Tillbridge Solar

Tillbridge Solar Project
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7. Climate Change

7.1 Introduction

7.1.1 This chapter of the Environmental Statement (ES) presents the findings of an assessment of the likely significant effects on climate change as a result of the proposed construction, operation and decommissioning of the Tillbridge Solar Project (hereafter referred to as 'the Scheme'). A description of the Scheme is presented in **Chapter 3: Scheme Description** of this ES **[EN010142/APP/6.1]**.

7.1.2 This chapter identifies and proposes measures to address the potential impacts and likely effects of the Scheme on climate change during the construction, operation and decommissioning phases. It also identifies the impact of climate change on the Scheme and the combined impact of future climate conditions on the surrounding environment.

7.1.3 In accordance with the requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (Ref 7-1), consideration has been given to the following aspects of climate change assessment:

a. **Lifecycle greenhouse gas (GHG) impact assessment –** the impact of GHG emissions arising over the lifetime of the Scheme on the climate;
b. **Climate change resilience (CCR) assessment –** the resilience of the Scheme to the impacts of future climate change; and
c. **In-combination climate change impact (ICCI) assessment –** the resilience of receptors in the surrounding environment to the combined impact of future climate conditions and the Scheme.

7.1.4 This chapter is supported by a **Flood Risk Assessment**, included in **Appendix 10-3** of this ES **[EN010142/APP/6.2]**, which is considered for the CCR and ICCI assessments. Additional details of legislation and policy pertinent to this chapter are given in **Appendix 7-1** of this ES **[EN010142/APP/6.2].**

7.2 Legislation and Planning Policy

7.2.1 **Appendix 7-1** of this ES **[EN010142/APP/6.2]** identifies the legislation, policy and guidance of relevance to the assessment of likely significant climate change effects of the Scheme.

7.3 Assessment Assumptions and Limitations

7.3.1 This section outlines the limitations of the data used to inform, and any key assumptions made, within the lifecycle GHG impact assessment, CCR review and ICCI assessment.

Scheme Parameters Assessed

7.3.2 The assessment has been based on parameters outlined in **Chapter 3: Scheme Description** of this ES **[EN010142/APP/6.1]**, supplemented with additional information needed to assess converters and other complex electrical components. The technology for solar PV panel arrays and BESS continues to evolve, to maintain commercial flexibility to meet the changing demands of the UK market. The 'Rochdale Envelope' approach has been applied within the EIA to ensure a robust assessment of the likely significant environmental effects of the Scheme, however any adverse impacts are expected to be lower because of developing technology.

Components and Materials

7.3.3 The largest sources of GHG emissions from the Scheme are likely to result from the manufacture and transport of solar PV panels and the BESS. The solar panels are manufactured in China, however there is also potential for similar panels to be procured from Germany to reduce the transport emissions. A conservative estimate, assumed for this assessment, is that the PV panels will be sourced from China as this will increase the embodied carbon in materials and transport emissions compared to panels being sourced from Europe.

7.3.4 A description of the components of the Scheme are given in **Table 3-1** of **Chapter 3: Scheme Description** of this ES **[EN010142/APP/6.1]**.

7.3.5 The Environmental Product Declaration (EPD) used as a reference for embodied carbon from the manufacture and supply of PV panels is for the Jolywood JW-D144N-166 module rated at 470 Watts (W) (Ref 7-15) (the "Jolywood EPD"). The Jolywood EPD includes data on embodied carbon in kilograms carbon dioxide equivalent per kilowatt hour (kg CO_2e/kWh) of electricity generated for various lifecycle stages including supply of raw materials, manufacture, and transport to a solar farm in China. The Jolywood EPD was published in November 2020, prepared in accordance with ISO 14025 and EN 15804, and subject to independent third-party verification.

7.3.6 The Jolywood EPD shows upstream manufacturing with an embodied carbon figure of 0.00748kg CO_2e/kWh. The generation data is from an actual site in southern China with a yield of 1182kWh/kWp/yr, whereas the site has an energy yield of 1126kWh/kWp/yr. Therefore, a correction is made for this to adjust the embodied carbon figure to 0.0082 kg CO_2e/kWh.

7.3.7 Outputs of PV panels are assumed to degrade by 2% in the first year and 0.45% per year thereafter. Operating the Scheme for 60 years, with a replacement of the solar PV panels halfway through operation, lifetime generation is estimated at 48.5 terawatt hours (TWh) of electricity.

7.3.8 The Scheme will also require other components and materials during the construction phase, including inverters, DC/DC converters, , switchgear, cables, steel frameworks to support the PV panels, roads, concrete and aggregates. Emissions factors for electrical equipment including panels, inverters, batteries, transformers, converters, charge controllers and switchgear have been derived from a literature review. Construction materials including road aggregates, concrete, steel, and cables have been derived using standard factors from Inventory of Carbon and Energy (ICE) V3 (Ref 7-16). There are 840 batteries, each of 2,750kWh capacity, giving a total capacity of 2,310MWh, enough to store around three hours of peak production from the solar system.

7.3.9 To estimate the embodied carbon from the manufacture of the BESS, benchmark figures from a Lithium-Ion battery were used, giving a figure of 155kgCO_2e/kWh (Ref 7-17).

7.3.10 For the embodied carbon of inverters an embodied energy figure of 210kWh per kW capacity was identified (Ref 7-18). This was converted from kWh of energy to kgCO_2e using the grid energy intensity of the countries they were produced in, with Spain identified as the likely source of materials.

7.3.11 The embodied carbon of switchgear was calculated from a benchmark reported by FutureFirma (Ref 7-19). Cabling was assumed to be made up of 60% aluminium and 40% plastic by weight when using ICE emission factors for embodied carbon.

Transport of Components, Materials, and Waste

7.3.12 Emissions from the transportation of components and materials to the Scheme have been calculated based on assumed transport modes and distances for all materials and components.

7.3.13 Heavy Goods Vehicle (HGV) and sea freight distances assumed for transportation of materials and waste are outlined below. The longest distance (worst-case) country of origin has been assumed for each of the key components of the Scheme, and assumptions have been made around the specific ports used based on proximity to relevant manufacturing facilities within each country:

a. All transport legs by road are assumed to be 100% laden for delivery, and have a return leg unladen, using corresponding emission factors from Department for Energy Security and Net Zero (DESNZ) (Ref 7-20). International freight deliveries are not assumed to return unladen.
b. Items procured from Europe are assumed to have a road transport distance of 1,770 km (based on half of the reasonable maximum distance equipment might be transported within Europe, plus the distance between Dover and the Scheme).
c. Items procured from UK, mainly building materials, are assumed to have a road transport distance of 50 km. Cranes are assumed to be transported over 100 km.
d. Items procured from China have a sea freight distance of 22,315 km (based on the sea freight distance between Shanghai and Immingham) and 50 km road transport distance.

Waste Management

7.3.14 Emissions from the disposal of construction waste assume standard wastage rates for materials (5% for concrete and aggregate; 2.5% for steel, aluminium and plastics). Volumes of packaging waste have been estimated on a pro-rata basis of installed capacity from other similar schemes. To calculate GHG emissions associated with waste treatment during construction and decommissioning, a worst-case-scenario assumption that 100% of waste will be sent to landfill has been applied. Emissions factors for waste disposal are taken from the UK Government conversion factors for company reporting (Ref 7-20).

7.3.15 Transport emissions from the disposal of waste assume that all disposal will take place within a 100km radius of the Order limits.

7.3.16 Emissions from the disposal of materials and components at the end of the design life are subject to significant uncertainty. For the purposes of this assessment, emissions factors for recycling of different categories of products and materials have been taken from the conversion factors for company reporting published by the UK Government (Ref 7-20).

7.3.17 At the decommissioning stage a conservative assumption that 70% of waste will be recycled, while 30% will be sent to landfill, has also been applied.

Use of Plant and Machinery

7.3.18 Emissions from use of plant and machinery during construction have been calculated based on an assumption of a total of 602,555 litres of diesel used throughout the construction project. This is based on the usage of similar solar projects. The emissions for diesel were taken from the 2023 conversion factors for company reporting published by the UK Government (Ref 7-20).

Consumption of Water

7.3.19 Consumption of water is estimated at 12 litres/day/person for staff. A further usage of $3m^3$/MWp of panels is also required. Emission factors for water supply are taken from the 2023 conversion factors for company reporting published by the UK Government (Ref 7-20). As a conservative estimate, it is assumed that all water supplied is removed for treatment via the wastewater network.

Worker Travel

7.3.20 At peak construction, there will be a maximum 1,395 workers present at the Order limits per day. Movements associated with these workers in and out of the Order limits will comprise approximately 631 individual car vehicles and 12 shuttle bus trips per day. As a worst-case scenario, the peak construction workers are assumed throughout the construction programme, however this is likely to be very conservative. It is assumed that staff will travel 25 km one way, which is a conservative estimate as it is expected staff would reside closer to the Order limits or stay in local accommodation. An emissions factor of an average petrol car (Ref 7-20) has been used for staff vehicles, and class 3 vans are assumed for the shuttle bus.

