OAKLANDS FARM SOLAR PARK

Applicant: Oaklands Farm Solar Ltd

Environmental Statement
Chapter 13 – Climate Change
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Planning Act 2008
Infrastructure Planning (Application: Prescribed Forms and Procedure) Regulations 2009 - 5(2)(a)

Chapter 13
Climate Change

Introduction

13.1 This chapter of the Environmental Statement (ES) considers the potential effects of the Proposed Development on climate change and the effect of climate change on the Proposed Development. Human-induced climate change is the greatest health threat facing humanity, and is widely recognised as being the leading cause of the global economic, environmental and social challenges facing the world today[1]. A major cause of climate change is the rise in the concentration and volume of greenhouse gases (GHG) in the atmosphere, a significant contributor to which is the use of fossil fuels to generate electricity.

13.2 The purpose of the Proposed Development is to generate electricity from a renewable source of energy; reducing the need for electrical generation from the combustion of fossil fuels and supporting the UK's shift to a decarbonised energy system. Consequently, the electricity produced by the Proposed Development will result in a saving in emissions of carbon dioxide (CO_2) with associated environmental benefits. This climate change assessment therefore draws largely on this premise.

13.3 The assessment has been carried out in line with the requirements in Schedule 4 to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) which requires, inter alia:

> *"A description of the likely significant effects of the development on the environment resulting from, inter alia: (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change."*

13.4 This chapter therefore considers the following:

[1] United Nations Human Rights Office of the High Commissioner (2022) Climate change the greatest threat the world has ever faced, Un expert warns. Available at: https://www.ohchr.org/en/press-releases/2022/10/climate-change-greatest-threat-world-has-ever-faced-un-expert-warns [Accessed 13/11/23]

- **Emissions reduction**[2]: the potential effects of the Proposed Development on climate change, with measures included in the project to reduce the emissions of greenhouse gases (GHGs).
- **Climate change adaptation**: both the vulnerability of the Proposed Development to climate change, and any implications of climate change on the predicted impacts of the Proposed Development, as assessed by the other topic specialists ('in-combination climate impacts').

13.5 By its very nature, climate change interacts with a range of other environmental and social topics and therefore elements of this topic are considered throughout this ES and other planning documents. To ensure both emissions reduction and climate change adaptation are fully assessed, this chapter carries out the assessment for these two elements separately drawing on recognised climate change projections, existing guidance and emerging good practice as well as being informed by relevant information presented in other chapters in this ES and further documents which form part of the application.

13.6 The climate change assessment was undertaken by LUC and 3ADAPT, consultants competent in climate change assessment, carbon management and sustainability.

Scope of the Assessment

Effects Assessed in Full

13.7 The following effects have been identified for consideration in this assessment:

- Direct and indirect effects during construction on climate change (GHG emissions):
  - Transportation of materials and waste
  - Worker transportation.
- Construction related products and materials (embodied Carbon).
- Direct and indirect effects during operation on climate change (GHG emissions):
  - Worker transportation

[2] Also known as 'climate change mitigation' and this is not to be confused with EIA mitigation. Climate change mitigation seeks to specifically reduce a development's greenhouse gas emissions. EIA mitigation is measures that aim to avoid, prevent, reduce or offset any identified significant adverse effects of a development.

  - Maintenance activities
  - Operational energy consumption.
- Direct and indirect effects during decommissioning on climate change (GHG emissions):
  - Transportation of materials and waste
  - Worker transportation.
- In-combination effects on landscape and visual, ecology and water resources and flood risk (Climate Change Adaptation).
- The vulnerability of the Proposed Development to climate change ((Proposed Development Resilience) Climate Change Adaptation).

Effects Scoped Out

13.8 On the basis of the desk based survey undertaken, through consultation on the PEIR, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, the following topic areas have been 'scoped out' of detailed assessment:

- Cumulative effects during construction on climate change (GHG emissions).
- Cumulative effects during operation on climate change (GHG emissions).
- Cumulative effects during decommissioning on climate change (GHG emissions).
- In-combination effects on historic environment, ground conditions, transport and access, noise and vibration, socio-economics, tourism, recreation and land use and glint and glare (Climate Change Adaptation).

Consultation

13.9 In undertaking the assessments, consideration has been given to the scoping responses and other consultation which has been undertaken as detailed in **Table 13.1**.

Table 13.1: Consultation Responses

Consultee and Date	Issue Raised	Response/Action Taken
Scoping Consultation Responses		
Planning Inspectorate September 2021	The ES should specify the calculation methods used to quantify the greenhouse gas emissions relating to the Proposed Development.	The 'Desk Based Research and Data Sources' section of the emissions reduction assessment specifies the calculation methods.
	The ES should explain the term "*environmental receptors sensitive to climate change*" and set out what they are and how the Proposed Development may affect them in terms of climate change.	The 'Assessment of Potential Effects' Section sets out the environmental receptors sensitive to climate change.
	The scoping report does not set out how a significant effect would be determined for the purposes of the Climate Change Impact Assessment. This should be clearly set out in the ES.	The 'Assessing Significance' section discusses the IEMA guidelines in relation to significant effects for the emissions reduction and climate change adaptation assessments and sets out how significant effects would be determined.
	Advised the ES should include a description and assessment (where relevant) of the likely significant effects the Proposed Development has	The 'Assessment of Potential Effects' section considers the likely significant effects the Proposed Development has on climate and the 'Proposed Development Resilience' section

Consultee and Date	Issue Raised	Response/Action Taken
	on climate and the vulnerability of the Proposed Development to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development.	identifies the vulnerability of the Proposed Development to climate change.
Derbyshire County Council (DCC) 20th September 2021	DCC note that a Climate Change Strategy is being prepared and is due to be published in the next few months and may provide local context for consideration of the impacts on climate change by the Proposed Development.	Noted. The relevance of this strategy has been considered in the 'Local Policy' section of the emissions reduction assessment.
PEIR Consultation Responses		
Derbyshire County Council (DCC) and South Derbyshire District Council (SDDC) 06/06/22	The SDDC officer raised a query in terms of soil compaction and how this will be avoided.	Please see the Soil Management Plan appended to the Outline Construction Environmental Management Plan (**Appendix 4.3**).
	The DCC officer noted an error in paragraph 13.19 of the PEIR in that the climate change strategy is a	This has been corrected in the ES.

Consultee and Date	Issue Raised	Response/Action Taken
	Derbyshire County Council document, not South Derbyshire District Council as referred to.	
	The DCC officer also stated that a Carbon Management Plan, which aligns with the requirements set out in PAS 2080, should ideally be developed for a scheme of this nature and size as part of the Construction Environmental Management Plan (CEMP).	A Carbon Management Plan has not been prepared. However, the Outline Construction Environmental Management Plan at **Appendix 4.3** has incorporated mitigation from this assessment which reflects the Proposed Development's commitment to reducing carbon emissions. The crux of the Emissions Reduction assessment is whether the Proposed Development contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050, and the assessment includes the baseline conditions, the framework and methodology for assessing the baseline and GHG assessment against available carbon budgets, which aligns with the requirements set out in PAS 2080[3].
	Under the Climate Change Adaptation (Resilience) assessment, DCC would expect to see an	The vulnerability of the Proposed Development to climate change (project resilience) has been considered in the

[3] British Standards Institute (no date) PAS 2080 Carbon Management In Infrastructure.

Consultee and Date	Issue Raised	Response/Action Taken
	assessment of any potential the proposed development might have to exacerbate climate change impacts, such as drought, flood risk or overheating due to a reduction in shading and cooling from vegetation loss.	Project Resilience section of this chapter with respect to rising temperatures, extreme weather events such as strong winds, and wild fires, and the extent to which climate exacerbates or ameliorates the effects of the Proposed Development on the environment (in-combination impacts) has been considered in the Climate Change Adaptation section of this chapter.
Targeted Consultation Responses		
DCC 24/03/23	No further comments have been received regarding climate change and carbon reduction. The comments on the PEIR dated 6 June 2022 remain relevant.	Noted
SDDC 21/04/23	SDDC note that the original comments made by the Council on 6 June 2022 in relation to the Preliminary Environmental Information Report (PEIR) remain valid	Noted

Emissions Reduction

Assessment Methodology

UK Legislation, Policy and Strategy

The Climate Change Act 2008.

13.10 The Climate Change Act 2008 sets legally binding targets for reducing emissions of greenhouse gases by 2050. The net UK carbon account for 2050 must be at least 100% lower than the 1990 baseline to reach that Net Zero target.

The UK Carbon Budgets.

13.11 To support continuous efforts to achieve Net Zero by 2050 under the Climate Change Act 2008, a series of sequential carbon budgets have been developed. Each budget provides a five-year statutory cap on total GHG emissions, which should not be exceeded in order to meet the UK's emission reduction commitments. These legally binding targets are currently available to the 6th carbon budget period (2033-2037) which was legislated for on 24 June 2021 (BEIS, 2021) and includes a targe to reduce emissions by 78% by 2035.

The UK's Net Zero Strategy.

13.12 The 2021 Report to Parliament: Progress in Reducing Emissions highlighted that whilst the UK Government has made historic climate promises, it has been too slow to follow these with delivery. Therefore, sustained reductions in emissions will require a strong Net Zero Strategy[4]. The strategy includes policies and proposals for decarbonising all sectors of the UK economy in order to meet net zero by 2050.

British Energy Security Strategy

[4] Climate Change Committee (2021) Progress in Reducing Emissions, 2021 Report to Parliament. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1028157/net-zero-strategy.pdf

13.13 In 2022 the UK Government published the British Energy Security Strategy[5] aiming to *"accelerate our progress towards new zero"*. In terms of solar energy, the Government target is to see a five-fold increase in solar deployment by 2035, taking solar capacity from 14GW to 70GW.

National Planning Policy Framework

13.14 The National Planning Policy Framework (NPPF)[6] was revised in February 2019 and again in July 2021, and most recently in December 2023. Paragraph 159 requires new developments to be planned for in ways that *"can help reduce greenhouse gas emissions, such as through its location, orientation and design*".

National Policy Statement for Energy (EN-1)

13.15 The NPS EN-1[7] sets out the government's policy for delivery of major energy infrastructure and has a basic requirement set by the AoS (Appraisal of Sustainability) to speed up the transition to a low carbon economy and thus help to realise UK climate change commitments sooner rather than later (paragraph 1.7.2).

13.16 With regard to decision making section 3.1 states:

> "*The UK needs all the types of energy infrastructure covered by this NPS in order to achieve energy security at the same time as dramatically reducing greenhouse gas emissions.*
>
> *It is for* industry *to propose new energy infrastructure projects within the strategic framework set by Government. The Government does not consider it appropriate for planning policy to set targets for or limits on different technologies.*
>
> *The IPC should therefore assess all applications for development consent for the types of infrastructure covered by the energy NPSs on the basis that the Government has*

[5] Uk Government (2022) British Energy Security Strategy. Available online at: https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy#introduction [Accessed 09/01/24]

[6] UK Government (2021) National Planning Policy Framework. Available at: https://assets.publishing.service.gov.uk/media/65a11af7e8f5ec000f1f8c46/NPPF_December_2023.pdf

[7] Department for Energy and Climate Change (2011) Overarching National Policy Statement for Energy (EN-1)

demonstrated that there is a need for those types of infrastructure and that the scale and urgency of that need is as described for each of them.

The *IPC should give substantial weight to the contribution which projects would make towards satisfying this need when considering applications for development consent under the Planning Act 2008*."

13.17 Paragraph 3.2.1- 3.2.2 of the November 2023 draft NPS EN-1[8] to be designated also states: *"The government's objectives for the energy system are to ensure our supply of energy always remains secure, reliable, affordable, and consistent with net zero emissions in 2050 for a wide range of future scenarios, including through delivery of our carbon budgets and NDC[9]. We need a range of different types of energy infrastructure to deliver these objectives."*

13.18 Paragraph 3.3.61 notes the urgency for new low carbon NSIPs, stating *"The need for all these types of infrastructure is established by this NPS and is urgent"*.

International Agreements

13.19 The 'Paris Agreement' was established in 2015 and aims to meet the climate change targets first introduced in the 'Kyoto Protocol' in 1992. Article 2 of the Paris Agreement sets out the ambition of holding the increase of global average temperature to "*well below 2ºC"* and to pursue efforts to limit temperature increase to 1.5ºC. It was acknowledged that to achieve these ambitions, there is a requirement to ensure Parties reach global peaking of greenhouse gas emissions as soon as possible and to do so by employing means that allow pathways toward "*low greenhouse gas emissions and Climate-resilient development".* The Paris Agreement entered into force on 4th November 2016 and the UK ratified the Agreement on 18th November 2016. The commitments set out in the Agreement were reaffirmed recently in the Glasgow Climate Pact (November 2021).

Local Planning Policy

13.20 In June 2019, South Derbyshire District Council (SDDC) declared a climate emergency and pledged to become a carbon neutral organisation by 2030 and achieve carbon neutrality

[8] Department for Energy Security and Net Zero (2023) Draft Overarching National Policy Statement for Energy (EN-1)

[9] Nationally Determined Contribution

across South Derbyshire before the Government target of 2050. The SDDC Climate and Environmental Action Plan 2021-30[10] was published in May 2021 and sets the context for, and scope of, the challenges that need to be addressed.

13.21 On 14th October 2021, DCC approved their climate change strategy for 2021-2025[11]. The strategy outlines DCC's ambition to become a net zero organisation by 2032 or sooner, in addition to how they will help the County achieve net zero by 2050. The strategy includes ambitions to expand local renewable energy generation across DDC, recognising the County has a high concentration of natural resources available to achieve this.

Guidance

13.22 This assessment is carried out in accordance with the principles contained within the following documents:

- Institute of Environmental Management (IEMA) (2022) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance. Second Edition.
- IEMA (2017) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.
- BEIS (2021): Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal
- DECC (2013) Guidance on Annual Verification for emissions from Stationary Installations
- BSI (2011) PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.
- WBCSD (2015) The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard.

[10] SDDC (2021) Climate and Environmental Action Plan 2021-30. Available at: https://www.southderbyshire.gov.uk/our-services/climate/climate-and-environment-emergency/what-the-council-is-doing/climate-environment-action-plan

[11] DDC (2021) Derbyshire County Council's Climate Change Strategy: Achieving Net Zero. Available at: https://www.derbyshire.gov.uk/site-elements/documents/pdf/environment/climate-change/climate-change-strategy.pdf

Study Area

13.23 Following the latest IEMA Guidance[Error! Bookmark not defined.], the study area for the lifecycle GHG impact assessment is considered the global climate. The assessed receptor is the global atmosphere since GHG emissions are not geographically limited, and the impact would contribute towards a global effect rather than directly affecting any specific local receptor(s). This chapter assesses the impact of the Proposed Development on the global climate by considering all major sources of GHG emissions arising over the lifecycle of the Proposed Development and includes direct GHG emissions arising from activities within the Site as well as indirect emissions from activities outside the Site (for example, the transportation of materials to the Site, and embodied carbon within construction materials).

