows the same principles as the CCR Review but focuses on different receptors as identified by other discipline chapters.

Impact Assessment Methodology

Sensitivity

6.6.6 The receptors for ICCI are receptors within the surrounding environment that will be impacted by the Proposed Development in combination with future climatic conditions. Baseline conditions for the ICCI assessment are determined using the climate change projections data from UKCP 18 (Ref 6-46).

6.6.7 Once potential ICCIs have been identified in relation to the Proposed Development, the likelihood of climate impacts occurring during construction, operation and decommissioning phases is categorised. This is the same process as was undertaken for the CCRA. This includes consideration of any embedded mitigation measures and good practice. These classifications are defined in **Table 6-20**.

Table 6-20: Likelihood of a climate impact occurring

Level of likelihood of climate hazard	Qualitative description	Quantitative description
Very likely	Likely that the event will occur many times (reoccurs frequently)	>90-100% probability that the impact will occur
Likely	Likely that the event will occur sometimes (reoccurs infrequently).	>66-90% probability that the impact will occur
Possible, about as likely as not	Possible that the event will occur (has occurred rarely)	>33-66% probability that the impact will occur
Unlikely	Unlikely that the event will occur (not known to have occurred).	>10-33% probability that the impact will occur
Very unlikely	Almost inconceivable that the event will occur.	0-10% probability that the impact will occur

Magnitude of Impacts

6.6.8 The likelihood of a climate risk occurring and the likelihood of a climate impact to a receptor is then combined to determine the likelihood of an ICCI occurring. This is illustrated in **Table 6-21**.

Table 6-21: Level of likelihood of an ICCI occurring

Level of likelihood of climate impact occurring	Definition of likelihood
High	Likelihood of climate hazard occurring is high and impact is always/ almost always going to occur.
Moderate	Likelihood of climate hazard occurring is high and impact occurs often or the likelihood of climate hazard occurring

Level of likelihood of climate impact occurring	Definition of likelihood
	is moderate and impact is likely to occur always/ almost always.
Low	Likelihood of climate hazard occurring is high, but impact rarely occurs or the likelihood of climate hazard occurring is moderate and impact sometimes occurs or the likelihood of climate hazard occurring is low and impact is likely to occur always/ almost always.
Negligible	All other eventualities – highly unlikely but theoretically possible.

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

6.6.10 The ICCI consequence criteria are defined in **Table 6-22** below 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 6-22: Consequence criteria for ICCI assessment

Consequence	Consequence criteria
High	The climate change parameter in-combination with the effect of the Proposed Development causes the significance of the impact of the Proposed Development 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 Proposed Development 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 Proposed Development, 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 Proposed Development does not alter the significance of the effect defined by the topic.

Significance of Effects

6.6.11 The significance of potential effects is determined using the matrix in **Table 6-23**. Where an effect has been identified as moderate or high, against the matrix in **Table 6-23**, these will be classed as a likely significant ICCI effect. If likely significant ICCI effects are evaluated, then appropriate additional mitigation measures (secondary mitigation) are identified.

Table 6-23: ICCI significance criteria (where 'S' is significant and 'NS' is not significant)

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

**NS= Not Significant; S=Significant*

Limitations and Assumptions

6.6.12 This Chapter forms the climate assessments which have been based on information available at the time of preparing this ES.

6.6.13 Similarly to the CCRA, limitations and assumptions made in the ICCI assessment are based on a review of historic and future climate data. The ICCI assessment is undertaken in conjunction with other technical disciplines and, as such, assumptions are applied based on the professional judgement of those authors.

Baseline Environment

6.6.14 This section describes the existing and anticipated future baseline conditions for the ICCI assessment.

Current Baseline

6.6.15 The baseline for the ICCI assessment is the climate in the location of the Proposed Development for the 30-year period of 1981 to 2010 (the standard baseline for climate data). Historic climate data recorded by the closest meteorological station to the Proposed Development (Waddington) for the 30-year period of 1981 to 2010 was obtained from the Met Office website (Ref 6-45) and is summarised in **Table 6-18.**

Future Baseline

6.6.16 The future baseline is expected to differ from the present-day baseline described above. UKCP18 (Ref 6-46) provides probabilistic climate change projections for pre-defined 30-year periods for annual, seasonal and monthly changes to mean climatic conditions over land areas. Projected temperature and precipitation variations have been presented in **Table 6-18**.

6.6.17 Using an RCP 8.5 pathway, construction risks are assessed against the 2020 to 2049 projection data, operation against 2040 – 2069 and 2070 – 2099, and decommissioning against 2070 to 2099 projection data as a conservative worst-case scenario.

Embedded Mitigation

6.6.18 A range of embedded mitigation will be considered for incorporation into the design to mitigate the combined impact of climate change and the Proposed Development on the surrounding environment, as identified by each technical discipline. Embedded mitigation measures are outlined in **Appendix 6-C: In-combination Climate Change Impact Assessment [EN010154/APP/6.3]**.