Land Use Change

7.3.21 An assessment of GHG impacts from land use change associated with the conversion of arable land to grassland has been omitted from this chapter. Though land use change due to the Scheme is anticipated to have an overall net positive GHG impact, due to the higher carbon sequestration value of grassland in comparison to cropland, it is expected that the land will return to its original use upon decommissioning of the Scheme, with any carbon stored in soil or vegetation re-released to the atmosphere. The beneficial GHG impact from land use change is therefore considered to only be temporary (approximately 60 years) and has therefore been excluded from the lifecycle GHG impact assessment. This is a robust worst-case approach and likely to underestimate the beneficial effect of the Scheme, as tree and hedgerow planting may be retained after decommissioning. Any carbon sequestered in these areas would remain in the soil and vegetation following decommissioning.

Construction Phase

7.3.22 The earliest that construction is expected to start is Q3 2025 and finish by late 2027, with operation subsequently commencing at beginning of 2028. Therefore, a construction period of 24 months has been assumed.

Operation Phase

7.3.23 It is assumed that the Scheme will have an average energy consumption of 9.69 GWh per year. This correlates to 1% of the Scheme's electricity production. Projections for grid electricity emission intensities are taken from UK Government projections (Ref 7-21).

7.3.24 Operational maintenance from the replacement of components during the design life of the Scheme are based on replacement rates for similar schemes and based on the design life of the components. It is assumed that all of the PV panels will require replacement once during the Scheme's design life. All BESS cells are assumed to require replacement five times based on a life cycle of 5-15 years (10 years taken as the midpoint). All transformers and cables are assumed to require replacement twice based on a replacement time of 25-30 years. Converters are assumed to be replaced three times based on a life cycle of 10-20 years (15 years taken as the midpoint).

7.3.25 Sulphur hexafluoride (SF_6) is an extremely powerful GHG with a global warming potential (GWP) of 23,900. GWP is a measure used to compare non-CO_2 greenhouse gases to CO_2. CO_2 has a GWP of 1, so if a theoretical gas has a GWP of 2 then it has twice the warming effect over the selected timespan. Fugitive emissions of SF_6 from certain electrical items such as gas-insulated switchgear have historically been a significant source of emissions. Manufacturers of such equipment are now increasingly able to offer SF_6-free components, and those that do continue to use SF_6 are sealed-for-life with extremely low leakage rates. For this reason, it is assumed that emissions of SF_6 from this Scheme will be minimal and not material to this GHG assessment.

7.3.26 A without-project baseline for the Scheme assumes that lifetime electricity output would otherwise be generated by Combined Cycle Gas Turbines (CCGT), which have a typical operational carbon intensity of 0.354 $kgCO_2e/kWh$. It is assumed the energy expected to be generated by the Scheme over its lifetime (52.1 TWh) would instead be required to be supplied by CCGT in this baseline without-project scenario.

Decommissioning

7.3.27 Emissions from the decommissioning process at the end of the design life are very difficult to estimate due to the substantial uncertainty surrounding decommissioning methodologies and approaches so far into the future. It has been assumed that the resources and effort required for decommissioning will be equivalent to those required for construction. Once again, this is considered to be a worst-case scenario.

7.3.28 There is a significant amount research around recycling of solar panels. Methods for recycling PV panels are being developed worldwide to reduce the environmental impact of PV waste and to recover valuable materials from the waste. Current recycling practices are inefficient as Waste Electrical & Electronic Equipment (WEEE) recycling plants are not equipped with specialised PV recycling equipment. The overall recycling rate achieved by current recycling processes is around 24%, well below the current minimum target of 80% (in mass) of reuse and recycling, as set by the WEEE Directive Ref 7-22). However, much more efficient recycling processes are already being developed. For example, the Full Recovery End-of-Life Photovoltaic (FRELP) process is recognised as one of the most advanced PV waste recycling process currently developed. The FRELP process is capable of achieving recycling rates for aluminium, copper, glass, silicon and silver of at least 88% (as much as 95% for some materials). Due to this, over the lifetime of the Scheme, developments in PV waste recycling are expected to improve.

7.3.29 Materials are currently assumed to be split 70:30 between recovery methods and landfill disposal and modelled the same as in Waste Management for Construction. It is likely that transport associated with waste will decarbonise significantly in line with UK's Net Zero commitment by the time the Scheme is being decommissioned; similarly there will likely be improved recyclability for electrical components. Therefore, emissions associated with decommissioning are likely overestimated.

7.4 Assessment Methodology

Study Area

Lifecycle GHG Impact Assessment

7.4.1 The Study Area for the lifecycle GHG impact assessment considers all GHG emissions arising over the lifecycle of the Scheme. This includes direct GHG emissions arising from activities within the Order limits and indirect emissions from activities outside the Order limits (for example, the transportation of materials to the Order limits and embodied carbon within construction materials).

Climate Change Resilience (CCR) Review

7.4.2 The Study Area for the CCR review is the Order limits i.e. it covers all assets and infrastructure which constitute the Scheme, during construction, operation and decommissioning.

In-Combination Climate Change Impact (ICCI) Assessment

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

Sources of Information

7.4.4 The following key sources of information were considered for the completion of the above assessments:

GHG Impact Assessment

a. Information provided by Tillbridge Solar Limited.

CCR Assessment

a. Met Office historical climate data;

b. UKCP18 climate projections; and

c. Information provided by Tillbridge Solar Limited.

Impact Assessment Methodology

Lifecycle GHG Impact Assessment

7.4.5 The likely effects of the Scheme on the climate during construction have been calculated in line with the GHG Protocol (Ref 7-23) and the GHG ‘hot spots’ (i.e. materials and activities likely to generate the largest amount of GHG emissions) have been identified. This will enable priority areas for mitigation to be identified. This approach is consistent with the principles set out by the Institute for Environmental Management and Assessment (IEMA) document ‘Assessing Greenhouse Gas Emissions and Evaluating their Significance’ (Ref 7-24).

7.4.6 This lifecycle approach considers emissions from the following lifecycle stages of the Scheme: construction, operation and maintenance, and decommissioning.

7.4.7 Where activity data allows, expected GHG emissions arising from the construction, operation and maintenance, and decommissioning activities, and embodied carbon in materials of the Scheme, have been quantified using a calculation-based methodology as per the following equation as stated in the methodology paper accompanying the conversion factors for company reporting published by the UK Government (Ref 7-20):

Activity data x GHG emissions factor = GHG emissions value

7.4.8 In line with the GHG Protocol (Ref 7-23), when defining potential impacts the seven Kyoto Protocol GHGs have been considered, specifically:

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

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

7.4.10 Where data are not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIAs (Ref 7-24).

7.4.11 **Table 7-1** summaries the key anticipated GHG emissions sources associated with the Scheme, which were scoped in during the consultation process.

Table 7-1: Potential sources of GHG emissions

Lifecycle Stage	Activity	Primary Emissions Sources
Enabling	Transportation and disposal of earthworks/ waste	GHG emissions from transportation and disposal of earthworks/ pre-construction waste
	Land clearance	GHG emissions associated with the loss of carbon stock

Lifecycle Stage	Activity	Primary Emissions Sources
Product Manufacture	Raw material extraction and manufacturing of products/ materials	Embodied GHG emissions associated with product and material manufacture
	Transport of products/ materials to Site	GHG emissions from fuel consumption of transportation of products and materials to the Scheme
Construction	On-site construction activity	Energy (electricity, fuel, etc.) consumption from plant and vehicles, generators on-site, and material consumption
	Transport of construction workers	Energy (electricity, fuel, etc.) consumption from worker commuting
	Transportation and disposal of earthworks/ waste	GHG emissions from transportation and disposal/treatment of earthworks/ construction waste
Operations	Operation of the Scheme	GHG emissions from energy use and additional traffic
	Transportation and disposal of waste	GHG emissions from transportation and disposal of waste
	Building and grounds maintenance	GHG emissions associated with replacement materials/products
	Emissions displacement	Avoided or displaced emissions through use of any renewable energy systems or offsetting
Decommissioning	Removal and / or renewal of the Scheme	GHG emissions arising from fuel consumption for plant and vehicles and disposal of materials

CCR Review

7.4.12 The EIA Regulations (Ref 7-1) require the inclusion of information on the vulnerability of the Scheme to climate change. Consequently, an assessment of climate change resilience for the Scheme has been undertaken which identifies potential climate change impacts in accordance with IEMA Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation (Ref 7-26).

7.4.13 The assessment has included all infrastructure and assets associated with the Scheme. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the United Kingdom Climate Projections 2018 (UKCP18) (Ref 7-27).

7.4.14 The assessment of potential impacts and the Scheme's vulnerability considers the mitigation measures that have been designed into the Scheme, as discussed in **Section 7.7**. Potential impacts considered include higher temperatures and more extreme rainfall events.

7.4.15 The assessment also identifies and accounts for existing resilience measures for each risk either already in place or development for infrastructure and assets.

7.4.16 Climate parameters considered in the CCR Review during construction, operation and decommissioning of the Scheme include the following:

a. Extreme weather events;
b. Flood risk;
c. Temperature change and;
d. Precipitation change.