Desk Based Research and Data Sources

13.24 A desk-based assessment has been completed to determine the potential effects of the Proposed Development on the climate. These have been calculated in line with the GHG Protocol (WBCSD, 2015) and GHG 'hot spots' (i.e. materials and activities likely to generate the largest amount of GHG emissions) have been identified. This has enabled priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA's 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance'.

13.25 A 16-month construction programme has been assumed for the purposes of this assessment (from Spring 2026 to Summer 2027), followed by a 40-year operational lifetime (Summer 2027 to Spring 2067) and a 12-month decommissioning phase (Summer 2067 to Summer 2068).

13.26 Where activity data has allowed, expected GHG emissions arising from the construction, operational and decommissioning phases of the Proposed Development have been quantified using a calculation-based methodology as per the following equation as stated in the BEIS 2021 emissions factors guidance[12]:

- Activity data x GHG emissions factor = GHG emissions value.

[12] BEIS (2022) Greenhouse Gas Reporting: Conversion Factors 2021. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

13.27 Where data is not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIA[13].

13.28 An overview of methodologies for identifying effects related to the construction phase is presented below. GHG emissions sources within the scope of the construction emissions include the embodied carbon of products and equipment, the transportation of these materials to the Site boundary, as well as the emissions associated with construction workers' transport to the Site.

- Construction worker employment generation has been aligned with the average of 114 people working on-site during the 16 month construction period, as outlined in paragraph 12.68 in **Chapter 12: Socio-Economics, Tourism and Recreation**.
- A one-way distance of 30km per journey has been assumed for the worker transportation calculations, which is a conservative estimate as, where possible, staff will reside much closer to the Site, and employees not from the local area would stay in local accommodation.
- The BEIS 2021 emissions factors for 'Average car' and 'Average van', including well-to-tank (WTT) emissions, have been applied to this distance and total worker numbers to calculate GHG emissions associated with worker transport during construction and decommissioning.
- Products and equipment considered in this assessment include the solar panels, solar inverters, transformers, substations and Battery Energy Storage System (BESS) containers. While the specific manufacturer and model of the PV modules has not yet been confirmed, indicative information on the number and size of modules likely to be installed is available.
- A likely worst-case country of origin of China has been assumed as a conservative estimate for products and equipment, with distances estimated from manufacturing facilities in Shanghai. Corresponding HGV and sea freight distances of 350km and 21,880km respectively have been assumed for transportation of materials.
- For HGV transportation of materials, the BEIS 2021 emissions factor for 'Rigid HGV – 7.5-17t' has been applied, including WTT emissions. It has been assumed that HGVs are 100% laden. Emissions per unit distance have been multiplied by the assumed distance above.

[13] IEMA (2022) Assessing Greenhouse Gas Emissions and Evaluating their Significance: 2nd Edition

- For sea freight transportation, the BEIS 2021 emissions factor for 'Products tanker – Average' has been applied, including WTT emissions. Emissions per unit distance have been multiplied by the assumed distance above.
- The embodied carbon of the solar panel modules to be installed within the Proposed Development was estimated by taking their indicative size and weight data from comparable supplier product information (Trina Solar, 2019[14]), and using the embodied carbon benchmark (Life Cycle Analysis stages A1-A5, B1-B7, C1-2) from the Environmental Product Declaration (EPD) for a comparably sized module manufactured in China (Trina Solar, 2020[15]).
- To calculate the embodied carbon within the inverters, typical manufacturer information about material composition breakdown (Willmott Dixon, 2022[16]) and unit weights (Solar Edge, 2018[17]) were used as a benchmark to estimate material quantities associated with the inverters required for the Proposed Development. Embodied carbon factors for each of these materials from the Inventory of Carbon and Energy version 3 database (University of Bath and Circular Ecology, 2019[18]) have been applied.

[14] Trina Solar (2019) The Duomax Half-Cell Dual Glass 72 Layout Module Product Sheet. Available at: https://static.trinasolar.com/sites/default/files/EN_Datasheet_DuomaxM_DEG15M.20II_201907.pdf. [Accessed 13/11/23]

[15] Trina Solar (2020) Environmental Product Declaration. Available at : [redacted] [Accessed 13/11/23]

[16] Wilmott Dixon (2022) Whole life carbon of photovoltaic installations: Technical Report. Available at : [redacted] [Accessed 13/11/23]

[17] Solar Edge (2018) Three Phase Inverter with Synergy Technology Product Sheet. Available at: https://www.solaredge.com/sites/default/files/se_commercial_three_phase_inverters.pdf_[Accessed 13/11/23]

[18] University of Bath and Circular Economy (2019) Embodied Carbon ICE Database. Available at: https://circularecology.com/embodied-carbon-footprint-database.html [Accessed 13/11/23]

- For the embodied carbon of the BESS energy storage cells, embodied carbon benchmarks have been applied using data from Life Cycle Analysis (LCA) of lithium-ion batteries (Dai et al., 2019[19]) and been multiplied by the indicative energy generation specifications.
- To calculate the embodied carbon of the Proposed Development's Substation, the material composition breakdown (Harrison et. al., 2010[20]) was used as a benchmark to estimate material quantities. Embodied carbon factors for each of these materials from the Inventory of Carbon and Energy version 3 database (University of Bath and Circular Ecology, 2019[18]) have been applied.
- Assumed reference values for the construction phase calculations can be seen below in full in **Table 13.2.**

[19] Dai, Q.; Kelly, J.C.; Gaines, L.; Wang, M. Life Cycle Analysis of Lithium-Ion Batteries for Automotive Applications. Batteries 2019, 5, 48. https://doi.org/10.3390/batteries5020048

[20] Harrison, GP, Maclean, EJ, Karamanlis, S & Ochoa, LF 2010, 'Life cycle assessment of the transmission network in Great Britain', Energy Policy, vol. 38, no. 7, pp. 3622-3631. https://doi.org/10.1016/j.enpol.2010.02.039

Table 1.1: Construction phase assessment assumptions

Type	Description	Value	Unit	Source
Transport Emission Factor	HGV Rigid (>7.5 tonnes-17 tonnes)	0.687	kgCO2e/km	BEIS (2021)[21]
	HGV Rigid (>7.5 tonnes-17 tonnes) - WTT	0.167	kgCO2e/km	
	Product tanker average	0.00903	kgCO2e/ tonne.km	
	Product tanker average - WTT	0.00203	kgCO2e/ tonne.km	
	Average van	0.241	kgCO2e/km	
	Average van - WTT	0.0590	kgCO2e/km	
Product Weight	Battery unit	18,000	kg per unit	Sungrow (2021)[22]
	Solar Panel	31.4	kg per unit	Trina Solar (2019)[23]

[21] BEIS (2021) Greenhouse gas reporting: conversion factors 2021. https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2021

[22] Sungrow (2021) Energy Storage Syste, Product Catalogue. Available at: [redacted] [Accessed 13/11/23]

[23] Trina Solar (2019) The Duomax Half-Cell Dual Glass 72 Layout Module Product Sheet. Available at: [redacted]. [Accessed 13/11/23]

Type	Description	Value	Unit	Source
	Solar Inverter unit	48	kg per unit	Solar Edge (2018)[24]
	Battery Power Conversion System Unit	1,500	kg per unit	Solar Edge (2018)[25]
Material Compositions	Inverter unit	0.3% stainless steel, 13.4% steel, 4.6% zinc, 12.2% copper, 7.7% aluminum, 14.6% electronics, 3.1% ceramic and 44.1% epoxide resin	%	Willmott Dixon (2022)[26]
	Substations	0.002% aluminum, 0.5% copper, 1.7% steel, 0.4%	%	Harrison et. al. (2010)[27]

[24] Solar Edge (2018) Three Phase Inverter with Synergy Technology Product Sheet. Available at: [redacted] Accessed 13/11/23]

[25] Solar Edge (2018) Three Phase Inverter with Synergy Technology Product Sheet. Available at: [redacted] [Accessed 13/11/23]

[26] Wilmott Dixon (2022) Whole life carbon of photovoltaic installations: Technical Report. Available at : [redacted] [Accessed 13/11/23]

[27] Harrison, GP, Maclean, EJ, Karamanlis, S & Ochoa, LF 2010, 'Life cycle assessment of the transmission network in Great Britain', Energy Policy, vol. 38, no. 7, pp. 3622-3631. https://doi.org/10.1016/j.enpol.2010.02.039

Type	Description	Value	Unit	Source
		other, 19.3% concrete, 77.0% limestone chipping, 0.4% fencing, 0.7% oil		
Embodied Carbon	Battery unit	73	kgCO2e/kWh	Dai et. al. (2019)[28]
	Solar panel – Upstream (A1 – A2)	0.00557	kgCO2e/kWh	EPD Trina Solar (2020)[29]
	Solar panel – Core Stage (A3 – A5, B1 – B7, C1 – C2)	0.00673	kgCO2e/kWh	
	Polyethylene	2.54	kgCO2e/kg	University of Bath and Circular Ecology (2019)[30]
	Polypropylene	4.49	kgCO2e/kg	
	Other Plastics	3.31	kgCO2e/kg	
	Steel	3.02	kgCO2e/kg	
	Zinc	4.18	kgCO2e/kg	
	Aluminium	13.10	kgCO2e/kg	
	Ceramics	0.70	kgCO2e/kg	

[28] Dai, Q.; Kelly, J.C.; Gaines, L.; Wang, M. Life Cycle Analysis of Lithium-Ion Batteries for Automotive Applications. Batteries 2019, 5, 48. https://doi.org/10.3390/batteries5020048
[29] Trina Solar (2020) Environmental Product Declaration. Available at : https://www.epditaly.it/wp-content/uploads/2016/12/MR-101.1_Trina-Solar_EPD_SM-DEG15M.20-II_TSM-DEG15MC.20-II_TSM-DEG17M.20-II_TSM-DEG17MC.20-II-PV-Double-Glass-Panels.pdf [Accessed 13/11/23]
[30] University of Bath and Circular Economy (2019) Embodied Carbon ICE Database. Available at: https://circularecology.com/embodied-carbon-footprint-database.html [Accessed 13/11/23]

Type	Description	Value	Unit	Source
	Epoxide Resin	5.70	kgCO2e/kg	
	Electronics	5.30	kgCO2e/kg	
	Copper	2.71	kgCO2e/kg	
	Tin	14.47	kgCO2e/kg	

13.29 An overview of methodologies for identifying effects related to the operational phase is presented below. GHG emissions sources within the scope of the operational emissions include operational energy use (i.e. for auxiliary services and standby power), fuel used for the transportation of workers to the Proposed Development and maintenance activities (including embodied carbon in replacement parts, plant and machinery requirements).

- Operational energy generation data was estimated by applying an industry standard capacity factor for solar PV to the indicative capacity specifications to estimate a 105,996~~157,067~~ MWh for the first year of operation[31]. Efficiency losses of the PV modules over time has been accounted for based on an industry standard degradation factor 0.55% for each subsequent year (Carigiet et. Al., 2021)[32]. Over the 40 year lifetime, this results in an estimated total energy generation of 3,815,246~~5,653,501~~ MWh. This assessment is considered "worst-case" in terms of climate benefits, based on an assumed capacity of 110 MW alternating current (AC). This is a conservative estimate, as the site's footprint could potentially deliver a greater capacity if maximized. A lower assumed capacity means lower projected renewable energy generation, resulting in reduced climate benefits compared to the offset grid electricity.
- Operational energy use (i.e. for auxiliary services and standby power) for the Proposed Development during the night has been estimated from recent comparable schemes. Whilst corresponding energy requirements could also be supplied from the BESS, to be consistent

[31] Capacity Factor is approximately 11% - so 110~~65~~MW x 24hrs x 364days

[32] Fabian Carigiet, Christoph J. Brabec, Franz P. Baumgartner, Long-term power degradation analysis of crystalline silicon PV modules using indoor and outdoor measurement techniques, Renewable and Sustainable Energy Reviews, Volume 144, 2021, 111005, ISSN 1364-0321, https://doi.org/10.1016/j.rser.2021.111005.

with the conservative approach taken, it has been assumed that this will be met by energy imported from the National Grid. Therefore, the night-time energy use will result in GHG emissions as a result of the production of grid electricity, using current 2022 and projected grid GHG intensities (BEIS, 2022[12]) over the operational phase of the Proposed Development. These GHG intensity factors are shown in more detail in **Plate 13.1**.

- GHG emissions associated with operational maintenance have been represented by the embodied carbon emissions resulting from the replacement of product components. To calculate the associated GHG emissions for the embodied carbon and transportation of replaced products, estimated emissions from the equivalent activities during construction scaled on a pro rata basis to the proportion of embodied and transportation emissions for the construction phase.

13.30 Assumed reference values for the operational phase calculations can be seen below in full in **Table 13.3.**

Table 13.3 Operational phase assessment assumptions

Type	Description	Value	Unit	Source
Energy Generation	Capacity Factor	11%	%	BEIS (2016)[33]
	Annual Degradation Factor	0.55%	%	Carigiet et al. (2021)[32]
Operation and Maintenance	Night-time energy demand	0.01	kWh/kWh generation	Sunnica Energy Farm Project Team (2021)[34]
	Replacement rate of solar panels	0.2	% per year	
	Replacement rate of solar inverters	4.4	% per year	
	Replacement rate of battery inverters	3.1	% per year	
	Replacement rate of substations	10.0	% per year	Harrison et. al. (2010)[35]
	Replacement rate of battery units	8 – 9	years	Outline Battery Safety Management Plan (2023) (see **Appendix 4.6**)

[33] Department for Business, Energy and Industrial Strategy (2016) Electricity Generation Costs. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566567/BEIS_Electricity_Generation_Cost_Report.pdf [Accessed 18/12/23]

[34]Sunnica Energy Farm Project Team. Environmental Statement Chapter 6: Climate Change. 18 November 2021. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-001781-SEF_ES_6.1_Chapter_6_Climate%20Change.pdf

[35] Harrison, GP, Maclean, EJ, Karamanlis, S & Ochoa, LF 2010, 'Life cycle assessment of the transmission network in Great Britain', Energy Policy, vol. 38, no. 7, pp. 3622-3631. https://doi.org/10.1016/j.enpol.2010.02.039

13.31 An overview of methodologies for identifying effects related to the decommissioning phase is presented below. GHG emissions sources within the scope of the decommissioning emissions include the transportation of products and equipment from the Site boundary, as well as the emissions associated with worker transport.