Assessment of Effects

6.6.19 The potential impacts and effects of the Proposed Development have been assessed using the methodology in **Section 6.6** of this chapter.

6.6.20 The significance of potential ICCIs is detailed in **Appendix 6-C: In-combination Climate Change Impact Assessment [EN010154/APP/6.3]**.

6.6.21 The ICCI assessment has been considered by all other technical disciplines within the ES. The following ES Chapters **[EN010154/APP/6.1]** did not identify any significant ICCI's as part of their assessment:

a. Chapter 7: Cultural Heritage

b. Chapter 8: Ecology and Nature Conservation

c. Chapter 9: Water Environment

d. Chapter 10: Landscape and Visual Amenity

e. Chapter 11: Noise and Vibration

f. Chapter 13: Traffic and Transport

g. Chapter 14: Other Environmental Topics

6.6.22 Future climate projections have been reviewed and the sensitivity of receptors to both climate change and the Proposed Development have been examined before commenting on the adequacy of the climate change resilience measures built into the Proposed Development.

6.6.23 As a result of the embedded mitigation and good practice measures (as presented in the Embedded Mitigation and the respective sections in the technical chapters,) it is concluded that all ICCIs during the construction, operation, and decommissioning phases have been identified to be not significant.

6.7 Additional Mitigation and Enhancement

6.7.1 Additional mitigation measures or enhancement measures are required where significant adverse effects are identified after considering the embedded mitigation measures. No significant adverse effects have been identified in the lifecycle GHG impact or ICCI assessments therefore no additional mitigation or enhancement measures are proposed.

6.7.2 For the CCRA, three **significant adverse** effects related to temperature change were identified during operation without additional mitigation, two to the workforce and one to assets. Furthermore, storms and severe weather could damage infrastructure, block access roads, and disrupt power supplies, leading to cascading effects across interconnected networks. These disruptions may interrupt critical services, including water supply, IT systems, and transportation, with rural areas being particularly vulnerable due to limited backup infrastructure and alternative resources.

6.7.3 Additional mitigation and monitoring like developing an Emergency Response Plan and using temperature monitoring equipment on assets, as listed in **Appendix 6-B: Climate Change Risk Assessment [EN010154/APP/6.3],** results in a reduction to two **significant adverse** residual effects during operation, that of the two risks to the workforce from increased summer and increased annual temperatures. While risks to assets can be reduced through these additional adaptation measures, risks to the workforce tend to result in higher consequences (i.e. fatalities) and are harder to mitigate beyond shutting down operations or suspending workers from site, noting that this reduces risk as far as practicable. The high likelihood of the impact occurring affects both assets and the workforce, which can't be mitigated against. A consequence level of Minor has been assessed for the workforce in high temperatures when considering the additional measure of removing workers from site in these conditions. A lower consequence rating has been assessed for assets when considering the additional mitigation measure of temperature monitoring (insignificant). Hence, two **significant adverse** effects persist to the workforce from increases in summer temperatures and increases in annual temperatures, while the significant adverse effect on assets in the initial assessment has been reduced through temperature monitoring equipment.

6.7.4 During the decommissioning phase, increases in annual temperatures present one **significant adverse** effect for the workforce (see **Appendix 6-B: Climate Change Risk Assessment [EN010154/APP/6.3]**. Similarly, as described in **Section 6.7.2**, no further adaptation measures are possible beyond providing adequate PPE and ceasing outdoor and non-essential work if conditions are too dangerous. While the consequence rating is minor, the likelihood of increased annual temperatures is assessed as likely. This results in one **significant adverse** residual effect for the decommissioning period.

6.8 Residual Effects and Conclusions

6.8.1 The potential effects of the Proposed Development have been assessed using the methodology as detailed in **Sections 6.4 - Section 6.6** of this Chapter.

6.8.2 **Table 6-24** to **Table 6-26** provide a summary of the residual effects for construction, operation, and decommissioning. There is one **significant beneficial** residual effect identified in the lifecycle GHG impact assessment during operation of the Proposed Development. The carbon payback period for the Proposed Development against the current grid mix is four years, and two years when comparing against unabated CCGT with further carbon savings delivered for each subsequent year of operation. This indicates the contribution that the Proposed Development will have towards the UK meeting its legally binding carbon budgets over the estimated 60-year operational phase.

6.8.3 There have been no significant residual effects identified in the CCR assessment for the construction ~~and decommissioning~~ period~~s~~, and three **significant adverse** effects identified for the operational and decommissioning periods, following additional adaptation and monitoring measures.

6.8.4 There have been no significant adverse residual effects identified in the ICCI assessment for the construction, operation, and decommissioning phases.