7.4.17 Once potential climate risks have been identified, the likelihood of their occurrence during the project phase is categorised. Likelihood is categorised into five levels depending on the probability of the hazard occurring. **Table 7-2** presents the likelihood levels and definitions used. This is in line with the definitions presented in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (Ref 7-29).

Table 7-2: Climate Risk Likelihood Descriptions

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

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

7.4.18 The consequence of an impact has been measured using the criteria detailed in **Table 7-3**. The probability and consequence have taken into account embedded design and impact avoidance measures.

Table 7-3: Climate Consequence Descriptions

Level of consequence of climate impact	Definition of Consequence
High	Significant disruption to construction and operations, unable to deliver services, resulting in high financial losses.
Moderate	Disruption to construction and operations and ability to deliver services, resulting in some financial losses/ cost implications.
Low	Minor disruption to construction and operations but does not significantly impact ability to deliver services.
Negligible	Negligible disruption to construction and operations, does not impact ability to deliver services.

In-Combination Climate Change Impact (ICCI) Assessment

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

Significance Criteria

Lifecycle GHG Impact Assessment

7.4.20 IEMA guidance (Ref 7-24) states there are currently no agreed methods to evaluate thresholds of GHG significance, and that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments. Professional judgement is therefore required to contextualise a project's GHG emissions impacts.

7.4.21 The IEMA guidance explains that "*the crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050*".

7.4.22 **Table 7-4** presents the different significance levels as per the latest version of IEMA guidance (Ref 7-24). The guidance emphasises that "*a project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area-based transition targets, results in a significant adverse effect. It is down to the practitioner to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects".*

7.4.23 Moderate, major adverse, and beneficial effects are deemed significant while all other significance levels are deemed to be not significant.

Table 7-4: GHG Impact Assessment Significance Criteria

Effect	Definition	Significant
Major Adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to UK's trajectory towards net zero.	Yes
Moderate Adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.	Yes

Effect	Definition	Significant
Minor Adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.	No
Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.	No
Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive impact.	Yes

7.4.24 As noted, in accordance with IEMA guidance the practitioner must exercise professional judgement on how best to contextualise a project's GHG impact. In GHG accounting, it is considered good practice to contextualise emissions against pre-determined carbon budgets. The UK has defined national carbon budgets set by industry bodies which have been determined as compatible with the net zero trajectory and international climate commitments. For this Scheme, the most appropriate sector carbon budget is for the electricity supply sector as defined in the Carbon Budget Delivery Plan (Ref 7-25). The electricity supply sectoral carbon budgets (**Table 7-5**) are in place to track the sector's pathway to carbon neutrality by 2050. Progress against these budgets is reviewed annually and future budgets are set 12 years in advance.

7.4.25 To assess the impact of GHG emissions form the Scheme, the carbon budgets for the electricity supply sector have been used as a proxy for the climate (**Table 7-5**). To provide further perspective, emissions from the Scheme have also been considered in the context of the UK carbon budgets (**Table 7-5**). The UK carbon budgets are in place to restrict the amount of GHG emissions the UK can legally emit in a five-year period. The UK is currently in the 4th Carbon Budget period, which runs from 2023 to 2027. The

5th Carbon Budget reflect the previous 80% reduction target by 2050. The 6th Carbon Budget aligns with the legislated 2050 net zero commitment.

7.4.26 UK national carbon budgets are currently only available to 2037 (Ref 7-30). The Carbon Budget Order 2021 (Ref 7-7), containing details of the 6th Carbon Budget for the period 2033-2037 was signed into law in June 2021. Beyond 2037, the Committee on Climate Change (CCC) has not issued formal advice on upcoming carbon budgets, though the CCC has published annual emissions totals that are consistent with a so-called Balanced Net Zero Pathway, and it is possible to aggregate these annual figures into indicative 5-year totals for the 7th, 8th and 9th Carbon Budget periods.

7.4.27 **Table 7-5** shows the approved UK carbon budgets up to 2037, which highlights the reduction in the amount of GHG the UK can legally emit in the future. Beyond 2037, the table shows indicative carbon budgets derived from the CCC's Balanced Net Zero Pathway. Any source of emissions contributing to the UK's carbon inventory will have a greater impact on the UK's future carbon budgets.

7.4.28 A qualitative approach has been taken for assessing the significance of GHG emissions arising as a result of the Scheme for the years beyond 2037. A quantitative approach is not possible beyond 2037, as although the carbon budges are set to decrease over time there will still be permitted GHG emissions beyond 2050, though these will require offsetting measures to ensure net emissions are zero. The rate at which they will decrease is not known, so it is not possible to predict the quantity of emissions permitted within the carbon budgets beyond 2037.

7.4.29 The earliest that the construction phase of the Scheme is estimated to commence is Q3 2025, with operation subsequently beginning in Q4 2027. Construction is therefore expected to fall within the period of the 4th UK national Carbon Budget which runs from 2023-2027.

7.4.30 Where possible, the operational phase of the Scheme (from 2028) has been compared to the relevant and available carbon budgets within the design life of the Scheme: the 4th, 5th and 6th Carbon Budgets covering the periods 2023-2027, 2028-32 and 2033-37, respectively. Beyond 2037, the operational phase of the Scheme has been compared to indicative carbon budgets.

7.4.31 As sectoral (electricity supply) carbon budgets exist, the UK carbon budgets have been used as a secondary measure to contextualise the impact of the Scheme.

7.4.32 It is noted that the contribution of most individual projects to national-level budget will be small and so the UK context will have limited value. This GHG emissions assessment therefore uses the IEMA guidance to assess the significance of effects (**Table 7-4**), with both sectoral and UK carbon budgets being used to provide context to the GHG emissions (**Table 7-5**).

Table 7-5: Electricity Sector Carbon Budgets

Carbon Budget	Total Budget ($MtCO_2e$)	Sectoral Carbon Budget Year	Annual Sectoral Carbon Budget ($MtCO_2e$)
4th (2023-2027)	2,544	2023	44.01
		2024	44.44
		2025	41.65
		2026	32.36
		2027	26.70
5th (2028-2032)	1,950	2028	23.75
		2029	22.40
		2030	18.55
		2031	15.77
		2032	12.09
6th (2033-2037)	1,725	2033	9.86
		2034	8.00
		2035	6.20
		2036	6.01
		2037	5.67
7th (2038-2042)	526	2038	5.52
		2039	5.39
		2040	5.11
		2041	3.75
		2042	3.45
8th (2043-2047)	195	2043	3.32

Carbon Budget	Total Budget ($MtCO_2e$)	Sectoral Carbon Budget Year	Annual Sectoral Carbon Budget ($MtCO_2e$)
		2044	3.15
		2045	2.27
		2046	2.02
		2047	1.61
9th (2048-2050)	17	2048	1.49
		2049	1.33
		2050	1.21

7.4.33 From 2050 onwards, the UK is legally obliged to offset any residual emissions in line with its net zero target for 2050. Therefore, over time, the level of impact of any emissions, or emissions reductions, could be considered to become more significant in the context of the UK meeting its carbon reduction target as the quantity of permitted emissions gets smaller.

CCR Review

7.4.34 The significance of CCR is determined as a function of the likelihood of a climate change risk occurring and the consequence to the receptor if the hazard occurs. This is detailed in **Table 7-6**. Where a risk is determined as high or moderate, this has been deemed significant. Low and negligible risks are classified as not significant.

Table 7-6: CCR Significance Criteria

		Measure of Consequence			
Likelihood of climate-related impact occurring		Negligible	Low	Moderate	High
	Negligible	Negligible	Low	Low	Low
	Low	Low	Low	Low	Moderate
	Moderate	Low	Low	Moderate	High
	High	Low	Moderate	High	High

In-Combination Climate Change Assessment

7.4.35 The significance of likely effects is determined using the matrix in **Table 7-6**. Where an effect has been identified as a moderate or high, it is classed as a significant ICCI effect. If significant ICCI effects are assessed, then appropriate additional mitigation measures (secondary mitigation) are identified.

7.5 Stakeholder Engagement

7.5.1 A request for an EIA Scoping Opinion, **Appendix 1-2: EIA Scoping Opinion** of this ES **[EN010142/APP/6.2]**, was sought from the Secretary of State through the Planning Inspectorate in 2022 as part of the EIA Scoping Process for the Scheme. A summary of consultation responses relating to climate change, to date, are presented in **Table 7-7**.