13.32 For HGV transportation of materials and waste to their disposal point, an average distance of 50km has been assumed to reflect a conservative estimate. Correspondingly, the BEIS 2021 emissions factor for 'Rigid HGV–7.5-17t' has been applied, including WTT emissions. It has been assumed that HGVs are 100% laden. Emissions per unit distance have been multiplied by the assumed distance above.

13.33 For worker transportation, it has been assumed that an equivalent number of workers will be required on site at decommissioning as per the construction stage. Correspondingly, a 1-way distance of 30km per journey has been assumed for the worker transportation calculations, which is a conservative estimate as, where possible, staff will reside much closer to the site limits, and employees not from the local area would stay in local accommodation. The BEIS 2021 emissions factors for 'Average car' and 'Average van', including WTT emissions, have been applied to this distance and total worker numbers to calculate GHG emissions.

13.34 To reduce the lifetime impact associated with the embodied carbon of all products and equipment, recycling of reclaimed materials would be required at end of life decommissioning, adhering to UK government WEE guidelines (Environment Agency, 2023)[36]. Solar panel infrastructure is highly recyclable, with current rates approximately at 96% of the material.[37] However due to uncertainty of processes and quantity of material required, the energy required for disposal and recycling has not been assessed.

13.35 Furthermore by the estimated end of operational lifetime in the mid-2060s, recycling technologies and efficiencies are likely to have significantly improved, and any remaining decommissioning GHG emissions associated with energy generation, transportation, operation

[36] Environment Agency (2023) Electrical and Electronic Equipment: Producer Responsibilities. Available at: https://www.gov.uk/guidance/electrical-and-electronic-equipment-eee-producer-responsibility [Accessed 13/11/23]

[37] CSG (2023) Waste specialist to launch solar panel recycling service. Online article available at: https://www.csg.co.uk/news/waste-specialist-to-launch-solar-panel-recycling-service [Accessed 13/11/23]

of plant and waste disposal throughout the supply chain are anticipated to be much lower as a result of grid decarbonisation of machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050.

13.36 The assessment of the embodied carbon in the construction phase includes estimates for the upstream impacts from extraction and processing of raw materials, transportation of the raw material to the factory and manufacturing of equipment. However due to the high recyclability of materials involved, it is likely that this represents a conservative approach as this GHG impact will likely be significantly reduced by the use of already recycled and reclaimed materials, prior to their use in the Proposed Development. Furthermore for the same reason it is likely that a significant proportion of the materials following the decommissioning of the Proposed Development will also be recycled and re-claimed and thus not require disposal. However since the conservative assumption around the recyclability of materials was already applied to the estimate embodied carbon impacts in the construction phase, it was therefore considered that accounting for this same conservative assumption for a second time in the decommissioning phase would lead to an excessively conservative estimate of the GHG impacts, and thus the assumption of high recyclability of materials in the decommissioning phase was considered appropriate, especially given the expected increases in technology and infrastructure.

Field Survey

13.37 This assessment is desk based, drawing largely from published guidance, data and industry standards.

Assessing Significance

Sensitivity

13.38 The sensitivity of the receptor (global atmosphere) to increases in GHG emissions is always considered 'high', following IEMA Guidance[13], given the severe consequences of global climate change and the cumulative contributions of all GHG emission sources.

Magnitude

13.39 The magnitude of effect on the climate has been assessed by the change in mass of GHG emissions in units of tonnes of carbon dioxide equivalent, (tCO2e). This follows standard approaches in quantifying GHG emissions, aligning with IEMA Guidance[13], and therefore

providing the estimate of magnitude of the emissions of the Proposed Development in absolute terms, rather than the relative terms (grading from low to high) used in other aspects of the EIA.

Significance

13.40 The predicted significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity and magnitude of change as detailed in **Table 13.5** below. Major and moderate effects are considered significant in the context of the EIA Regulations.

13.41 As of February 2022, recently updated IEMA industry guidance[13] for assessing the significance of GHG impacts for EIA, standard GHG accounting and reporting principles have been followed to assess effect magnitude. According to the IEMA guidance on assessing GHG emissions in EIA, *"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."*

13.42 This updated guidance *"describes five distinct levels of significance which are not solely based on whether a project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a science-based 1.5°C aligned transition towards net zero"*. The guidance also states it is down to the professional judgment of the practitioner to determine how best to contextualise a project's GHG impact and assign the level of significance.

13.43 In line with IEMA guidance[13], UK national carbon budgets have been used for the purposes of this assessment to determine the level of significance for the Construction phase. Since the effects of GHG emissions cannot be geographically constrained, more localised budgets or targets can be less meaningful, especially since it is unclear whether emerging local authority or regional budgets will add up coherently to the UK budget. In addition, national carbon budgets have the advantage of being clearly defined and based on robust scientific evidence.

13.44 As shown in **Table 13.4** below, the appropriate UK national carbon budget that spans the construction programme of the Proposed Development (2026 to 2027), is the 4th carbon budget (2023 to 2027).

Table 13.4 Relevant Carbon Budgets for this Assessment

Carbon budget	Total budget (MtCO2e)
4th (2023-2027)	1,950
5th (2028-2032)	1,725
6th (2033-2037)	965

13.45 In GHG accounting it is common practice to consider exclusion of emission sources that are <1% of a given emissions inventory on the basis of a 'de minimis' contribution. Both Department of Energy and Climate Change (DECC, 2013[38]) and the PAS 2050 Specification (BSI, 2011[39]) allow emissions sources of <1% contribution to be excluded from emission inventories and these inventories are to be considered complete for verification purposes.

13.46 The IEMA guidance[Error! Bookmark not defined.] also states that projects with any non-significant adverse effects are considered in terms of their compatibility with the 1.5°C trajectory (in terms of rate of emissions reduction), and also ensure they comply with up-to-date policy and 'good practice' reduction measures.

13.47 Therefore the GHG intensity of the Proposed Development (defined as the operational emissions divided by the energy generation) has been compared with both the forecasted 2022 GHG intensity of the grid (152 gCO2e/kWh), as well as the projected grid GHG intensity as published by BEIS (BEIS, 2022[12]) over the operational phase of the Proposed Development, considering both the Proposed Development a whole, as well as only the aspects related to the Energy Generation i.e. excluding the BESS components.

13.48 This assesses the relative contribution of the Proposed Development to the UK's trajectory towards net zero, since the projected grid intensity takes into account key variables related to climate change policies where funding has been agreed and where decisions on policy design are sufficiently advanced to allow robust estimates of policy impacts to be made.

[38] DECC (2013) Guidance on Annual Verification for emissions from Stationary Installations.

[39] BSI (2011) PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.

13.49 This approach to assessing significance of both construction and operational impacts is summarised in the table below.

Table 13.5: Significance Criteria

Significance of Effect	IEMA Guidance	Construction/ Decommissioning	Operational
Major Adverse	*"..not compatible with the UK's net zero trajectory"*	Net annual GHG emissions represent more than or equal to 1% of the relevant annual National Carbon Budget.	Net annual operational GHG intensity greater or equal to the 2022 grid GHG intensity.
Moderate Adverse	*"..does not fully contribute to decarbonisation"*		
Minor Adverse	*"…compatible with the budgeted, science based 1.5°C trajectory"*	Net annual GHG emissions represent less than 1% of the relevant annual National Carbon Budget.	Annual operational GHG intensity of Energy Generation (excluding Energy Storage) less than the BEIS 2022 grid GHG intensity but greater than the relevant annual decarbonised grid GHG intensity.
Negligible	*"…goes substantially beyond the reduction trajectory"*		
Minor Beneficial		Net annual GHG emissions are net zero.	Annual operational GHG intensity of Energy Generation (excluding Energy Storage) equal to the relevant annual decarbonised grid GHG intensity.

Significance of Effect	IEMA Guidance	Construction/ Decommissioning	Operational
Moderate Beneficial	*"…GHG emissions to be avoided or removed from the atmosphere"*	Net annual GHG emissions are negative (ie. Net sequestration of GHG emissions).	Annual operational GHG intensity of Energy Generation (excluding BESS) less than the relevant annual decarbonised grid GHG intensity.
Major Beneficial			

Assessment Limitations

13.50 Whilst some information gaps, such as the detailed energy generation modelling, have been identified, it is considered that there is sufficient information to enable an informed decision to be taken in relation to the identification and assessment of likely significant environmental effects of the Proposed Development on the climate.

13.51 Where available, product or design data specific to the Proposed Development required to undertake the lifecycle GHG impact assessment was provided by the project design team. Where data was unavailable, reasonable assumptions have been made based on professional judgement, and analysed using methodologies and data sources previously outlined in this Section.

Baseline Conditions

13.52 The Site consists mainly of arable land, scattered trees, woodlands and hedgerows. The abundance of vegetation within the Site suggests a relatively high carbon sink potential.

13.53 The baseline for the lifecycle GHG impact assessment is a 'do nothing' scenario whereby the Proposed Development is not implemented.

13.54 The baseline conditions include the existing carbon stock (e.g. carbon sequestered within vegetation present) and sources of GHG emissions (e.g. from agricultural vehicles and machinery) within the Site from the existing activities on-site. As the land use within the Site is

largely agricultural, it is estimated that the baseline conditions of the land will have minor levels of associated GHG emissions.

13.55 Whilst the growing of crops will sequester carbon in the short term for the duration of a growing cycle, this carbon would be subsequently released in a relatively short cycle during the agricultural practices of management, harvesting and consumption.

13.56 The resulting net GHG emissions of the baseline conditions are therefore dependent on soil and vegetation types present, and fuel use for the operation of agricultural vehicles and machinery. However, it is anticipated that these emissions will not be material in the context of the overall Proposed Development.

13.57 Therefore, for the purposes of the lifecycle GHG impact assessment, a conservative GHG emissions baseline of zero is applied, which due to the likely existing minor levels of associated GHG emissions, represents a robust worst-case approach.

Future Baseline in the Absence of the Proposed Development

13.58 The future baseline in the absence of the Proposed Development is assumed to be the same as that of the baseline conditions previously outlined in this Section, representing a ‘do nothing’ scenario whereby the Proposed Development is not implemented.

Design Considerations and Embedded Mitigation

13.59 The following mitigation measures have been assumed to apply to the construction, operational and decommissioning phases. This is because the key activities assessed during the operational phase include the maintenance requirements for product and equipment replacement and associated transport to the Site, and therefore require similar mitigation measures to the initial construction activities.

13.60 This mitigation will be implemented to reduce the GHG impact of the Proposed Development and is incorporated into the outline CEMP and CTMP (**Appendix 4.3**), to be secured by Development Consent Order (DCO) requirement. Specific mitigation measures will include:

- Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable.
- 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.
- Reusing suitable infrastructure and resources already available in the Site where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements).
- Implementing staff minibuses to transport construction personnel to site or using car sharing options where possible.
- Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Proposed Development.
- Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current UK emissions standards.
- Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.

Assessment of Construction Effects

13.61 The assessment of effects is based on the Proposed Development description as outlined in **Chapter 4: Project Description**. Please refer to the Scope of the Assessment section of this chapter for a breakdown of impacts assessed during the construction phase.

Predicted Construction Effects

13.62 The greatest GHG impact during the construction phase is due to the embodied carbon in construction materials which accounts for 978% of the total emissions generated by the Proposed Development.

13.63 Total GHG emissions from the construction phase are estimated to equate to 85,055~~104,218~~ tCO2e. A breakdown of estimated GHG emissions from the construction of the Proposed Development is presented in **Table 13.6**.

13.64 GHG emissions from construction activities will be limited to the duration of the construction programme (approximately 16-months). When annualised, the total annual construction emissions equate to 63,791~~78,163~~ tCO2e.

Table 13.6*:* Summary of Construction GHG Emissions

Emissions Source	Emissions (tCO2e)	% of Construction Emissions
Products (Embodied)	82,748~~101,606~~	9~~8~~%
Transportation of materials & waste	1,954~~2,258~~	2%
Worker transportation	353	<1%
Total	**~~104,218~~85,055**	**100%**

13.65 GHG emissions from construction have been assessed to identify the significance of their impact. **Table 13.7** presents the estimated construction emissions against the carbon budget period during which they arise. Construction emissions will fall under the 4th UK carbon budget.

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

Table 13.7*:* UK carbon budgets relevant to construction period

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO2e)	Annual Construction Emissions During Carbon Budget Period (tCO2e)	Construction Emissions as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	~~78,163~~63,791	0.0163~~200~~%

13.67 Annual emissions from the construction of the Proposed Development do not contribute to “equal to or more than” 1% of the annualised 4th carbon budget. The magnitude of effect is

therefore considered low. GHG emissions from the construction of the Proposed Development are therefore considered to have a **Negligible** to **Minor Adverse** effect on the climate.

Proposed Mitigation

13.68 Mitigation will be implemented to reduce the GHG impact of the Proposed Development, as previously outlined in the Embedded Mitigation (paragraph 13.6013.60) that relates to the construction, operational and decommissioning phases.

13.69 There will be unavoidable GHG emissions resulting from the construction phase of the Proposed Development as materials, energy and fuel use, and transport will be required.

13.70 Therefore it is not appropriate to define any mitigation measures further to those detailed in the section referenced above.

Residual Effects

13.71 As outlined in the Proposed Mitigation section, there will be unavoidable GHG emissions resulting from the construction phase, and thus the residual construction effects would remain **Negligible** to **Minor Adverse** (**not significant**).

Assessment of Operational Effects

13.72 The assessment of effects is based on the Proposed Development description outlined in **Chapter 4: Project Description.** Please refer to the Scope of the Assessment section for a breakdown of impacts assessed during the operational phase.

Predicted Operational Effects

13.73 The greatest GHG impact during the operational phase is as a result of maintenance activities, associated with embodied carbon and transport of replacement parts and equipment, which account for 99% of the total emissions.

13.74 Total operational GHG emissions equate to approximately 91,61089,875 tCO2e over the 40-year design life, as presented in **Table 13.8**. On an annualised basis, this is equivalent to 2,24790 tCO2e per year of operation.