Table 6-24: Summary of Effects: Construction

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during construction of the Proposed Development on the climate.	Release of GHG emissions.	Not required	During the construction of the Proposed Development, there will be unavoidable GHG emissions due to the use of materials, energy, fuel, and transportation. However, additional GHG savings are expected to be achieved by implementing the GHG mitigation measures listed in the Embedded Mitigation Section.	Minor adverse – Not Significant
The Proposed Development (including workforce)	Impact of projected future climate change on the Proposed Development.	Impact of future climate change.	Not required. Optional adaptation measures listed in **Appendix 6B: Climate Change Risk Assessment [EN010154/APP/6.3]** include water pumps for critical infrastructure areas.	During the construction of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed in the Embedded Mitigation Section could reduce the impact of climate change on the Proposed Development.	Low - Not Significant
Various - identified by each environmental discipline in their assessment	Combined impact of future climate conditions and the Proposed Development.	Impact of future climate change and the Proposed Development.	Not required	The impact of climate change during the Proposed Development's construction will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce this impact.	Negligible/ Low/ Very Low – Not Significant

Table 6-25: Summary of Effects: Operation

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during operation of the Proposed Development on the climate.	Release of GHG emissions.	Not required	During the operation of the Proposed Development, there will be unavoidable GHG emissions due to operational maintenance activities. However, the Proposed Development is expected to achieve emissions savings in comparison to the alternative future baseline scenario, in line with the UK's net zero trajectory.	**Beneficial - Significant**
The Proposed Development (including workforce)	Impact of projected future climate change effects on the assets, workers, access and machinery of the Proposed Development – as detailed in **Appendix 6-B Climate Change Risk Assessment**.	Impact of future climate change.	Additional mitigation measures for climate change impacts are listed in **Appendix 6-B: Climate Change Risk Assessment [EN010154/APP/6.3].**	During the operation of the Proposed Development, the impact of climate change will be unavoidable. These residual effects following additional mitigation are described in **Appendix 6B: Climate Change Risk Assessment [EN010154/APP/6.3].**	Low to High - **Significant**
Various - identified by each discipline in their assessment	Combined impact of future climate conditions and the Proposed Development.	Impact of future climate change and the Proposed Development.	Not required	During the operation of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce the impact of climate change on the Proposed Development.	Negligible/ Low/ Very Low – Not Significant

Table 6-26: Summary of Effects: Decommissioning

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during decommissioning of the Proposed Development on the climate.	Release of GHG emissions.	Not required	During the decommissioning of the Proposed Development, there will be unavoidable GHG emissions due to decommissioning activities. These cannot be meaningfully quantified at this time but are likely to be lower than those of the construction period due to improvements in carbon reductions from waste disposal and recycling.	Minor adverse –Not Significant
The Proposed Development (including workforce)	Impact of projected future climate change effects on assets, workers, access and machinery of the Proposed Development.	Impact of future climate change.	Additional mitigation measures are listed in **Appendix 6B: Climate Change Risk Assessment [EN010154/APP/6.3].**	During the decommissioning of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed in the Embedded Mitigation Section could reduce the impact of climate change on the Proposed Development. Planned controls are also listed in **Appendix 6B: Climate Change Risk Assessment [EN010154/APP/6.3].**	Low to ~~Medium~~ High – ~~Not~~ **Significant**
Various - identified by each discipline in their assessment	Combined impact of future climate conditions and the Proposed Development.	Impact of future climate change and the Proposed Development.	Not required	During the decommissioning of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce the impact of climate change on the Proposed Development.	Negligible/ Low/ Very Low – Not Significant

6.9 Cumulative Assessment

6.9.1 According to IEMA Guidance on assessing GHG emissions in EIA, the concentration of GHGs in the atmosphere and their impact on climate change are influenced by all sources and sinks globally, whether they are human-caused or not. Unlike many topics in EIA that only focus on projects within a specific geographical area, GHG emissions and their effects are global in nature. For example, air pollutant emissions primarily affect nearby areas, but GHGs disperse around the world due to their persistence in the atmosphere. Therefore, when assessing the cumulative effects of GHGs, it is essential to consider all global sources rather than just focusing on individual projects. This is because a specific local impact of GHG emissions does not have a greater local climate change effect. When considering GHG emissions, it is crucial to account for the cumulative contributions of all GHG sources that contribute to the overall context. If the assessment is limited to a specific geographic or sectoral boundary, then the consideration of cumulative contributions will also be within that boundary.

6.9.2 The GHG assessment provided within this chapter is considered inherently cumulative as it presents the impact of the Proposed Development in the context of the UK's GHG reduction targets, used to represent the key sensitive receptor, (i.e. the global atmosphere). This includes the provision of legally binding limits on GHG emissions that can be emitted by the UK if it is to meet its net zero target. This assessment is considered comprehensive and includes a worst case within the defined assessment parameters.

6.9.3 It is not feasible to assess cumulative effects with regards to climate change risk, as the effects of climate change are not contained within a project boundary. That being said, the cross-cutting impacts of climate change are identified and presented in the ICCI assessment for this Proposed Development, considered to be, by nature, a cumulative assessment undertaken by each of the technical disciplines regarding sensitive receptors in the surrounding environment. Refer to **Appendix 6-C: In-combination Climate Change Impact Assessment** of this ES **[EN010154/APP/6.3]** for further detail.

6.10 References

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