Table 7-7 Scoping Opinion Responses (Climate Change)

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
Planning Inspectorate	Inspectorate disagrees with the scoping out of an in combination climate change impact assessment (ICCI)	ICCI assessment has been included in this chapter of the ES.	Results presented in **Section 7.8**
	Scoping out increased wind as a climate variable in the climate risk assessment. The Inspectorate agrees	No response required	**Section 7.6**
	The scoping out of precipitation as a variable in the climate risk assessment. The Inspectorate disagrees.	Precipitation change is scoped into this ES.	**Sections 7.6-7.8**
	Clarity of which forms of electricity will be displaced by energy generated by the Scheme.	For the purpose of this assessment, energy produced by the Scheme is considered to displace that generated by natural gas fuelled CCGT	**Section 7.8**
	This assessment should include a description and assessment of any likely significant effects resulting from the vulnerability of the Scheme to climate change. Where relevant, it should describe and assess the adaptive capacity that has been incorporated into the design of the Scheme.	The CCR assessment addresses all likely significant effects that could result from the vulnerability of the Scheme to climate change. The adaptive capacity incorporated into the design of the Scheme is summarised in the section of this chapter on Embedded Mitigation.	**Sections 7.7-7.8**
Bassetlaw District Council	Any efforts to reduce carbon emissions from the project itself should be scoped into the ES. Please note Policies ST50 and ST51 from the emerging Draft Bassetlaw Local Plan and	Measures incorporated into the design of the Scheme to reduce potential carbon emissions is discussed in the section of this chapter on Embedded Mitigation. The assessment has	**Section 7.7** **Appendix 7-1 [EN010142/APP/6.2]**

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
	Policy DM10 from the Bassetlaw Core Strategy.	been undertaken in line with policies ST50, ST51 and DM10, which are taken into consideration in **Appendix 7-1: Climate Change Legislation, Policy and Guidance** of this ES **[EN010142/APP/6.2]**.	
Fillingham Parish	To what extent the scheme may be assessed in terms of its ability to contribute to the targets set in the Climate Change Act 2008. Applying such large-scale solar schemes without overall consideration of the wider balancing of the National Grid will lead to waste and inefficiency. Tillbridge Solar is encouraged to explicitly and transparently describe the role the scheme is expected to play in the transition to a low-carbon economy	The GHG assessment considers the contribution of the Scheme to UK carbon budgets, with attention specifically given to the role of the Scheme in facilitating the transition to a low carbon energy network.	**Section 7.8**
Glentworth Parish Council	What is the wider environmental impact of the project (manufacture of components, transportation from source and materials involved in construction); a description of the infrastructure associated with solar panels, the environmental impact of decommissioning the solar farm after its 40-year lifetime; the reasoning for choosing solar over other more locally manufactured energy such as wind.	The GHG assessment considers the whole life cycle GHG impacts of the scheme including embodied carbon within materials, their transportation, and construction activities. The **Statement of Need [EN010142/APP/7.1]** sets out the role and need for large solar and storage schemes to contribute towards the decarbonisation of the UK.	**Section 7.8** **Statement of Need**: Chapters 6 to 9 **[EN010142/APP/7.1]**.

7.5.2 Further consultation in response to formal pre-application engagement was undertaken through the Preliminary Environmental Information (PEI) Report. **Table 7-8** outlines the statutory consultation responses relating to climate change and how these have been addressed through the ES. Responses have been grouped thematically where relevant, but all relevant consultees are listed. No additional comments were received in relation to climate change during the subsequent round of targeted consultation.

Table 7-8 Main matters relevant to climate change impacts raised through the Statutory Consultation

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
Stow Parish Council	As far as we are aware, solar PV panels are not manufactured in UK or Europe. The associated carbon (and other pollutants) production during manufacture and transportation followed by construction of this site is not to be taken lightly. What mitigation will be used to offset the manufacture and transportation of the panels.	The manufacture and transportation of the solar PV panels have been considered in the assessment of the lifetime GHG impact of the Scheme. Mitigation of these impacts will be achieved though the reduction in fossil fuel consumption and contributing to the decarbonisation of the national electricity grid.	Sections 7.7-7.8
Bassetlaw District Council	Climate change (including the impact of the development itself) has been scoped into the PEIR which is welcomed by the Local Planning Authority. The chapter within the PEIR itself appears comprehensive and assesses key baselines. Although the development itself will inevitably produce some carbon emissions, especially during the construction and decommissioning phases, it is clear that these will be more than mitigated for by the provision of 1,065,000MWh of clean energy per annum. Nevertheless, efforts to	Carbon emissions associated with the construction, operation and decommissioning is considered in the GHG impact assessment contained within this chapter. Further options to reduce the carbon impact of the Scheme will be actively considered throughout the detailed design and construction phases.	Sections 7.7-7.8

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
	reduce carbon emissions produced by the project should be carried forward.		
Resident	Respondents noted their concern about climate change and the challenge the world faces and that habits need to change to reduce environmental impact and try and reverse some of the damage that has been done to date. Respondents also suggested that the Government has ignored climate change for too long and at the expense of future generations and young adults alive today.	This Scheme, and other renewable energy projects across the UK, contributes to a tangible effort nationwide of achieving net zero emissions by 2050. The decarbonisation of the electricity grid is a vital part of this commitment which can only be realised through the development of projects such as the Scheme.	**Section 7.8**
Resident	Respondents noted that burning fossil fuels is not sustainable but noted that the production of solar panels is also environmentally damaging. The lost potential food production coupled with energy insecurity is a challenge for us all.	The GHG impact of the construction of solar PV panels has been considered in the GHG impact assessment section of this chapter**, Section 7.8**. Similar projects have demonstrated a significant improvement in lifetime GHG emissions for solar installations when compared to traditional fossil fuel energy sources. Additionally, diversifying the electricity grid will only benefit energy security. While the site selection was initially driven from an established point of connection to the national grid, the Applicant has considered many factors in determining the site selection for the Scheme including environmental and planning considerations and designations.	**Section 7.8** **Chapter 2: Scheme Location [EN010142/APP/6.1]**. **Chapter 4: Alternatives and Design Evolution [EN010142/APP/6.1]**.

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
		Consideration has also been given to minimise the use of any Best and Most Versatile Land (grade 1, 2 or 3a). This has been minimised where possible within the Scheme.	
Resident	Concerns were raised about carbon emissions in the manufacturing and installation of the project and disruption to the local community.	The GHG impact of the construction of solar PV panels has been considered in the GHG impact assessment section of this chapter. Similar projects have demonstrated a significant improvement in lifetime GHG emissions for solar installations when compared to traditional fossil fuel energy sources. Additionally, diversifying the electricity grid will only benefit energy security. The effects of the Scheme on local communities and Public Rights of Way (PRoW) are considered within **Chapter 14: Socio-Economics and Land Use** of the ES **[EN010142/APP/6.1]**. The Applicant recognises that construction activity can be disruptive and has the potential to impact upon local communities. The Applicant has assessed the likely impacts of construction within the technical chapters of the ES submitted as part of the DCO application. Where significant impacts have been identified, the Applicant is proposing mitigation which is outlined in the **Framework Construction Environmental Management Plan (CEMP) [EN010142/APP/7.8]**.	**Section 7.8** **Chapter 14: Socio-Economics and Land Use [EN010142/APP/6.1]**. **Framework CEMP [EN010142/APP/7.8]**

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
Resident	Respondents noted concerns around the impact of global warming, noting that science suggests we are going over 1.5C of warming and nearly 1.3C of global heating.	This Scheme comprises part of the UK Government's commitment to achieve net zero emissions by 2050. This will assist in limiting further global temperature increases.	**Section 7.8**
Resident	Respondents suggested that climate change is normal and there is not an emergency. Respondents also suggested that scientific evidence is variable and opinions differ.	The development of this Scheme is part of the Government's legal commitment to achieve net zero carbon emissions by 2050. More details on the severity and the supporting scientific evidence for climate change can be found in the IPCC's Sixth Assessment Report. https://www.ipcc.ch/report/sixth-assessment-report-cycle/	**Section 7.8**
Resident	Respondents were concerned that the scheme is being developed for commercial gain, rather for the benefit of climate change.	Projects such as this Scheme are a vital component of the UK Government's commitment to achieve net zero carbon emissions by 2050. A detailed assessment of the carbon benefits are presented within this chapter.	**Section 7.8**
Resident	Respondents recognised that Climate change is an issue, but farmland shouldn't be lost to solar panels. Respondents recognised that solar panels should be on all new builds and the numerous warehouses across the country.	The Applicant has considered many factors in determining the site selection for the Scheme including environmental and planning considerations and designations. The site selection was initially driven from an established point of connection and consideration has been given to minimise the use of any Best and Most Versatile Land (grade 1, 2 or 3a). This has been minimised where possible within the Scheme. Consideration was also given to the available brownfield land on the register. The brownfield land that was	**Section 7.3** **Statement of Need**: chapters 6 to 9 **[EN010142/APP/7.1]**.