Table 13.8*:* Summary of Operational GHG Emissions

Emissions Source	Emissions (tCO2e)	% of Operational Emissions
Worker transportation	308	<1%
Maintenance	~~90,606~~89,098	99%
Operational energy consumption	469~~695~~	1%
Total	**~~91,610~~89,875**	**100%**

13.75 The operational GHG emissions presented in **Table 13.5** are considered to reflect a robust worst-case as the calculations for worker transportation and maintenance have been carried out using current emissions factors to estimate emissions over the operational lifetime of the Proposed Development. However, carbon and emissions associated with energy and fuel use throughout the supply chain are anticipated to be lower in the future as a result of grid decarbonisation and machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050.

13.76 The average operational GHG intensity of both the Proposed Development (including BESS aspects) and just the Energy Generation (excluding BESS aspects) have been calculated by dividing the corresponding total operational GHG emissions (outlined above) by the total energy generation of the Energy Generation.

13.77 When considering the Proposed Development as a whole, this gives an average operational GHG intensity of 23.6~~16.2~~ grams of CO2 equivalent per kWh (gCO2e/kWh). This operational GHG intensity is well below the 2022 GHG intensity of the grid (152 gCO2e/kWh), as published by BEIS (BEIS, 2022[12]).

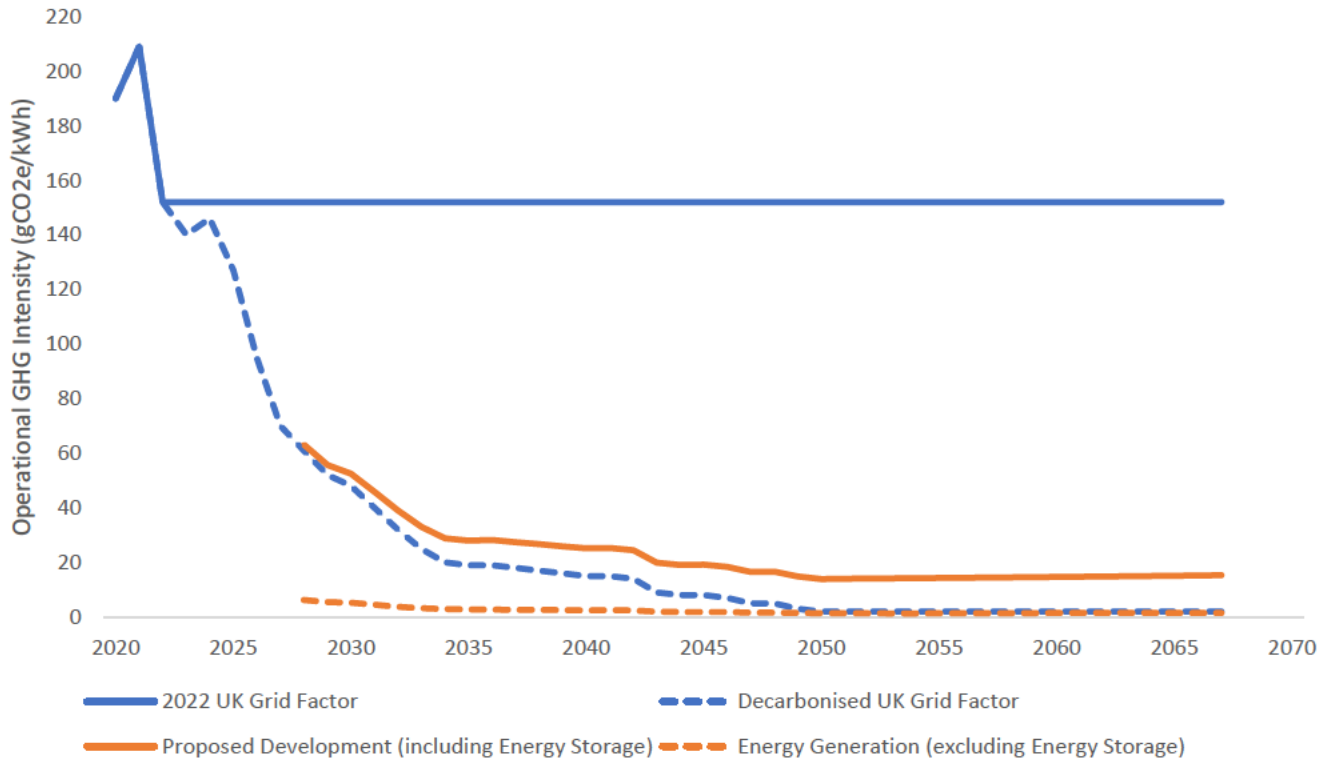
13.78 When considering only the aspects relating to the solar Energy Generation, this gives an average operational GHG intensity of 2.3~~1.8~~ grams of CO2 equivalent per kWh (gCO2e/kWh). In addition to being well below the forecasted 2022 GHG intensity of the grid, this also remains below the projected decarbonised grid GHG intensity (BEIS, 2022[12]) over the operational phase of the Proposed Development. These comparisons can be seen in **Plate 13.1** below.

13.79 These decarbonised projections assume a significant extent and rate of grid decarbonisation assumed by BEIS. In fact current BEIS forecasts indicate a required newly installed energy capacity of over 150,000MW (130% the current energy generation capacity in

2022) by 2040. Over half this increase, nearly 100,000MW, is projected to be met by newly installed renewable capacity[40].

13.80 Projects such as the Proposed Development will contribute towards the UK achieving the forecasted decarbonised grid mix by contributing to the projected rapid increase of required new renewable capacity as indicated above.

[40]Department for Energy Security and Net Zero (2023) Energy and Emissions Projections Data Table. Available at https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fassets.publishing.service.gov.uk%2Fgovernment%2Fuploads%2Fsystem%2Fuploads%2Fattachment_data%2Ffile%2F1141573%2FAnnex_K_All_Power_Producer_cumulative_new_capacity_Mar2023revision.ods&wdOrigin=BROWSELINK [Accessed 13/11/23]



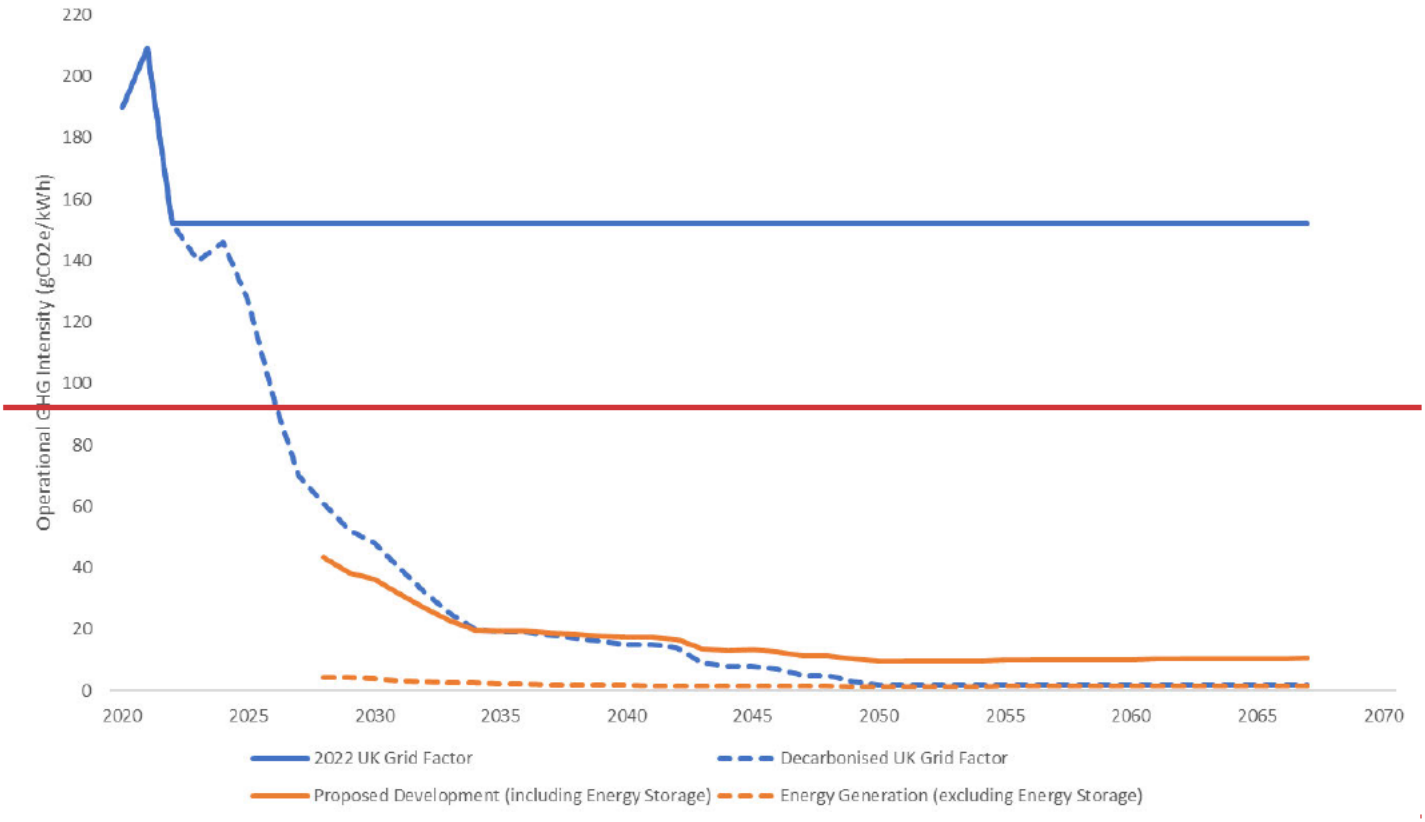


Plate 13.1: Operational GHG Intensity of UK Grid projections and estimated operational Proposed Development and Energy Generation emissions.

13.81 Over the 40 year operational lifetime, the Proposed Development is estimated to produce a cumulative energy generation of ~~5,653,501~~3,815,246 MWh resulting in total GHG emissions of **89,875 ~~91,610~~tCO2e** (see **Table 13.8** and solid orange line in **Plate 13.1**).

13.82 To contextualise the effects of the Proposed Development's operational GHG emissions, an alternative scenario has been assumed where the corresponding energy generation would be supplied by the National Grid.

13.83 Using the 2022 Grid Factor as the GHG emission intensity for the generation of this energy supply, see **Plate 13.1**, it has been estimated that **579,917~~859,332~~ tCO2e** would be emitted to generate the equivalent amount of electricity over the operational lifetime of the Proposed Development from the projected grid energy mix (represented by the solid blue line shown above in **Plate 13.1**), (BEIS, 2022[12]).

13.84 The avoided GHG emissions are therefore 490,042~~767,723~~ tCO2e (simply the difference between the operational GHG emissions of the Proposed Development (89,875~~91,610~~ tCO2e) and the estimated emissions from the equivalent energy supply from the grid (579,917~~859,332~~ tCO2e)). When considering the GHG emissions for the solar energy generation only (excluding BESS), the operational GHG emissions for the Proposed Development are estimated to be 8,876 ~~10,359~~ tCO2e, equivalent to avoided emissions of 571,041~~848,974~~ tCO2e compared to the same equivalent energy supply from the grid (579,917~~859,332~~ tCO2e).

13.85 In addition, it should be recognised when comparing the two operational intensities, that unlike the estimate for the Proposed Development, the BEIS Grid Factor GHG intensities do not account for maintenance (including embodied carbon associated with replacement), land use change or worker transport requirements, and thus the GHG emission saving from the operational phase of the Proposed Development is even greater.

13.86 Even when taking into account the conservative approach taken, **Plate 13.1** clearly shows that that the estimated annual operational GHG intensity of the Energy Generation is significantly less than the relevant annual projected decarbonised grid GHG intensity. Therefore, the operational phase of the Proposed Development on GHG emissions is considered to have a **moderate to major beneficial (significant) effect** and will help deliver the UK's ambitious targets for emissions reductions.

Proposed Mitigation

13.87 Mitigation will be implemented to reduce the GHG impact of the Proposed Development, as previously outlined in the Embedded Mitigation (paragraph 13.6013.60) section that relate to the construction, operational and decommissioning phases. No additional mitigation is required as the effect is already beneficial.

Residual Operational Effects

13.88 The residual operational effects would remain **moderate to major beneficial (significant)** as presented above.

Assessment of Decommissioning Effects

13.89 The assessment of effects is based on the project description outlined in **Chapter 4: Project Description.** Please refer to the Scope of the Assessment section for a breakdown of impacts assessed during the decommissioning phase.

Predicted Decommissioning Effects

13.90 Total GHG emissions from the decommissioning phase are estimated to equate to 382 tCO2e. A breakdown of estimated GHG emissions from the decommissioning of the Proposed Development is presented in **Table 13.9** below.

13.91 GHG emissions from decommissioning activities will be limited to the duration of the decommissioning programme (approximately 12 months).

Table 13.9*:* Summary of Operational GHG Emissions

Emissions Source	Emissions (tCO2e)	% of Decommissioning Emissions
Transportation of materials and waste	2630	78%
Worker transportation	353	932%
Total	**378382**	**100%**

13.92 To contextualise the emissions associated with the decommissioning phase of the Proposed Development, these are presented alongside the total emissions from the construction phase in **Table 13.10** below.

Table 13.10*:* Construction and Decommissioning GHG Emissions

Emissions Source	Emissions (tCO2e)
Construction	85,055~~104,218~~
Decommissioning	378~~382~~

13.93 As shown in **Table 13.10** above, the GHG emissions associated with the decommissioning phase are considerably less than those during the construction phase, with the value of 378~~382~~ tCO2e representing 0.4% of the construction phase emissions.

13.94 To assess the significance of effect of the construction phase, the GHG emissions were compared to the relevant UK carbon budgets. However, this approach is not possible for the timescale of the decommissioning phase (indicative decommissioning period likely to commence in 2065), as the current UK national carbon budgets only span up to the year 2037.

13.95 Since the magnitude of GHG emissions from the decommissioning phase of the Proposed Development is considerably less than those for the construction phase, it is therefore considered that the effect of these emissions is also low with a **negligible to minor adverse** (not significant) effect on the climate.

Proposed Mitigation

13.96 Mitigation will be implemented to reduce the GHG impact of the Proposed Development, as previously outlined in the Embedded Mitigation section paragraph 13.60~~13.60~~). Therefore no additional mitigation is required.

Residual Decommissioning Effects

13.97 As outlined in the Proposed Mitigation section, there will be unavoidable GHG emissions resulting from the decommissioning phase, and thus the residual decommissioning effects would remain **negligible to minor adverse** (not significant) as presented above.

Cumulative Effects

13.98 The assessment methodology uses relevant UK National Carbon Budgets as a proxy for the identified receptor of the global climate, in line with IEMA guidance**Error! Bookmark not defined.**. Effects of GHG therefore cannot be geographically constrained.