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
		identified was less than 5ha in size or already allocated within the emerging local policy at the time of the search. Therefore, it was concluded that there was no available or suitable brownfield land for the Scheme. In order to achieve net zero, the use of rooftops is not sufficient to meet the growing energy demands alongside the decarbonisation of the energy sector. Powering up Britan Strategy concludes that an acceleration of the delivery of renewables is necessary to achieve net zero including a quintuple of our solar power by 2035. Therefore, large scale solar developments are needed such as the Scheme. The Statement of Need **[EN010142/APP/7.1]** discusses the need for large scale solar projects to contribute to the UKs net zero goals.	
Resident	Respondents questions whether GHG emissions associated with the manufacture, transport, construction had been considered and why it had been phased as 'not significant'. Respondents were also concerned about pollution from maintenance, disposal, fire risks.	The GHG impact of the construction of solar PV panels has been considered in the GHG impact assessment of this chapter. Similar projects have demonstrated a significant improvement in lifetime GHG emissions for solar installations when compared to traditional fossil fuel energy sources. The significance of the GHG impact of the Scheme, been assessed in line with current IEMA guidance.	**Section 7.4**
Resident	Respondents questioned how the phase 'helping the UK to achieve net zero by 2050' can be justified	While there may be a margin of error within carbon accounting, significant efforts are being made to quantify all emissions sources across the UK, particularly when it comes to new developments. For this Scheme in	**Section 7.8**

Consultee	Summary of main matter raised	How has the matter been addressed?	Location of response in the chapter
	given the unquantified level of GHG emissions.	particular, a detailed GHG impact assessment has been carried out, quantifying all emissions associated with the construction, operation and decommissioning of the Scheme. This has been compared to traditional fossil fuel sources of energy to demonstrate how this Scheme will contribute to the goal of achieving net zero emissions by 2050.	
Resident	Concerns were raised about solar panels being made in China, predominantly with energy from fossil fuels. Respondents were also concerned about a large carbon footprint before the Scheme operational and the number of years to negate the impact.	GHG emissions associated with the construction and transport of solar panels to Site have been considered in this GHG impact assessment. GHG savings of the solar installation have been compared to emissions associated with fossil fuel energy production over the intended design life of the Scheme (60 years). As presented in the 'Assessment of Likely Impacts and Effects' (Section 7.8) the Scheme will result in a net reduction of GHG emissions over its lifespan and represents an overall carbon benefit.	**Section 7.8**

7.6 Baseline Conditions

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

Existing Baseline

Lifecycle GHG Impact Assessment

7.6.2 The land within the Order limits consists mainly of Agricultural Land Classification (ALC) Grade 3b (moderate quality agricultural land) with some Grade 3a (good quality agricultural land). Baseline agricultural GHG emissions are dependent on soil and vegetation types present, and fuel use for the operation of vehicles and machinery.

7.6.3 While the current land use within the Order limits will have minor levels of associated GHG emissions, it is anticipated that these emissions will not be material in the context of the overall Scheme. Therefore, for the purposes of the lifecycle GHG impact assessment, a GHG emissions baseline of zero is applied. This represents a worst-case assessment for the purposes of the GHG calculations.

CCR Assessment and ICCI Assessment

7.6.4 The current baseline for the CCR review and ICCI assessment is the current climate in the location of the Scheme. Historic climate data obtained from the Met Office (Ref 7-28) recorded by the closest Met Office station to the Scheme (Scampton) for the 30-year climate period of 1981-2010 (the standard baseline for climate data) is summarised in **Table 7-9** below.

Table 7-9. Baseline Climate Data

Climate Factor	Month	Figure
Mean annual maximum daily temperature (°C)	-	13.44 °C
Mean annual minimum daily temperature (°C)	-	5.74 °C
Mean Summer maximum daily temperature (°C)	-	20.38 °C
Mean Winter minimum daily temperature (°C)		0.84 °C
Frost days per annum (days)		49.77 days

Climate Factor	Month	Figure
Warmest month on average (°C)	July	21.32 °C
Coldest month on average (°C)	February	0.64 °C
Mean annual rainfall level (mm)		613.15 mm
Mean Summer rainfall (mm)		173.73 mm
Mean Winter rainfall (mm)		138.51 mm
Wettest month on average (mm)	June	60.48 mm
Driest month on average (mm)	February	35.93 mm

7.6.5 The Met Office historic 30-year averages for the England North and East region identify gradual warming between 1961 and 2020, with increased rainfall. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm/year) is summarised in **Table 7-10**.

Table 7-10: Historical Climate Averages

Climate Period	Mean maximum annual temperatures (°C)	Mean annual rainfall (mm/yr)
1961-1990	11.94	745.85
1971-2000	12.25	748.30
1981-2010	12.63	773.70
1991-2020	12.99	793.06

Future Baseline

Lifecycle GHG Impact Assessment

7.6.6 The future baseline for the GHG assessment is a business-as-usual position where the Scheme does not go ahead. The same assumptions as for the current baseline will apply, in that while the current land use within the Scheme will have minor levels of associated GHG emissions and minor carbon sequestration from vegetation, it is anticipated these will not be material in the context of the overall Scheme.

7.6.7 Therefore, for the purpose of the GHG assessment, the future baseline for the GHG assessment is considered to be zero.

CCR Assessment and ICCI Assessment

7.6.8 The future baseline is expected to differ from the present-day baseline conditions described above. UKCP18 provides probabilistic climate change projections for pre-defined 20-year periods for annual, seasonal and monthly changes to mean climatic conditions over land areas. For the purposes of the assessment, UKCP18 probabilistic projections for pre-defined 20-year periods for the following average climate variables have been obtained.

a. Mean annual temperature;
b. Mean summer temperature;
c. Mean winter temperature;
d. Maximum summer temperature;
e. Minimum winter temperature;
f. Mean annual precipitation;
g. Mean summer precipitation; and
h. Mean winter precipitation.

7.6.9 Projected temperature and precipitation variables are presented in **Table 7-11**. UKCP18 probabilistic projections have been analysed for the 25 km^2 grid square within which the Scheme is located. These figures are expressed as anomalies in relation to the 1981-2010 baseline.

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

7.6.11 As the anticipated life of the Scheme is at least 60 years, the CCR and ICCI assessments have considered a scenario that reflects a high level of GHG emissions (RCP8.5) at the 10%, 50% and 90% probability levels up to 2099 to assess the impact of climate change over the assessed lifetime of the Scheme. It is noted that the UKCP18 data to cover this period runs to 2099, beyond the 60 year lifespan, however this approach is considered conservative to allow flexibility in the length of the Scheme's lifetime.

Table 7-11: Future Climate Baseline Projections (UKCP18)

Climate Variable	Time Period		
	2020-2049	**2050-2079**	**2070-2099**
Mean annual air temperature anomaly at 1.5m (°C)	+1.1 (+0.5 to +1.6)	+2.3 (+1.3 to +3.5)	+3.5 (+2.1 to +5.1)
Mean summer air temperature anomaly at 1.5m (°C)	+1.3 (+0.4 to +2.1)	+2.9 (+1.4 to +4.5)	+4.5 (+2.3 to +6.8)
Mean winter air temperature anomaly at 1.5m (°C)	+0.9 (+0.2 to +1.7)	+2.0 (+0.7 to +3.5)	+3.0 (+1.2 to +5.0)
Maximum summer air temperature anomaly at 1.5m (°C)	+1.4 (+0.3 to +2.5)	+3.3 (+1.2 to +5.3)	+5.0 (+2.2 to +7.9)
Minimum winter air temperature anomaly at 1.5m (°C)	+0.9 (+0.1 to +1.8)	+2.1 (+0.6 to +3.8)	+2.9 (+1.2 to +4.8)
Annual precipitation rate anomaly (%)	+0.2 (-6.6 to +6.8)	-2.3 (-11.5 to +6.9)	-2.4 (-13.8 to +9.3)
Summer precipitation rate anomaly (%)	-3.7 (-21.4 to +14.3)	-20.9 (-44.1 to +2.8)	-30.7 (-55.1 to -3.8)
Winter precipitation rate anomaly (%)	+3.5 (-4.3 to +12.1)	+10.2 (-2.7 to +25.5)	+16.5 (-0.9 to +36.8)

7.7 Embedded Mitigation Measures

Lifecycle GHG Impact Assessment

7.7.1 A range of mitigation has been embedded into the Scheme to mitigate the impacts of the Scheme on the climate. Below are the measures included in the **Framework CEMP [EN010142/APP/7.8]**, and **Framework Decommissioning Environmental Management Plan (DEMP) [EN010142/APP/7.10]** prepared to accompany the DCO application and secured as necessary through a requirement of the **draft DCO [EN010142/APP/3.1]**:

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

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

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

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

e. Implementing measures in accordance with the **Framework Construction Traffic Management Plan (CTMP) [EN010142/APP/7.11]** to reduce the volume of construction staff and employee trips to the Scheme, while encouraging the use of lower carbon modes of transport by identifying and communicating local bus connection and pedestrian/cycle access routes to/from the Scheme to all construction staff, and providing appropriate facilities for the safe storage of cycles;

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

g. Conducting regular planning maintenance of the construction/decommissioning plant and machinery to optimise efficiency.

CCR Assessment and ICCI Impact Assessment

7.7.2 Multiple embedded mitigation measures have been incorporated into the Scheme design to mitigate the impacts of climate change on the Scheme and the in-combination impacts on nearby receptors.

7.7.3 The **Framework CEMP [EN010142/APP/7.8]** and **Framework DEMP** [**EN010142/APP/7.10]** sets out measures for the management of activities within floodplain areas during construction (i.e. to be kept to a minimum and with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable). In addition, the **Framework CEMP [EN010142/APP/7.8]** incorporates measures to prevent an increase in flood risk during the construction works, including the provision of temporary settlement and drainage measures. Further measures to reduce flood risk include:

a. Topsoil and other construction materials will be stored outside of the 1-in-100 year floodplain extent where feasible. If areas located within Flood Zone 2/3 are to be utilised for the storage of construction materials, this would be done in accordance with the applicable flood risk activity regulation, if required.

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

c. During the construction/decommissioning phase, the contractor will monitor weather forecasts on a monthly, weekly and daily basis, and plan works accordingly. For example, works in the channel of any watercourse will be avoided or halted were there to be a significant risk of high flows or flooding.

d. The construction laydown area site office and supervisor will be notified of any potential flood occurring by use of the Floodline Warning Direct or equivalent service.

7.7.4 Details to manage flood risk during construction and operation are included in **Appendix 10-3: Flood Risk Assessment** of this ES **[EN010142/APP/6.2]**. In addition, **Appendix 10-4: Outline Drainage Strategy** of this ES **[EN010142/APP/6.2]** sets out that attenuation in the form of Sustainable Drainage Systems (SuDS) will be incorporated to control any increase in the rate of flow towards receiving watercourses including allowances for climate change.

7.7.5 Further detail on embedded measures to mitigate flood risk and the location of floodplains within the Order limits can be found in **Chapter 10: Water Environment** and **Appendix 10-3: Flood Risk Assessment** of this ES **[EN010142/APP/6.1]**.

7.7.6 Mitigation measures to protect against the adverse effects of climate change on the natural environment within the Order limits can also be found in **Chapter 15: Soils and Agriculture [EN010142/APP/6.1]** and the **Framework Landscape and Ecology Management Plan (LEMP) [EN010142/APP/7.17]**. These measures include:

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

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

7.8 Assessment of Likely Impacts and Effects

Lifecycle GHG Impact Assessment

7.8.1 The impacts and effects (both beneficial and adverse) associated with the construction, operation (including maintenance), and decommissioning of the Scheme (as described in **Chapter 3: Scheme Description** of this ES **[EN010142/APP/6.1]**) are outlined in the sections below. The assessment has been completed using a combination of project specific data and benchmarks based on other similar capacity UK solar farm schemes.

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

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

Construction (2025-2027)

7.8.4 GHG impacts during the construction phase consist primarily of the embodied carbon associated with the manufacture of battery and solar PV components. The manufacture of the PV panels is estimated to account for 429,125tCO_2e, with the BESS providing a further contribution of 358,050tCO_2e. **Table 7-12** summarises the emissions resulting from the manufacture of components required for construction.

Table 7-12: Materials Embodied Emissions

Emissions Source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
PV Panels	399,328	46%
Combiner Boxes	48,631	6%
Inverters	48,631	6%
Switchgears	336	<1%

Emissions Source	Embodied emissions (tCO_2e)	Proportion of total embodied emissions
Transformers	6,668	<1%
BESS	358,050	39%
Converters	9,114	1%
Cabling	408	<1%
Concrete	1,058	<1%
Steel	1,435	<1%
CCTV	221	<1%
Fencing	516	<1%
Road/Aggregates	647	<1%
Total Products	875,043	

7.8.5 Other sources of emissions during construction within the scope of the GHG emissions assessment included water, energy and fuel use for construction activities, transportation of materials and workers to the Order limits and the transportation and disposal of waste.

7.8.6 Based on the assumptions listed in **Section 7.3** total GHG emissions from the construction phase are estimated to equate to 910,126tCO_2e. **Table 7-13** below summarises the overall construction emissions and their source.

Table 7-13. Construction Phase Emissions Sources

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total embodied emissions
Products and Materials	875,043	96%
Transportation of products and materials	28,100	3%
Worker commuting	5,029	<1%
Waste (including transport)	94	<1%

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total embodied emissions
Fuel use	1,858	<1%
Water use	2	<1%
Total Construction	**910,126**	

Operation (2028-2088)

7.8.7 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 Order limits, and maintenance activities (including embodied carbon in replacement parts, plant and machinery requirements, fuel and water use during maintenance activities, transportation of material and waste transport from the Order limits).

7.8.8 It is assumed that the annual grid energy requirement for operations at the Scheme will equate to 9.69 GWh per year. The UK Government published projections of grid carbon intensity for each year to 2100, with the emissions per kWh of electricity generated set to decline over the period to 2050. Operational energy emissions will therefore be highest in year one of operation, and decrease thereafter. Applying these projected grid factors, emissions in the first year of operations are estimated to be 561tCO_2e, falling to 22tCO_2e/year by 2050, by which time the national grid is assumed to be substantially decarbonised. Lifetime emissions from grid power consumption total 5,007tCO_2e. This is assuming a worst-case scenario where the energy required will not be drawn directly from the solar PV or BESS.

7.8.9 Based on the proposed maintenance rate for the required components (PV panels, inverters, cabling, transformers, BESS and converters) as described in **Section 6.3**, and applying the same embodied and transportation emissions used for the construction phase, the replacement of these components is estimated to result in embodied emissions of 2,376,964tCO_2e, an additional 63,007tCO_2e from transport to the Order limits, and 23,324tCO_2e from the transport and disposal of replaced components.

7.8.10 With the exception of the emissions data for PV panels, which have been derived from an EPD, the embodied carbon factors on which these figures are based are subject to considerable uncertainty. Furthermore, the BESS system is required to be replaced on average every 10 years and this results in a considerable embodied carbon impact. However, replacements that occur later in the design life of the Scheme will likely have a lower carbon impact due to increased efficiency of manufacturing, ongoing decarbonisation of electricity consumed during the manufacturing process, and the availability of more reliable and accurate data.

7.8.11 As discussed in **Section 7.3**, land use change is anticipated to have a beneficial impact during the lifetime of the Scheme. However, as this beneficial impact is largely reversed during decommissioning, the GHG impact associated with land use change has been excluded from the lifecycle GHG impact assessment. This is assumed to represent a robust worst-case scenario as some areas of ecological mitigation and grasslands may remain after decommissioning.

7.8.12 Total operational emissions over the design life of the Scheme are estimated at 2,470,621tCO_2e. Over 99% of these emissions are associated with the materials and transport of the replacement components required throughout operation. The largest proportion of this (1,852,892tCO_2e) relates to the replacement of the BESS at 10 year intervals throughout the Scheme's lifecycle. **Table 7-14** below summaries operational emissions and their sources.

Table 7-14: Operational Phase Emissions Sources

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total operational emissions
Maintenance (Replacement Components)	2,463,295	99%
Staff Transport	2,293	<1%
Energy Use	5,007	<1%
Water Use	25	<1%
Operations Total	2,470,621	

Decommissioning (2088)

7.8.13 GHG emissions from the decommissioning phase are subject to a high degree of uncertainty, as the conditions that will apply in 2088 cannot be described with any confidence. For the purposes of this assessment, it is assumed that decommissioning emissions from the use of plant, worker travel and waste replicate the emissions produced during the construction phase. This is likely to be a conservative estimate as the emissions associated with these activities are anticipated to decrease into the future.

7.8.14 Emissions from the disposal and recovery of materials and components at the end of the Scheme's design life have been estimated based on the assumption that 100% of materials and components will go to landfill. This calculation is also likely to be a conservative estimate as it is anticipated that recycling rates will increase into the future. Emissions from the end-of-life disposal of all material and products is estimated at 1,197tCO_2e.

7.8.15 Emissions from the transportation of materials and products at end of life have been estimated on the assumption that disposal will occur 100km from the Site. Applying the most recent DESNZ emissions factor (Ref 7-20) for HGV travel gives end of life transport emissions of 3,766tCO_2e. This is likely to be an overestimate as HGV transport decarbonises into the future.

7.8.16 Land use change has been excluded from the GHG assessment as discussed in **Section 7.3**, due to the beneficial GHG impacts of conversion of cropland to grassland during operation being returned to cropland following the decommissioning of the Scheme, with any carbon stored in soil or vegetation re-released to the atmosphere. This is considered to be a robust worst-case approach and is likely to underestimate the beneficial effect of the Scheme as some vegetation may be retained after decommissioning.

7.8.17 **Table 7-15** summarises the emissions resulting from the decommissioning phase.

Table 7-15: Decommissioning Phase Emissions Sources

Emissions Source	Carbon Emissions (tCO_2e)	Proportion of total decommissioning emissions
Fuel Use	1,858	16%
Worker Transport	5,029	42%
Waste	1,197	10%
Water Use	2	<1%
Materials Transport	3,766	32%
Decommissioning Total	11,853	

Total GHG Impact

7.8.18 Lifetime emissions from the construction, operation and decommissioning of the Scheme are summarised in **Table 7-16**. The total GHG emissions over the Scheme lifetime is 3,377,116tCO_2e.

Table 7-16: GHG Impact Summary

Lifecycle Phase	Carbon Emissions (tCO_2e)	Proportion of total emissions
Construction	910,126	26.8%

Lifecycle Phase	Carbon Emissions (tCO_2e)	Proportion of total emissions
Operation	2,470,621	72.8%
Decommissioning	11,853	0.3%
Total	3,392,600	

Carbon Intensity of the Scheme

7.8.19 Renewable energy generation from the Scheme during the first year of operation is estimated to be 866,394MWh, taking into consideration a 2% reduction in PV panel performance during the first year. A 0.45% degradation factor has been applied for each subsequent year, and the entire array is assumed to be replaced midway through the design life of the Scheme, resulting in an estimated generation figure of 751,022MWh in the final year of operation, and a total energy generation figure of 48.5TWh over the 60-year Scheme lifetime.