13.99 Furthermore, any cumulative GHG emissions from other schemes would also be considered by the UK carbon budgets. This approach is inherently cumulative, since it accounts national budgets that are managed centrally by the Government.

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

Summary of Lifetime GHG Emissions

13.101 As outlined above, the residual effects from the construction, operational and decommissioning phases have been assessed as **Negligible** to **Minor Adverse (not significant), Moderate to Major Beneficial (significant)** and **Negligible to Minor Adverse (not significant)** respectively.

13.102 However, to further contextualise the effects of the Proposed Development and its contribution towards the UK's ability to meet its carbon reduction targets, the lifetime GHG emissions are presented below and contextualised in terms of national projections. This clearly shows that the Proposed Development can be considered compatible with the budgeted, science based 1.5°C trajectory towards the UK's goal of achieving net zero emissions by 2050.

As shown previously in **Plate 13.1**, the estimated operational GHG intensity of the Proposed Development is considerably lower than that of the current grid energy mix, and remains well below the projected grid average over its lifetime.

13.103 Whilst the national BEIS Energy Grid Mix is currently only projected to 2040, this shows a clear trend and assumption of increasing contribution of renewable energy sources such as solar power, such as the Proposed Development, to the UK supply[40]). This long-term trend is also expected to continue beyond 2040 and over the lifetime of the Proposed Development.

13.104 Therefore, without low-carbon energy generation projects such as the Proposed Development, the average grid GHG emissions intensity will not decrease as is projected in **Plate 13.1** above, and will adversely affect the UK's ability to meet its carbon reduction targets.

13.105 When considering the effects across all phases of the Proposed Development, the total lifetime GHG emissions are presented in Table 13~~Table 13~~.11 below.

Table 13.11*:* Summary of Lifetime GHG Emissions of the Proposed Development

Stage	Emissions (tCO2e)
Construction	85,055~~104,218~~
Operational	89,875~~91,610~~
Decommissioning	378~~382~~
Total Lifetime	**~~196,209~~175,308**

13.106 Based on the total energy generation of the Proposed Development and the lifecycle GHG emissions of 175,308~~196,209~~ tCO2e, the lifetime GHG intensity of the Proposed Development is 45.9~~34.7~~ gCO2e/kWh. When considering only the aspects relating to the solar Energy Generation, and corresponding lifecycle GHG emissions of 51,558~~72,207~~ tCO2e, this gives a lifetime GHG intensity for the Energy Generation of 13.5~~12.8~~ gCO2e/kWh This compares extremely favourably with fossil fuel electricity generation and is comparable with other low carbon energy generation (Pehl et. al., 2017[41]), as shown below in **Plate 13.2**

[41] Pehl, M., Arvesen, A., Humpenöder, F. et al. Understanding future emissions from low-carbon power systems by integration of life-cycle assessment and integrated energy modelling. Nat Energy 2, 939–945 (2017).

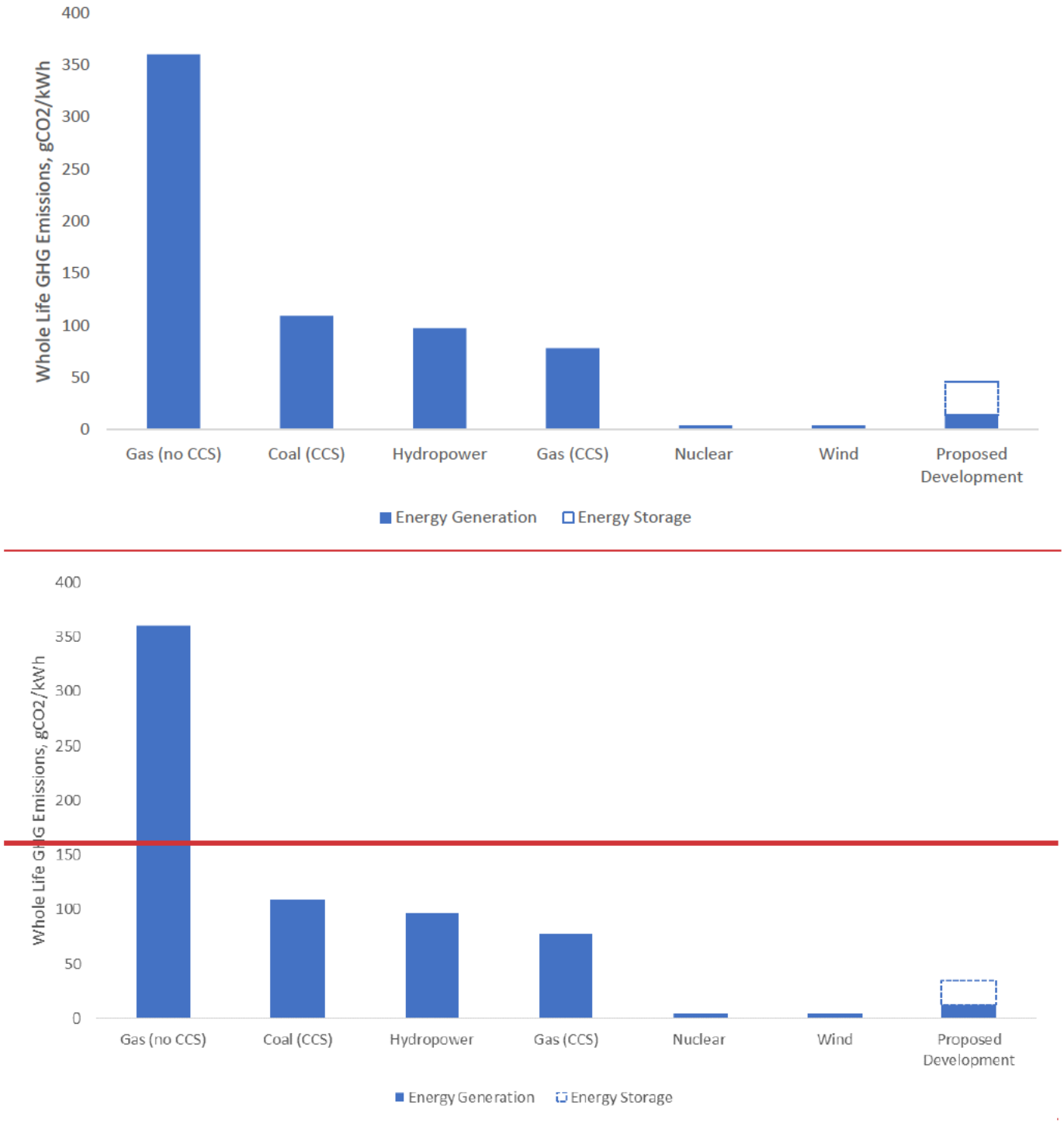
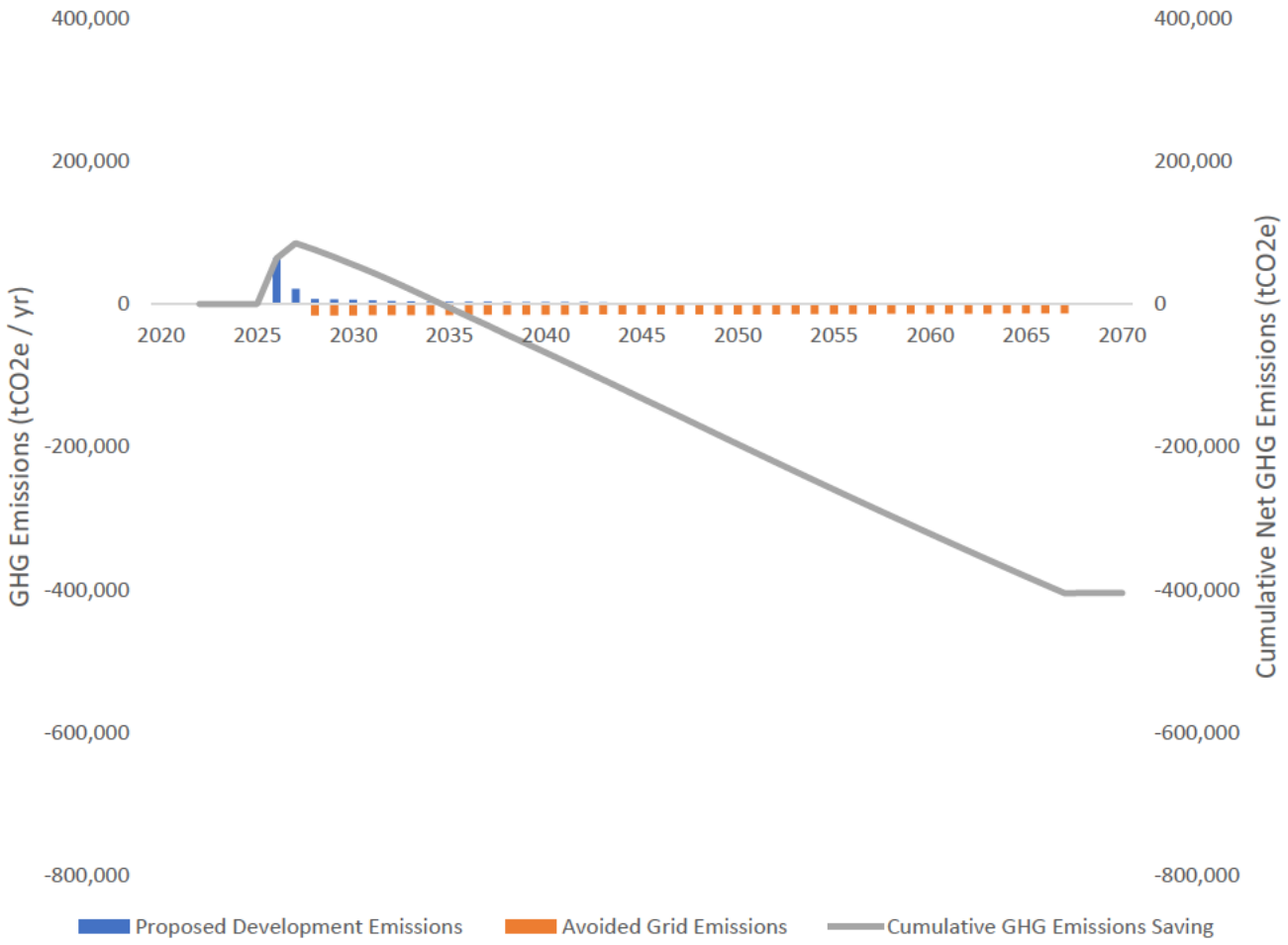


Plate 13.2: Whole Life Cycle GHG intensities of the Proposed Development and Alternative forms of Energy Generation (Pehl et. al., 2017[41])

13.107 In addition, the lifecycle GHG emissions of the Proposed Development of ~~196,209~~175,308 tCO2e can be put into further context when compared against the previously estimated emissions that would result from sourcing the equivalent energy supply from the grid,

~~859,332~~579,917 tCO2e (and represented by the solid blue line as shown above in **Plate 13.1**). Over the lifecycle of the Proposed Development, this would therefore result in total GHG emissions saving of ~~663,123~~404,609 tCO2e, as shown by the grey line below in **Plate 13.3**.

13.108 As also shown by the grey line below in **Plate 13.3**, whilst the total ('cumulative') GHG emissions initially increase, representing the initial required 'investment' in GHG emissions during the construction phase, once operational, the avoided GHG emissions of the Proposed Development compared to the UK Grid Factors quickly offset this initial 'investment' in GHG emissions, soon falling below zero and estimated to reach a 'carbon payback' in the year 2033, or approximately 8 years after the start of construction.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-600,000
-800,000
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
GHG Emissions (tCO2e / yr)
Cumulative Net GHG Emissions (tCO2e)
Proposed Development Emissions
Avoided Grid Emissions
Cumulative GHG Emissions Saving

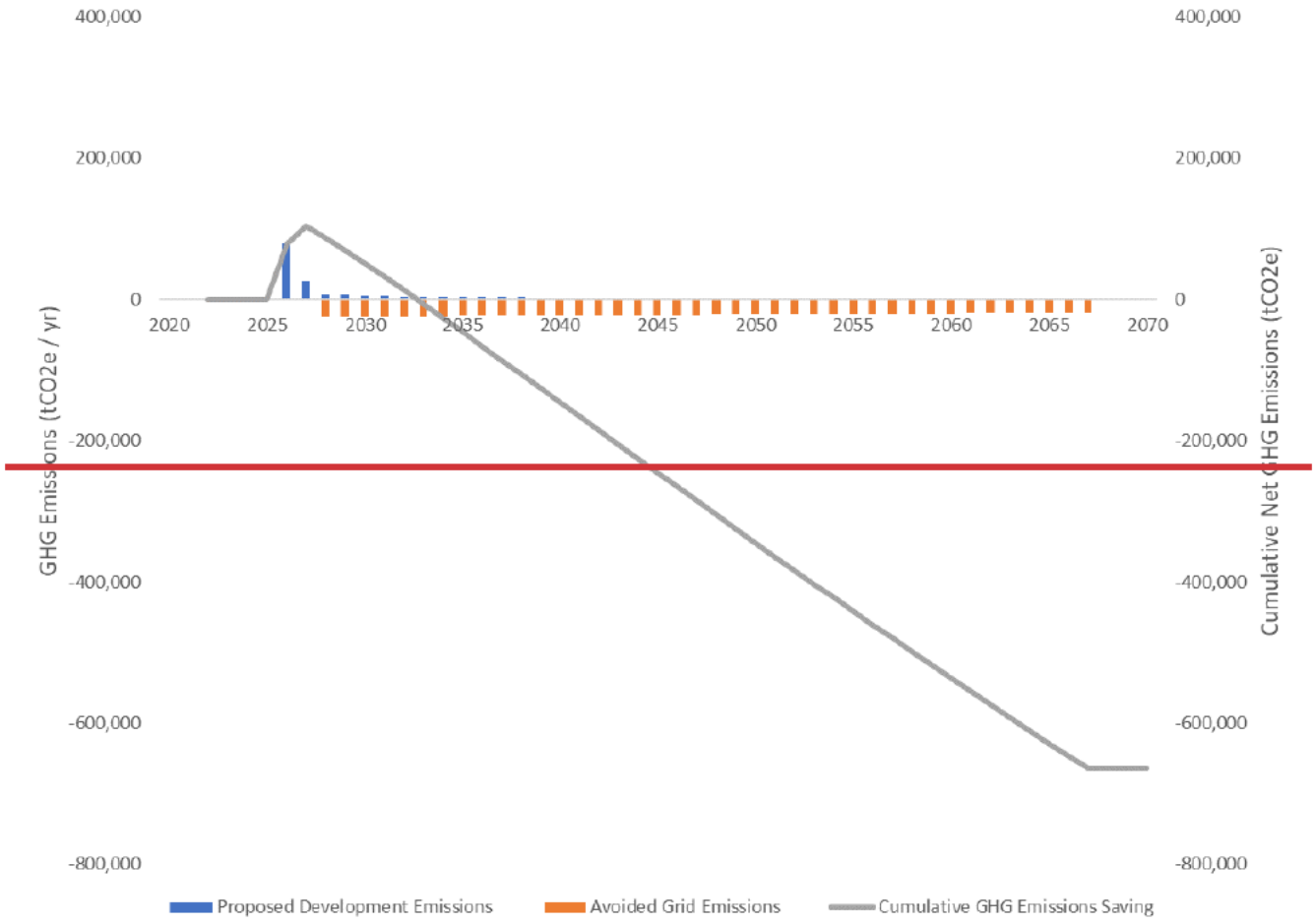

Plate 13.3: Total Lifetime GHG Emissions of the Proposed Development

Climate Change Adaptation (Resilience)

Assessment Methodology

UK Legislation, Strategy and Policy

The Climate Change Act 2008:

13.109 The Climate Change Act 2008 requires the Government, on a five-year cycle, to compile an assessment of the risks for the UK arising from climate change, and then to develop an adaptation programme to address those risks and deliver resilience to climate change on the ground.