7.8.20 Dividing this lifetime generation figure into lifetime emissions total (**Table 7-16**) gives a total carbon intensity value of 70.0gCO_2e/kWh.

7.8.21 The current UK grid carbon intensity is 207CO_2e/kWh, however these figures are not suitable for direct comparison as the published UK grid carbon intensity figure only takes into account the operational emissions from the generation of electricity, the majority of which is fossil fuels used to power gas-fired and occasionally coal-fired power stations. For an appropriate comparison to be made between the Scheme and the UK grid, only the operational carbon emissions should be considered when assessing the carbon intensity of the Scheme, excluding emissions at the construction and decommissioning phase.

7.8.22 When only considering operational emissions, the carbon intensity of the Scheme falls to 50.9gCO_2e/kWh. This figure still includes the embodied carbon of replacement of infrastructure which represents over 99% of the carbon footprint of the scheme.

7.8.23 The carbon intensity of the most carbon-efficient fossil-fuelled technology currently available, a CCGT generation facility, is 354gCO_2e/kWh (Ref 7-31). The operational carbon intensity of the Scheme is therefore 86% lower than that of the counterfactual CCGT or 80% lower when considering the whole life carbon of the Scheme (i.e. including the construction and decommissioning phases).

7.8.24 When considering whole life carbon emissions, the Scheme would represent a saving of over 15 million tonnes CO_2e, relative to the counterfactual CCGT.

7.8.25 Various other low-carbon energy generation methods are available, such as on and offshore wind , biomass and nuclear power. Each of these technologies will have a different carbon intensity in terms of total emissions per kWh of electricity generated. Additionally, each specific instance of these technologies will have a varying final carbon intensity figure, making a comparison between the Scheme and a broad generation technology unreliable.

7.8.26 As the UK electricity sector continues to decarbonise, a range of different low-carbon generation technologies will be required to support an electricity generation system that can balance emissions reduction, security of supply and affordability.

BESS Carbon Savings

7.8.27 The use of the BESS provides the opportunity for additional carbon savings. Battery storage is a fast response power source when compared to traditional energy generation methods, this allows for energy to be quickly provided to the grid when supply from other renewable sources is lower. As the UK grid moves to decarbonise fast response power supply sources such as BESS will be necessary when working to balance supply and demand within the energy grid. This function of grid balancing is currently often performed by using high-carbon intensity power sources, such as open cycle gas turbines (OCGT), so the use of battery charged from solar PV generation can deliver a direct carbon saving relative to an OCGT.

7.8.28 If the BESS is charged from energy produced by the Scheme, and discharged into the grid once each day, at a round trip efficiency rate of 85%, with the batteries replaced on average every 10 years at 80% of their original capacity, it will supply 37.57 TWh to the electricity grid over its 60 year operational lifetime. As the operational carbon intensity of the Scheme is 50.9gCO_2e/kWh and the comparable figure for an OCGT is 460gCO_2e/kWh, the additional use of BESS for grid balancing purposes would save a total of 18,689,252tCO_2e, or an additional 3,982,923tCO_2e compared with directly discharging to grid.

7.8.29 The BESS can also be used for additional grid balancing purposes independent of the solar PV element of the Scheme, charging the battery from the grid overnight during period of low demand and feeding it back when demand increases in the morning. The carbon impact of this scenario can be modelled on the assumption that the average carbon intensity of electricity used to charge the battery is 0.01tCO_2e/MWh (the projected average for the operational lifetime of the Scheme) and the battery is used in place of an OCGT operating at a carbon intensity of 0.46tCO_2e/MWh. Should the BESS be used for an additional overnight charge-discharge cycle as described here, it would result in savings of over 16 million tonnes of CO_2e over its operational lifetime, over and above the savings from use of the battery when charged directly from the solar farm.

7.8.30 While these figures are subject to a degree of uncertainty, they demonstrate the ability of the BESS system, when used for grid balancing purposes, to significantly reduce carbon emissions over its operational lifetime. These additional savings from the use of the BESS are not considered in the overall GHG assessment below.

Overall GHG Impact

7.8.31 In line with IEMA guidance on Assessing GHG Emissions and Evaluating their Significance (Ref 7-24) and the UK's target of net-zero carbon by 2050, the UK's 4th, 5th and 6th Carbon Budgets have been used to contextualise emissions from the Scheme.

7.8.32 The Scheme has very low emissions relative to the carbon budget totals. However, the ongoing operation of the Scheme will inevitably result in some residual emissions by 2050. The vast majority of these residual emissions are operational emissions. The Scheme will achieve substantial emissions reductions compared to the without-project baseline, i.e. in a scenario in which the Scheme does not go ahead and the power it generates is provided by a CCGT facility.

7.8.33 Beyond 2037, it is anticipated that direct operational emissions will decrease over time due to continuing grid decarbonisation, and machinery and vehicle electrification, in line with the UK's net-zero carbon emission target for 2050. Indirectly, the generation of electricity with a much lower carbon intensity than the grid average will result in reduced GHG emissions overall. This indirect emissions reduction will far outweigh any direct emissions resulting from the operations of the Scheme over its lifetime. Overall, the operation of the project will provide GHG performance that supports the trajectory towards net zero.

7.8.34 The UK's fourth, fifth and sixth Carbon Budgets have also been used to contextualise the magnitude of GHG emissions form the Scheme in **Table 7-17**, depending on the years in which the emissions are expected to occur. Construction emissions will fall under the 4th UK carbon budget. The Scheme will be operational no earlier than 2028, and therefore operational emissions up to 2037 (end of the 6th carbon budget) will fall under the 5th and 6th UK Carbon Budgets, beyond which carbon budgets are yet to be published.

Table 7-17: UK Carbon Budgets and Scheme Emissions

Carbon Budget Period	Lifecycle Stage	Carbon Budget (tCO_2e)	Scheme Emissions (tCO_2e)	Proportion of Carbon Budget
4th carbon budget (2023-2027)	Construction	1,950,000,000	910,126	0.05%

Carbon Budget Period	Lifecycle Stage	Carbon Budget (tCO_2e)	Scheme Emissions (tCO_2e)	Proportion of Carbon Budget
5th carbon budget (2028-2032)	Operation	1,725,000,000	205,885	0.01%
6th carbon budget (2033-2037)	Operation	965,000,000	203,975	0.02%

7.8.35 UK carbon budgets are based on production emissions, rather than consumption. It should be noted that the bulk of carbon intensive manufactured components in this Scheme are manufactured overseas and imported to the UK.

7.8.36 In line with IEMA guidance (Ref 7-24), the sectoral carbon budgets for electricity supply have also been used to contextualise emissions from the Scheme.

7.8.37 The Scheme has very low emissions relative to the sectoral carbon budget (Ref 7-30) totals, and while the Scheme will result in residual emissions post 2050, as with the UK carbon budgets, it will achieve substantial emissions reductions relative to the without-project baseline.

7.8.38 The sectoral carbon budgets (electricity supply) have also been used to contextualise the magnitude of GHG emissions from the Scheme in **Table 7-18**, dependent on the years in which the emissions are expected to occur. Construction emissions will occur between Q3 2025 and Q4 2027. The Scheme will be operational no earlier than 2028, and therefore annualised emissions up to 2050 will fall during the operation of the Scheme. The emissions in **Table 7-18** assume that the carbon intensity of components remains constant throughout the Scheme's design life, however this is unlikely to be the case and the figures are reported as a worst-case-scenario.

Table 7-18: Electrical Supply Carbon Budgets Compared to Scheme Emissions

Carbon Budget Year	Lifecycle Stage	Carbon Budget (tCO_2e)	Scheme Emissions (tCO_2e)	Proportion of Carbon Budget
2025	Construction	41,650,081	202,250	0.49%
2026	Construction	32,364,327	404,501	1.25%

Carbon Budget Year	Lifecycle Stage	Carbon Budget (tCO_2e)	Scheme Emissions (tCO_2e)	Proportion of Carbon Budget
2027	Construction	26,698,395	303,375	1.14%
2028	Operation	23,753,320	561	<0.01%
2029	Operation	22,398,435	474	<0.01%
2030	Operation	18,553,339	428	<0.01%
2031	Operation	15,771,201	368	<0.01%
2032	Operation	12,090,757	290	<0.01%
2033	Operation	9,857,164	230	<0.01%
2034	Operation	8,004,075	185	<0.01%
2035	Operation	6,201,104	178	<0.01%
2036	Operation	6,013,285	174	<0.01%
2037	Operation	5,665,442	358,954	6.50%
2038	Operation	5,523,168	158	<0.01%
2039	Operation	5,389,428	149	<0.01%
2040	Operation	5,105,198	142	<0.01%
2041	Operation	3,752,185	135	<0.01%
2042	Operation	3,452,359	58,158	1.75%
2043	Operation	3,323,141	81	<0.01%
2044	Operation	3,149,805	75	<0.01%
2045	Operation	2,267,351	70	<0.01%
2046	Operation	2,016,269	68	<0.01%
2047	Operation	1,605,366	358,842	24.10%
2048	Operation	1,489,110	46	<0.01%

Carbon Budget Year	Lifecycle Stage	Carbon Budget (tCO_2e)	Scheme Emissions (tCO_2e)	Proportion of Carbon Budget
2049	Operation	1,331,872	29	<0.01%
2050	Operation	1,205,459	22	<0.01%

7.8.39 GHG emissions saving are expected to be achieved throughout the lifetime of the Scheme compared to other fossil fuel energy generation types. Therefore, the GHG emissions during construction, operation and decommissioning of the Scheme can be considered to be 'offset' by the net positive impact of the Scheme on GHG emissions and the UK's ability to meet its carbon targets. It would be possible for a low-carbon energy generation project to have a GHG intensity below the projected grid for most of its lifetime, but above it towards the end of its lifetime and still have an overall positive impact on the UK's ability to meet its carbon targets. However, comparison to grid emissions is not a suitable comparison as decarbonisation of the grid relies on investment in low-carbon technologies, such as this Scheme. Emissions associated with the grid are also based only on the fuel consumed by power stations and are therefore not relevant in the context of the Scheme.