The Climate Change Committee

13.110 The Climate Change Committee's 2021 Progress Report to Parliament[42] outlines the UK Government's progress to date on adapting to climate change. This noted that only five of the 34 sectors assessed had shown noticeable progress in the past two years, with no sector yet scoring highly in lowering its level of risk in relation to climate change adaptation in England.

National Policy Statement for Energy (EN-1)

13.111 Part 2 of NPS EN-1[7] details the Government's energy and climate change strategy. This includes policies for mitigating climate change.

13.112 Paragraph 4.8.5 of NPS EN-1 notes that "*applicants must consider the impacts of climate change when planning the location, design, build and operation, and, where appropriate, decommissioning of new energy infrastructure".* Requirements of applicant assessments in the November 2023 Draft NPS EN-1 to be designated are set out in paragraphs 4.10.5 to 4.10.12.

National Policy Statement for Renewable Energy Infrastructure (EN-3)

13.113 NPS EN-3[43] (paragraph 2.3.1) and the November 2023 draft NPS EN-3[44] to be designated (paragraph 2.4.1) refers to the government's energy and climate strategy found in Part 2 of EN-1 and highlights the considerations applicants and IPC (now the Secretary of State) should take into account to ensure that renewable energy infrastructure is resilient to climate change.

National Policy Statement for Electrical Networks (EN-5)

13.114 Paragraph 2.4.1 and the November 2023 draft NPS EN-5[45] to be designated (paragraph 2.3.2) notes applicants are required to highlight to what extent the Proposed Development is expected to be vulnerable or resilient to the effects of climate change. For example to:

[42] UK Government (2021) 2021 Progress Report to Parliament. Available at: https://www.theccc.org.uk/publication/2021-progress-report-to-parliament/

[43] Department for Energy and Climate Change (2011) National Policy Statement for Renewable Energy Infrastructure (EN-3)

[44] Department for Energy Security and Net Zero (2023) Draft National Policy Statement for Renewable Energy Infrastructure (EN-3)

[45] Department for Energy Security and Net Zero (2023) Draft National Policy Statement for Electricity Network Infrastructure (EN-5)

- Flooding, particularly for substations that are vital for the electricity transmission and distribution network.
- Effects of wind and storms on overhead lines.
- Higher average temperatures leading to increased transmission losses.
- Earth movement or subsidence caused by flooding or drought (for underground cables).

National Planning Policy Framework

13.115 The National Planning Policy Framework (NPPF)[6] was revised in February 2019 and again in July 2021 and most recently in December 2023. Paragraph 158 requires developments to *"take a proactive approach to mitigating and adapting to climate change"*. Section 14 of the NPPF 'Meeting the challenge of climate change, flooding and coastal change' emphasises the planning system's pivotal role in sustainable development through shaping places that *"contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience;" (paragraph 157)*.

13.116 Paragraph 158 of the NPPF states that:

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

13.117 National Planning Practice Guidance (NPPG)[46] was published in March 2019 and paragraph 001 Reference ID: 6-001-20140306 recognises that the planning system can *"increase resilience to climate change impact through the location, mix and design of development"*.

13.118 The NPPG companion document to the NPPF sets out the required approach to climate change for the assessment of flood risk. It provides recommendations for sensitivity ranges and

[46] UK Government (2019) Planning Practice Guidance. Available at: https://www.gov.uk/government/collections/planning-practice-guidance

allowances for future increases in rainfall, sea levels, river flows and tidal effects such as wind speed and wave height.

13.119 Paragraphs 165 and 166 of the NPPF state that:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere. Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards".

Local Planning Policy

13.120 The Site is located within the SDDC local authority area. The South Derbyshire Local Plan 2011-2028 (adopted June 2016) identifies climate change as a key issue, with specific mention to the management of energy and water resources. Whilst climate change adaptation underpins the vision of the Local Plan "*Climate change and adaptation will lie at the heart of our strategy and residents and businesses will be supported to make efficient use of resources and cope with the effects of climate change which are already anticipated - such as reduced water availability and increased flooding*".

13.121 The Local Plan also has a strategic objective to "e*nsure future development is local distinctive and environmentally, socially and economically sustainable through the achievement of design excellence, addressing the causes and effects of climate change and reducing waste and pollution".*

Guidance

13.122 This assessment is carried out in accordance with the principles contained within the following document:

- IEMA (2020) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation[47].

13.123 The IEMA Guidance (2020) states that there are two key elements to assessing climate change adaptation in EIA:

- **Project resilience:** defined as "*the risks of changes in the climate to the project (i.e. the resilience or conversely the vulnerability of a project to future climate changes). This element will take into account the design of the proposed development and mitigation measures such as additional tree planting"*.
- **In combination impacts:** described as "*the extent to which climate exacerbates or ameliorates the effects of the project on the environment".*

13.124 Therefore, in line with the guidance above, the project resilience assessment will consider the effects of a changing climate on the Proposed Development. The in-combination assessment will consider the extent to which the climate worsens or improves the effects of the Proposed Development on the environment, on a topic-by-topic basis. Topics that have been judged to have a lower sensitivity to climate change are proposed to be scoped out of further assessment, whilst a more detailed assessment is provided for those topics that have been judged to have a higher sensitivity to climate change, and thus scoped in to the in-combination assessment.

Desk Based Research and Data Sources

13.125 To establish the current climate of the Proposed Development, data was sourced from the Met Office[48] for the closest climate station located to the Site. This was Sutton Bonnington climate station, located approximately 30km north-east of the Site.

13.126 As recommended in the IEMA guidance (IEMA, 2020)[47], the UK Climate Projections 2018 (UKCP18)[49] was used to establish future climate change projections for the Proposed Development. The UKCP18 are considered to be the most up to date assessment of how the UK climate may change over the 21st Century and provides a valid assessment of the UK's

[47] IEMA (2020) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation

[48] Met Office (2010) UK Climate Stations: Sutton Bonnington. Available [online] at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcrhe9cy8

[49] Met Office (2020) UK Climate Projections. Available [online] at: http://ukclimateprojections.metoffice.gov.uk/

future climate over land for a range of variables including temperature, precipitation and sea level rise, however, wind speed and storm frequency/intensity are considered separately as global modelling information is currently more limited.

Field Survey

13.127 The assessment has been desk based, drawing largely from published guidance and data.

Relevant Climate Change Projections

13.128 The UKCP18 projections for temperature and precipitation are presented for the UK as a whole and also on a regional basis. The UK projections consider three variables:

- **Timeframe*:*** the projections are presented between the years of 2010 and 2099. These are broken down into a series of time periods including 2020-2039, 2040-2059, 2060-2079 and 2080-2099.
- **Probability**: The projections are provided as probability distributions rather than single values, with figures provided for 5, 10, 50, 90 and 95% probability.
- **Representative Concentration Pathways (RCP)**: Four pathways have been adopted; RCP2.6, RCP4.5, RCP6.0 and RCP8.5. These pathways describe different GHG and air pollutant emissions as well as their atmospheric concentrations and land use with each one resulting in a different range of global mean temperature increases over the 21st century. RCP2.6 represents a scenario which aims to keep global warming likely below 2°C compared to pre-industrial temperatures. RCP4.5 and RCP6.0 represent intermediate scenarios while RCP8.5 describes a very high GHG emission scenario. All scenarios are considered to be equally plausible.

13.129 This assessment uses projections for the time period 2060-2079 and RCP8.5 and utilises the figures relating to the 10, 50 and 90% probability projections. As the most far-reaching projection, the 2060-2079 scenario is considered to be appropriate for the 40 year design life of the project. RCP8.5 is selected as a suitably precautionary approach as recommended as best practice in IEMA's Climate Change Resilience and Adaptation guidance. This RCP has been used to indicate the projected temperature, and precipitation for the East Midlands which encompasses the Proposed Development.

13.130 Information on wind speed and storms has also been considered, however changes in wind speeds are not currently available at the regional level and there remains considerable uncertainty in the projections, with respect to wind speed and storms.

Study Area

13.131 The study areas used for the in-combination assessment is as the study area defined in each of the topic chapters of the ES. The assessment aims to determine the influence of climate change and project-related impacts to the identified receptors in each of the assessments in those topic chapters. The study area for the project resilience assessment is the Proposed Development itself.

Assessing Significance

13.132 This assessment considers both the vulnerability of the Proposed Development to climate change and the implications of climate change for the predicted impacts of the project, as assessed by the other topic specialists ('in-combination climate impacts'). Potential receptors therefore include the following:

- Solar infrastructure receptors (including building materials, equipment and construction operations/processes).
- Socio-economic receptors (e.g. construction workers, permanent employees and users of the public rights of way (PRoW) crossing the Site).
- Environmental receptors (e.g. habitats and species).

13.133 When determining the likelihood of a climate hazard occurring, a worst case scenario has been assumed, whereby all climate hazards are considered likely to occur.

13.134 With respect to climate change adaptation and effect significance, section 7 of the IEMA Guidance (IEMA, 2020)[47] explains that in determining significance, account should be taken of the susceptibility of the receptor (e.g. ability to be affected by a change and the opposite of resilience) and the vulnerability of the receptor (e.g. potential exposure to a change).

13.135 A receptor with high susceptibility has no ability to withstand/not be substantially altered by the projected changes to the climate. A receptor with low susceptibility has the ability to withstand/not be altered much by the projected change to climate. A receptor with high vulnerability is directly dependent on existing/prevailing climatic factors and reliant on these

specific existing climate conditions continuing in the future (e.g. river flows and groundwater level) or only able to tolerate a very limited variation in climate conditions. Climatic factors have little influence on receptors with low vulnerability (and these receptors require limited consideration through the EIA process).

13.136 Using professional judgement, a combination of susceptibility and vulnerability, in addition to the value/importance of the receptor is used to reach a reasoned conclusion on sensitivity. The greater the susceptibility and/or vulnerability of the receptor, the greater the likelihood that receptor is of higher sensitivity.

13.137 Magnitude of change is based on a combination of likelihood, which takes into account the chance of the effect occurring over the relevant time period and also consequence, which reflects the geographical extent of the effect or the number of receptors affected (e.g. scale), the complexity of the effect, degree of harm to those affected and the duration, frequency and reversibility of effect. **Table 13.12** defines the likelihood of a climate impact occurring, after taking into account the mitigation measures that have been proposed.

Table 13.12: Likelihood of a Climate Impact Occurring

Likelihood of climate impact occurring (after considering mitigation measures)	Description of Likelihood
Likely	66-100% probability that the impact will occur during the life of the Proposed Development
Possible	33-66% probability that the impact will occur during the life of the Proposed Development
Unlikely	0-33% probability that the impact will occur during the life of the Proposed Development.

13.138 The approach to defining consequence criteria for the in-combination climate impact assessment is set out in **Table 13.13,** whilst **Table 13.14** defines the consequence criteria for climate change resilience. To assess the consequence of an in-combination climate change effect, for each environmental topic scoped in to the assessment, a level of consequence is

assigned to an effect based on the approach outlines in **Table 13.13** and their respective assessment methodology. For climate change resilience, professional judgement will be adopted when assigning a consequence criteria to a potential effect.

Table 13.13: Defining Consequence

Consequence	Consequence Criteria
High	The climate change factors in-combination with the effect of the Proposed Development causes the significance of the effect of the Proposed Development on the receptor, defined by the topic, to increase to major.
Medium	The climate change factors in-combination with the effects of the Proposed Development causes the significance of the effect of the Proposed Development on the receptor, as defined by the topic, to increase to moderate.
Low	The climate change factors in-combination with the effects of the Proposed Development causes the significance of the effect of the Proposed Development on the receptor, as defined by the topic, to increase to minor.
Negligible	The climate change factors in-combination with the effect of the Proposed Development causes no change to the significance of the effect of the Proposed Development on the receptor, as defined by the topic.

Table 13.14: Consequence Criteria

Consequence	Consequence Criteria
High	Major damage to infrastructure and complete loss of service; and/or Major financial impact; and/or Major health and environmental impacts.
Medium	Partial infrastructure damages and some loss of service; and/or Moderate financial impact; and/or Adverse effect on health and the environment.

Consequence	Consequence Criteria
Low	Localised infrastructure disruption; and/or No permanent damage, minor restoration work required; and/or Minor financial impacts and/or slight adverse health or environmental effects.
Negligible	No damage to infrastructure; and/or No impacts on health or the environment; and/or No adverse financial impact.

13.139 The significance of potential effects is then determined using the significance criteria matrix in **Table 13.15**. Where an effect has been determined to be either moderate or major, this has been deemed a significant environmental effect in the context of the EIA Regulations. For project resilience, significance should reflect the aims/purposes of the project. For example, as a solar project has the purpose of generating renewable electricity, an effect which temporarily removes this should be considered significant.

Table 13.15: Significance Criteria Matrix

Consequence	Likelihood		
	Likely	Possible	Unlikely
High	**Major**	**Major**	Minor
Medium	**Major**	**Moderate**	Minor
Low	**Moderate**	Minor	Negligible
Negligible	Minor	Negligible	Negligible

13.140 The IEMA guidance (IEMA, 2020[47]) also recommends consideration of the resilience of the Proposed Development to climate change, both to changes in average conditions and in extreme events. This considers if the Proposed Development can withstand the projected

climate changes (e.g. through design features and choice of construction materials) and can be future proofed, enabling resilience modifications to be added in the future if necessary.

Assessment Limitations

13.141 The assessment has been carried out using the UKCP18 projections. These are not climate change predictions as they include a degree of uncertainty. As stated in the UKCP18 Science Overview Report:

"*While the global and regional projections of future climate use the latest climate models and are diverse, they cannot cover all potential future climate outcomes out to 2100 (or beyond in the case of sea level).The probabilities represent the relative strength of evidence supporting different plausible outcomes for UK climate, based on the climate models, physical insight, observational evidence and statistical methodology used to produce them. However, they may not capture all possible future outcomes, because, for example, some potential influences on future climate are not yet understood well enough to be included in climate models.*"

Baseline Conditions

Current Climate

13.142 The current baseline is that of the current climate. Between the years of 1991 and 2020 at the Sutton Bonnington climate station, the average maximum temperature summer[50] temperature was 21.1ºC and the average minimum temperature was 11.5ºC. For the same location and over the same time period, the average maximum winter temperature was 7.8ºC and the average minimum temperature was 2ºC.

13.143 The average rainfall during the same time period and same location noted above was 60mm and 50mm respectively. No average wind speed has been recorded at this climate station.

[50] In accordance with the UKCP18 Derived Projections of Future Climate over the UK report, winter is classified as the months of December to February and summer is classified as the months of June to August

Extreme Weather Events

13.144 A heatwave and extreme drought conditions occurred over most of the UK during the late winter and early spring of 2002/2003. The spring period saw a record-breaking lack of rainfall and gave way to a long, warm summer in 2003[51].

13.145 In 2010/2012, most of the UK experienced exceptional departures from normal rainfall, runoff and aquifer recharge patterns. Generalising broadly, drought conditions developed through 2010, intensified during 2011 and were severe across much of England and Wales by the early spring of 2012. Record late spring and summer rainfall then triggered a hydrological transformation, with seasonally extreme river flows common through the summer and extensive flooding during the autumn and early winter[52].

Future Climatic Baseline Conditions

13.146 The UKCP18 projections show a general trend towards warmer, wetter winters and drier, hotter summers. However, it should be noted that both temperature and rainfall patterns across the UK are not consistent and will vary dependent on seasonal and regional scale and will continue to vary in the future (Met Office, 2018[53]).

Temperature

13.147 The UKCP18 projections show that temperatures within the East Midlands are projected to increase, with projected increases in summer temperatures greatest. The central estimate of increase in winter mean temperature is 2.4°C; there is a 90% probability of temperature change exceeding 0.8°C and a 10% probability of temperature change exceeding 4.2°C. The central estimate of increase in summer mean temperature is 3.4°C; there is a 90% probability of

[51] Marsh (2004) The Drought of 2003: A Hydrological Review. Available at: https://historicdroughts.ceh.ac.uk/content/hot-summer-2003

[52] Marsh et al. The 2010-12 Drought and Subsequent Extensive Flooding: A Remarkable Hydrological Transformation. Available at: https://historicdroughts.ceh.ac.uk/content/drought-flood-2010-2012

[53] Met Office (2018) UK and Global extreme events – Wind storms. Available at: https://www.metoffice.gov.uk/research/climate/understanding-climate/uk-and-global-extreme-events-wind-storms#:~:text=UK%20Projections,impacts%20of%20wind%20are%20experienced. Accessed 25/09/23

temperature change exceeding 1.5°C and a 10% probability of temperature change exceeding 5.4°C.

Precipitation

13.148 Winter rainfall is projected to increase, and summer rainfall is most likely to decrease. The central estimate of change in winter mean precipitation is an increase of 15%; there is a 90% probability of precipitation decreasing by up to 3% with a 10% probability of precipitation increasing by 35%. The central estimate of change in summer mean precipitation is a decrease of 26%; there is a 90% probability of summer precipitation decreasing by as much as 54% and a 10% probability of summer precipitation increasing by 2%. It should be noted, however, that rainfall patterns across the UK are not consistent and will vary dependent on seasonal and regional scales and will continue to vary in the future (Met Office, 2018).

Wind Speed and Storms

13.149 There are small changes in projected wind speed. Across the UK, near surface wind speeds are expected to increase in the second half of the 21st century with winter months experiencing more significant impacts of winds (Met Office, 2018[53]). This is accompanied by an increase in frequency of winter storms over the UK. However, the increase in wind speeds is projected to be modest.

Sunshine Hours and Cloud Cover

13.150 Climate change is expected to alter the amount of sunshine hours and cloud cover that different regions of the UK receive. In comparing two 30 year periods (1961-1990 and 1991-2020), the Met Office has found that sunshine has increased by 5.6% across the UK (Met Office, 2021[54]). North-eastern and eastern England have seen increases of more than 13%. A recent study from Imperial College London suggested that low clouds have a cooling effect whereas high clouds have a warming effect (Imperial, 2021[55]). There are no robust predictions

[54] Met Office (2021) Charting the UK's changing climate. Available at: https://metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2021/9120-new-climate-normal. Accessed 25/09/23

[55] Imperial College London (2021) Global satellite data shows clouds will amplify global heating. Available at: https://www.imperial.ac.uk/news/226553/global-satellite-data-shows-clouds-

on how this will affect the UK, however clouds are likely to play a significant role in the UK's future climatic condition.

Topics Scoped in to the Climate Change Adaptation Assessment

13.151 For each ES topic, consideration has been given as to the relevance of the climate change projections for receptor baseline conditions. Those with a higher sensitivity to climate changes have been scoped in to the climate change adaptation assessment, as follows:

- Landscape and Visual (operational phase).
- Ecology (construction and operational phase).

Landscape and Visual Impact (Chapter 5)

13.152 With respect to **Chapter 5: Landscape and Visual Impac**t, the Landscape Institute's Position Statement on climate change acknowledges that changes in average temperatures, precipitation and extreme weather events will have an effect on the landscape. Therefore, landscape and visual effects have been taken forward for further assessment for the operational phase, as the landscape mitigation planting will be fully delivered towards the final stages of the construction phase.

Ecology (Chapter 6)

13.153 Increased rainfall and flooding events, coupled with rising temperatures, may modify UK fauna over time, with shifts in species' ranges such as through an increase in invasive species diversity and range, changes to vegetation assemblages and contraction/expansion of range in faunal species. Given the sensitivity, Ecology has been carried forward for further assessment.

[Accessed 13/11/23]

Topics Scoped Out of the Climate Change Adaptation Assessment

13.154 ES topics where receptors have been identified to have a lower sensitivity to climate change are proposed to be scoped out of the climate change adaptation assessment. These topics, including the justification for scoping them out, are discussed further below.

Historic Environment (Chapter 7)

13.155 Changes in temperature and rainfall patterns can affect above and below ground heritage assets. For example, waterlogged archaeological sites are susceptible to changes and fluctuations within the water table and so the remains of known and unknown archaeological remains have the potential to be affected by climate change. Whilst the Site is not thought to contain any special preservation conditions, such as waterlogging or anoxic conditions, which will be altered by changes in groundwater regime, there is potential for below-ground heritage assets to be present within the Site ranging from local to national importance during the construction phase. However, an appropriate mitigation programme to address harm to, or loss of assets will be drawn up in consultation with the archaeological advisor to SDDC and will provide a record of the features lost as a result of the construction of the Proposed Development, preserving them by record. As such, this topic has been scoped out of the climate change adaptation assessment.

Water Resources and Flood Risk (Chapter 8)

13.156 The majority of the Site lies within Flood Zone 1 (low risk), with the exception of a corridor following an unnamed ‘Ordinary Watercourse’ which lies within Flood Zones 2 and 3. Therefore, increases in winter rainfall, in-combination with the increased number of winter storms has the potential to lead to greater periods of saturated ground with a subsequent increased potential for overland flow and localised surface water flooding.

13.157 However, the Flood Risk Assessment (see **Appendix 8.1: Flood Risk Assessment and Outline Drainage Strategy**) determined that climate will have a limited impact on flood risk over the lifetime of the Proposed Development. A worst-case assessment of the potential expansion of the 1% flood extent concluded it is unlikely to exceed the present day 0.1% flood extent. This is considered to be a conservative estimate of the future, especially given the Site is expected to be completed well within 100 years.

13.158 In addition, the drainage strategy for the Proposed Development will aim to ensure all surface water run-off is discharged to the ground as close to the point of interception as possible through source control measures to ensure the Site will not generate extra run-off. Whilst it is recognised that parts of the Proposed Development will remain at risk of flooding, the flood depth in these areas is expected to be less than 300mm and therefore, the solar panels are unlikely to be affected should this occur. Infrastructure such as the inverters, transformers and substations have also been designed so they are not located in fluvial or surface water flood risk areas.

13.159 Therefore, this topic is scoped out of the climate change adaptation assessment.

Ground Conditions (Chapter 9) and Agriculture and Soils (Chapter 15)

13.160 Increased rainfall has the potential to lead to increased soil loss through erosion and run-off, due to the arable nature of most of the land, which means soils are exposed due to regular ploughing. However, during the operation of the Proposed Development, arable crop production will cease and the land will be re-vegetated and/or grazed at low intensities, resulting in no periods of exposed bare soil. Heavy agricultural plant and machinery will no longer be required, thus reducing compaction effects on the soil. A number of measures will be included within the CEMP to minimise the impacts on soil and ground conditions during the construction phase, for example where periods of heavy rainfall are forecasted, precautions will be taken to prevent excess sediment run-off. Stockpiles of soils will be managed to prevent the sediment from being washed away during a rainfall event. On this basis, these topics have been scoped out of the climate change adaptation assessment.

Transport and Access (Chapter 10)

13.161 Increased rainfall/storms have the potential to lead to temporary traffic disruption during flooding episodes . Increased summer temperatures may cause some disruption and discomfort, although this will be temporary in nature and should be balanced against the likelihood that freezing conditions in winter will be less likely.

13.162 An increase in extreme weather events such as storms and snow may also cause travel disruption. Impacts from these events however are unlikely to be exclusive to the Site and it is assumed that, at a national and regional level, appropriate measures will be put in place to ensure that these risks are managed, as far as is reasonably possible, and do not have long

term impacts on transport infrastructure. Therefore, this topic has been scoped out of the climate change adaptation assessment.

Socio-Economics, Tourism and Recreation (Chapter 12)

13.163 Temperatures are projected to increase which could increase the risk of overheating for people exercising. There are two existing Public Rights of Way (PRoW) that cross through the Site, however, it is not envisaged that the Proposed Development will lead to an increase in recreational users. It is the users' responsibility to ensure that they are appropriately prepared for the climatic conditions. This is therefore no considered further in this assessment. In addition, it is recognised that construction workers and permanent members of staff associated with the operation of the Proposed Development have the potential to be affected by changing climatic conditions, particularly the risk of overheating and increased precipitation, and therefore this is further considered in the project resilience section of the assessment. On this basis this topic has been scoped out of the climate change adaptation assessment.

Noise (Chapter 11)

13.164 Increased rainfall may lead to an increase in road traffic noise as road surfaces become wet more frequently. In addition, where there are stronger more frequent winds, the influence of distant traffic noise on the soundscape may change. This may result in more frequently increased ambient sound levels, which potentially has the effect of reduced perception of noise from the Site. However, climate change is unlikely to result in increased noise emissions from the site. Therefore, this topic has been scoped out of the climate change adaptation assessment.

Glint and Glare (Chapter 14)

13.165 Whilst the existing Drakelow Solar Farm is located approximately 1.4km north-west of the Proposed Development, the main source of irradiance will remain the sun, which is deemed to be a more significant source of irradiance than solar reflections from solar panels. Road users are already made aware of safety when driving when the sun is out on a clear day. Dwellings will experience the most significant source of irradiance at sunset and sunrise, however existing hedgerows will be enhanced or strengthened with trees and new hedgerows woodland understorey belts will be planted to screen/filter views of the Proposed Development. This will be reviewed and managed appropriately throughout the lifetime of the Proposed

Development. Therefore, this topic has been scoped out of the climate change adaptation assessment.

Air Quality (Chapter 16)

13.166 No air quality management areas (AQMAs) have been declared by SDDC but there are 2 in the vicinity of Stapenhill and Burton-Upon-Trent within East Staffordshire. An increase in winter rainfall and/or in heavy rain days could lead to a possible decrease in relevant pollutant concentrations, with a decrease in summer rainfall leading to a possible increase in concentrations. Overall, however, it is not anticipated that baseline air quality conditions at the Site will fail to meet relevant air quality objectives as a consequence of projected climate change.

13.167 Whilst an increase in dry, hot weather in summer is also projected to lead to an increase in dust concentrations, particularly re-suspended dust particulates, the air quality assessment (see **Appendix 16.1: Air Quality Assessment**) concluded there would be negligible effects for dust soiling on health during the construction phase. In addition, a number of mitigation measures, in line with IAQM guidance, will be implemented across the Site and will be included as part of the CEMP. Therefore, this topic has been scoped out of the climate change adaptation assessment.

Assessment of Potential Effects

13.168 This section gives further consideration as to whether or not the projected climate change will materially affect any impact judgements, which may lead to additional potentially significant effects, taking account of relevant mitigation measures. The Proposed Development's resilience to climate change is also considered, particularly whether the Proposed Development could be affected by climate change to such an extent that the construction and/or operation of the Proposed Development was potentially no longer viable.

13.169 Receptors identified above, as potentially sensitive to a changing climate, are as follows:

- Landscape and Visual (operational phase)
- Ecology (construction and operational phase)

Landscape and Visual

13.170 Chapter 5: Landscape and Visual concludes that there will be moderate significant residual effects[56] on the landscape of the Site itself and the Village Estate Farmlands landscape character type (LCT) up to 0.5km from the Site, however, this will be minor for the wider LCT. For all other LCTs, negligible effects are predicted. With regards to visual effects, there will be minor to negligible effects on local communities and users of recreational routes within 5km of the Site. However, for users of recreation routes that cross the Site, moderate effects are anticipated. Moderate to minor effects are predicted on road users (within 2.5km of the Site), except for Cauldwell Road (between Rosliston and Linton) and Main Street/Walton Road (between Walton-on-Trent and Stapenhill) where negligible effects are predicted.

13.171 It is not anticipated that projected climatic change will materially alter predicted landscape and visual effects.

Landscape and Visual Mitigation

13.172 Proposed landscape mitigation and enhancement measures (see **Appendix 5.6: Outline Landscape and Ecological Management Plan**) for the Site will include the planting of new hedgerows, woodland understory belts with trees to filter views and species rich meadow grassland. Existing hedgerows will be enhanced and where necessary will also be strengthened with trees to screen or filter views. Consideration has been given to measures to cope with climate change at the Site, for example by planting resilient plant species so as to exploit the opportunity climate change presents to create ‘valuable new landscapes’, in line with Natural England guidance[57].

13.173 As such, whilst it is considered possible that an in-combination climate change effect could occur during the operational phase of the Proposed Development, the consequence of a

[56] The residual effects for the operational phases of the Proposed Development are based on the proposed development being operational for 10 years as this is a suitable point at which to judge the level of residual effects as adverse landscape and visual effects tend to decrease over time as the proposed landscape mitigation and enhancement becomes establishing and matures.

[57] Natural England (2021) Climate Change Risk Assessment and Adaptation Plan

climate effect is considered to be low. Therefore, a **minor (not significant)** in-combination effect is predicted for landscape and visual amenity during the operational phase.

Ecology

13.174 Increased rainfall and flooding events, coupled with rising temperatures, may modify UK fauna over time, with shifts in species' ranges. Natural England's 'Climate Change Risk Assessment and Adaptation Plan[58]' sets out the risks and threats posed by current climate change projections. In association with the RSPB, Natural England has also published a Climate Change Adaptation Manual[58] which details the potential effects of climate change on different habitat types.

13.175 Chapter 6: Ecology concludes that there will be no significant adverse effects on either the River Mease Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) or non-statutory designated sites. No significant effects are predicted on habitats or protected species during the construction phase. Significant beneficial effects from the Site level to local level are predicted on non-statutory designated sites, habitats, protected species, invertebrates and reptiles during the operational phase.

13.176 The Site is not located within an environmentally sensitive area and predominantly comprises agricultural fields used for producing arable crops. In relation to impacts upon flora, higher summer temperatures and associated water stress may impact on the existing hedgerow and tree species within the Site and cause an increase in the range and diversity of invasive species, such as Japanese Knotweed. Increased rainfall and flooding events, coupled with rising temperatures, are also likely to modify UK fauna and flora over time, with shifts in species' ranges and behavioral patterns such as breeding and hibernation.

13.177 The ecological mitigation and enhancements within the Proposed Development (see **Appendix 5.6: Outline Landscape and Ecological Management Plan**) will increase resilience to the ecological effects of climate change, through the creation and enhancements of hedgerows, creation of woodland understory planting with trees, including along the river corridor to the north of the Oaklands Farm area as well as creation of meadows along the field margins and in more open areas. This will improve ecological connectivity within the Site

[58] Natural England (2020) Climate Change Adaptation Manual

therefore increasing the ability of species to move and adapt, via the provision of habitats of high ecological value and/or those which provide a clear ecosystem service such as carbon storage through tree planting and improvements in relation to water and soil erosion through the provision of attenuation measures. In addition, the creation of new habitats noted above and the provision of bird and bat boxes will be beneficial for both bat and bird species offering both new shelter and foraging opportunities

13.178 . To prevent the spread of invasive species, in this case Japanese Knotweed, measures such as toolbox talks, marking and protective fencing will be implemented prior to commencing construction works. Best practice working measures will also be incorporated into the CEMP and control measures will be included in the Landscape and Ecological Management Plan (See **Appendix 5.6: Outline Landscape and Ecological Management Plan**) during the operation of the Proposed Development.

13.179 As construction of the Proposed Development is due to commence in Spring 2026 for 16 months it is considered unlikely that there will be an increase in the species ranges occupied by flora and fauna and invasive species during this period. The consequence is considered to be low. Therefore, a **negligible** (**not significan**t) in-combination climate effect is predicted during the construction phase.

13.180 The likelihood of an in-combination effect occurring during the operational phase of the Proposed Development is considered possible, with the consequence of a climate effect considered to be low. Therefore, a **minor** (**not significan**t) in-combination climate effect is predicted for the operational phase.

Project Resilience

13.181 In general, and taking account of design and additional mitigation measures proposed, it is not considered that the Proposed Development could be affected by climate change to such an extent that the construction and/or operation of the Proposed Development could potentially become unviable. Further details are provided below.

13.182 The UKCP18 projections show a general trend towards drier summers and wetter winters, with more extreme weather events. Solar PV panels are designed to capture the sun’s energy and therefore are designed to withstand extreme climatic conditions. The Applicant is

currently considering a range of solar PV modules to be installed across the Site. Of the models they are considering, these are designed to be able to operate in temperatures from -40°C ~ +85°C but derate at higher temperatures. The inverters will operate up to about 50 or 60°C and again will derate or shut down under very high temperatures.

13.183 Whilst it is possible that there would be slightly lower than expected generation with consistently higher temperatures, it is likely that this would be more than offset by less moisture in the air[59], and in any case, it would only be a reduction in low single digit percentages so generation would not be materially affected. A study from 2014 also suggested that climate change could lead to a mean increase in the UK's solar resource, although with greater seasonable variability and discrepancy between geographical regions (Burnett et al, 2014[60]). This could increase the energy output of the Proposed Development, accepting that there is a high degree of uncertainty in this projection.

13.184 The UKCP18 projections show a general trend towards warmer winters and hotter, drier summers. This has been taken into consideration when designing the landscaping strategy (See **Figure 5.8a** and **5.8b: Landscape Strategy Plan**) for the Proposed Development to ensure the species selected for planting on the Site are resilient to wild fires. The landscape strategy includes a mixture of deciduous trees including field maple, crab apple, pedunculate oak, aspen and small leaved lime. These species are considered to be more fire resilient than coniferous trees (which are drier and contain more volatile oils and resins that can more easily catch fire).

13.185 Whilst UK near surface wind speeds are expected to increase in the second half of the 21st century, with winter months in particular experiencing more significant impacts of winds, the Proposed Development will be designed to deal with the maximum loading expected. This includes the provision of woodland understorey belts with trees, new hedgerows with hedgerow trees and the enhancing and strengthening of existing hedgerows to fill in gaps where

[59] Air moisture can cause reflection and refraction reducing solar irradiance reaching the panels. A reduction in air moisture would reduce the incidence of this occurrence, thereby offsetting (to some degree) the effect of higher temperatures on the panels.

[60] Dougal Burnett, Edward Barbour, Gareth P. Harrison, (2014). The UK solar energy resource and the impact of climate change. Renewable Energy. Volume 71. Pages 333-343. Available at: https://doi.org/10.1016/j.renene.2014.05.034 [Accessed 09/10/23]

necessary, helping to filter and slow wind speeds throughout the Proposed Development. The landscaping design is shown in **Figures 5.8a and 5.8b: Landscape Strategy Plan.**

13.186 Solar PV modules selected for installation will also be certified to withstand other severe environmental conditions through their design. This will include antireflective and anti-soiling surfaces to minimise power loss from dirt and dust, in addition to resistance mechanisms to offer protection against snow load. The system will also be designed to deal with the maximum wind loading expected. As such, it is not considered likely that the solar PV modules will be affected by extreme weather events.

13.187 As temperatures are projected to increase along with the frequency and intensity of winter storms, this brings an increased risk of discomfort, particularly for permanent employees working at the Proposed Development during its operational life. To avoid employee discomfort, for example during periods of extreme temperatures or increased precipitation, construction and operational activities will be managed so that the hottest or wettest/coldest parts of the day are avoided to ensure worker safety, although it is noted that this may not always be possible during the construction phase. The design, orientation and positioning of welfare facilities for staff will also be carefully considered. Additionally, the risk of overheating/hypothermia will be incorporated into the Site risk assessment and the Proposed Development will comply with all relevant UK legislation related to the work environment including The Health and Safety at Work etc. Act 1974 and The Management of Health and Safety at Work Regulations 1999. This will include measures such as ensuring appropriate personal protective equipment (PPE) is worn for the Site conditions and adequate water supplies are available to ensure staff stay hydrated during hotter weather.

13.188 Whilst the consequence of a climate impact occurring would be high in the event of a wild fire, high winds or storm occurring, or medium for employee discomfort and extreme weather conditions, when the mitigation outlined above is taken into account, it is considered unlikely that these effects will occur. Therefore, **minor (not significant)** effects are predicted in relation to the Proposed Development's resilience to climate change.

Proposed Mitigation

13.189 No mitigation measures are proposed.

Residual Effects

13.190 The effects remain as reported above. There are no significant in-combination climate effects and no significant effects in relation to project resilience.

Cumulative Effects

13.191 With respect to climate change adaptation, this is a project specific consideration, namely the resilience of the Proposed Development to climate change and the extent to which projected climate change could alter other predicted impact judgements. More widely, in relation to potential interactions with other developments, and following the same logic with respect to required compliance with regulatory standards and relevant planning policy, **no significant cumulative effects** are anticipated.

Summary of Effects

13.192 To reflect the requirements of the 2017 EIA Regulations, an assessment has been undertaken of the potential effects of the Proposed Development on climate change; both emissions reduction, also known as 'climate change mitigation', and climate change adaptation. With respect to the latter, this has included both the vulnerability of the Proposed Development to climate change and also any implications of climate change for the predicted impacts of the project, as assessed by the other topic specialists ('in-combination climate impacts').

13.193 The assessment has been undertaken in accordance with published guidance on considering climate change in EIA and consequently reviews how climate change has been considered at all stages of project progression and assessment. As advised in guidance, it is informed by an understanding of future climate change scenarios and of the potential range of effects associated with these projections. These projections suggest that, in future, the Site and its surroundings will experience warmer, drier summers and milder wetter winters. Whilst heavy rain days are likely to increase throughout the year, there is still considerable uncertainty with respect to likely changes in both wind speed and storm frequency/intensity.

13.194 With regards to GHG emissions during the construction phase, there will be a total of ~~91,610~~85,055 tCO2e, with 9~~7~~9% arising from the embodied carbon in construction materials. Therefore, a **negligible** to **minor adverse** effect on the climate is predicted.

13.195 In relation to the operational phase, a **moderate to major beneficial** effect is predicted as when considering the aspects relating to the solar Energy Generation (excluding BESS), the average operational GHG intensity of ~~1.8~~2.3 grams of CO2 equivalent per kWh (gCO2e/kWh) is well below the 2022 GHG intensity of the grid (152 gCO2e/kWh), and also remains below the projected decarbonised grid GHG intensity (BEIS, 2022[12]). In addition, the operational GHG intensity of the whole Proposed Development (including BESS) of ~~16.2~~23.6 grams of CO2 equivalent per kWh (gCO2e/kWh), and is therefore estimated that the Proposed Development would result in avoided GHG emissions of 490,042~~767,723~~ tCO2e.

13.196 In relation to the decommissioning phase, a **negligible to minor adverse** effect is predicted as the Proposed Development is anticipated to emit 378~~382~~ tCO2e.

13.197 With respect to climate change adaptation, the assessment considered the likely climate change projections in relation to Landscape and Visual and Ecology. **No significant** effects were identified for these topic areas as a consequence of projected climate change.

13.198 Minor effects are predicted in relation to the Proposed Development's resilience to climate change.

13.199 Tables 13.16 – 13.18 below contain a summary of the likely effects of the Proposed Development.

Table 13.16: Summary of Effects: Emissions Reduction

Predicted Effect	Significance	Mitigation	Significance of Residual Effect
Construction			
GHG emissions as a consequence of construction activities.	Negligible to Minor Adverse	No further mitigation required above the embedded mitigation measures applied. These have been incorporated into the outline CEMP and CTMP	Negligible to Minor Adverse

Predicted Effect	Significance	Mitigation	Significance of Residual Effect
		accompanying the ES.	
Operation			
GHG emissions as a consequence of operational activities (40 years)	Moderate to Major Beneficial	No further mitigation required above the mitigation measures applied. It is the intention that these will be incorporated into the outline CEMP and CTMP accompanying the ES.	Moderate to Major Beneficial
Decommissioning			
GHG emissions as a consequence of decommissioning activities.	Negligible to Minor Adverse	No further mitigation required above the mitigation measures applied. It is the intention that these will be incorporated into the outline CEMP and CTMP accompanying the ES.	Negligible to Minor Adverse

Table 13.17: Summary of Effects: Climate Change Adaptation

Potential in-combination Effect	Committed mitigation measures	Probability of a climate impact occurring	Consequence of an impact occurring	Significance
Construction Phase				
Ecology (Shift in flora and fauna ranges and spread of invasive species)	Best practice methods detailed in CEMP Provision of bird and bat boxes Habitat Creation including species-rich grassland, hedgerows, scrub and woodland planting Japanese Knotweed control measures Sensitive timing of works to avoid bat and bird breeding seasons.	Unlikely	Low	Negligible
Operational Phase				
Landscape and Visual	Implementation of the LEMP which includes planting	Unlikely	Low	Negligible

Potential in-combination Effect	Committed mitigation measures	Probability of a climate impact occurring	Consequence of an impact occurring	Significance
(Landscape character)	of suitably resilient plant species.			
Ecology (Shift in flora and fauna ranges and spread of invasive species)	Implementation of the LEMP which includes habitat creation management and monitoring.	Possible	Low	Minor

Table 13.18: Summary of Effects: Project Resilience

Predicted Effect	Mitigation	Probability of a climate impact occurring	Consequence of an impact occurring	Significance
Construction Phase				
Employee Discomfort (e.g. overheating)	Health and Safety Training. Risk Assessments. Staggered working to avoid adverse climatic conditions.	Unlikely	Medium	Minor

Predicted Effect	Mitigation	Probability of a climate impact occurring	Consequence of an impact occurring	Significance
Extreme Weather Conditions	Mitigation through design of the Solar PV Modules.	Unlikely	Medium	Minor
High Winds/Storms	The planting of understory belts and trees, as well as hedgerows to help filter and slow wind speeds.	Unlikely	High	Minor
Operational Phase				
Employee Discomfort (e.g. overheating)	Health and Safety Training. Risk Assessments. Staggered working to avoid adverse climatic conditions.	Unlikely	Medium	Minor
Extreme Weather Conditions	Mitigation through design of the Solar PV Modules.	Unlikely	Medium	Minor

Predicted Effect	Mitigation	Probability of a climate impact occurring	Consequence of an impact occurring	Significance
High Winds/ Storms	The planting of understory belts and trees, as well as hedgerows to help filter and slow wind speeds.	Unlikely	High	Minor
Wild Fires	The planting of suitably resilient plant species, with reference to Natural England Guidance.	Unlikely	High	Minor