7.8.40 The GHG savings achieved throughout the lifetime of the Scheme demonstrate the role solar energy generation has to play in the transition to, and longer-term maintenance of, a low carbon economy in the UK. Without low-carbon energy generation projects such as the Scheme, the average grid GHG intensity will not decrease as is projected, which could adversely affect the UK's ability to meet its carbon reduction targets.

7.8.41 As the operational carbon intensity of the Scheme remains below a CCGT facility throughout its lifetime, it is considered that the overall GHG impact of the Scheme is **beneficial** and **significant**, as it will play a part in achieving the rate of transition required by nationally set policy commitments and supporting the trajectory towards net zero. The without-project baseline alternative of a CCGT facility would result in substantially higher GHG emissions. This Scheme demonstrates significant carbon saving, it is therefore beneficial and will have a positive impact on the climate.

Climate Change Resilience Assessment

7.8.42 **Table 7-19** summarises the assessment of climate change risk to the Scheme.

Table 7-19: Climate Change Resilience Assessment

Potential Climate Hazards	Potential Impacts on the Development	Proposed Adaptation Measures	Likelihood	Measure of Consequence	Significance Level
Construction					
Increased summer maximum temperatures	Increased temperatures may cause overheating of construction equipment.	Contractor to monitor weather reports and schedule construction appropriately. Further details are contained in the **Framework CEMP [EN010142/APP/7.8]**.	Negligible	Low	Low (Not Significant)
Increase in winter precipitation	Surface water flooding damaging foundations and preventing site access.	Flood risk mitigation details are available in the **Framework CEMP [EN010142/APP/7.8]**, **Flood Risk Assessment** and **Outline Drainage Strategy** (**Appendix 10-3 and Appendix 10-4** of the ES **[EN010142/APP/6.2]**). Also refer to **Chapter 10: Water Environment** of this ES **[EN010142/APP/6.1]**	Negligible	Low	Low (Not Significant)
Increased frequency and severity of extreme weather events (storms)	Damage to drainage. Prevention of site access due to flooding.	Flood risk mitigation details are available in the **Framework CEMP [EN010142/APP/7.8],** Flood Risk Assessment and Outline Drainage Strategy (**Appendix 10-3 and Appendix 10-4** of the ES	Low	Low	Low (Not Significant)

Potential Climate Hazards	Potential Impacts on the Development	Proposed Adaptation Measures	Likelihood	Measure of Consequence	Significance Level
		[EN010142/APP/6.2]). Also refer to **Chapter 10: Water Environment** of this ES **[EN010142/APP/6.1]**			
Increase in frequency and severity of heatwaves	Frequent and severe heatwaves may delay the construction schedule.	Contractor to monitor weather reports and schedule construction appropriately. Further details are available in the **Framework CEMP [EN010142/APP/7.8].**	Negligible	Low	Low (Not Significant)
Reduction in summer rainfall	Reduced water availability of water for construction.	No further measures are recommended due to likelihood and consequence.	Negligible	Negligible	Negligible (Not Significant)
Operation					
Increased summer and winter temperatures	Reduced cell efficiency and energy output due to higher temperatures. Increased degradation of solar PVs due to increased temperatures. Reduced capacity of transmission lines.	No further measures recommended. Temperature increase unlikely to significantly reduce energy output.	Low	Low	Low (Not Significant)

Potential Climate Hazards	Potential Impacts on the Development	Proposed Adaptation Measures	Likelihood	Measure of Consequence	Significance Level
	Increased losses within substation and transformers.				
Increased winter precipitation	Surface water flooding of Site location. Deterioration of structures and foundations due to increased soil moisture.	Flood risk mitigation details available in **Flood Risk Assessment** and **Outline Drainage Strategy** (**Appendix 10-3 and Appendix 10-4** of the ES **[EN010142/APP/6.2]**). Also refer to **Chapter 10: Water Environment** of this ES **[EN010142/APP/6.1]**.	Low	Minor	Low (Not Significant)
Reduced summer precipitation	Reduced water availability for cleaning solar PV panels.	No further measures recommended due to annual cleaning schedule for PV panels.	Negligible	Negligible	Low (Not Significant)
Increased frequency and severity of extreme weather events (storms)	Damage to PV panels due to storm events. Damage to drainage systems and flooding.	Flood risk mitigation details available in **Flood Risk Assessment** and **Outline Drainage Strategy** (**Appendix 10-3 and Appendix 10-4** of the ES **[EN010142/APP/6.2]**). Also refer to **Chapter 10: Water Environment** of this ES **[EN010142/APP/6.1]**.	Low	Low	Low (Not Significant)
Decommissioning					

Potential Climate Hazards	Potential Impacts on the Development	Proposed Adaptation Measures	Likelihood	Measure of Consequence	Significance Level
Refer to construction phase risks. These are assumed to be the same for the decommissioning phase for the purposes of this assessment.					

In-Combination Climate Change Assessment

7.8.43 **Table 7-20** details ICCI risks identified for the Scheme.

Table 7-20: In-Combination Climate Change Risk Assessment

Discipline/ Receptor	Climate Hazard	Likelihood of hazard occurring	Likely ICCIs identified	Description of ICCI and embedded mitigation	Likelihood of ICCI occurring	Consequence	Significance
Soils and Agriculture							
Soil Resource	Increased winter precipitation	Likely	Increased soil erosion due to higher rainfall	Green cover of all soil surfaces during operation at the Principal Site will decrease permeability and mitigate effects of increased precipitation . Further details are provided in the **Framework Landscape and Ecology Management Plan [EN010142/APP/7.17]**.	Negligible	Low	Not Significant
Water Environment							
Drainage	Increased winter precipitation	Likely	Increased stress on drainage system due to higher rainfall	**Appendix 10-4: Outline Drainage Strategy** of and **Appendix 10-3: Flood Risk Assessment** of this ES **[EN010142/APP/6.2]** has considered a 40% allowance for climate change, exceeding the projected change in precipitation	Negligible	Low	Not Significant

Discipline/ Receptor	Climate Hazard	Likelihood of hazard occurring	Likely ICCIs identified	Description of ICCI and embedded mitigation	Likelihood of ICCI occurring	Consequence	Significance
				rates during the operation of the Scheme.			

7.9 Additional Mitigation and Enhancements

7.9.1 No additional mitigation or enhancements beyond the measures already described in **Section 7.7** are proposed during construction, operation, or decommissioning of the Scheme, as no significant adverse effects have been identified.

7.9.2 The GHG emissions from construction, operation and decommissioning of the Scheme are accounted for within the lifetime GHG intensity figure for the Scheme. Therefore, it is considered that the GHG reductions achieved as a result of the operation of the Scheme itself adequately outweigh and offset the GHG impacts during the individual lifecycle stages.

7.10 Residual Effects

7.10.1 This section identifies the residual effects, following the implementation of additional mitigation and monitoring measures, known as 'residual effects' which cannot be eliminated through design changes or the application of standard mitigation measures.

7.10.2 The GHG emissions that occur during the construction and decommissioning of the Scheme are not possible to be removed through mitigation, and are therefore considered Minor Adverse, the overall beneficial GHG impact of the Scheme during its operational phase is considered to offset the negative effects of these emissions. Due to this, the mitigation measures outlined in **Section 7.7** are considered sufficient.

7.10.3 **Table 7-21** outlines the likely residual effects.

Table 7-21: Summary of Residual Effects

Receptor	Description of Impact	Significance of Effect Without Mitigation	Mitigation/Enhancement Measure	Residual Effect After Mitigation
GHG Impact Assessment				
Global Climate	GHG emissions occurring as a result of construction	Minor Adverse	Benefits of operational phase are considered to offset emissions that occur during construction.	Minor Adverse (not significant)
	Net GHG impact of operational activities	Beneficial	None required	Beneficial (significant)
	GHG emissions resulting from decommissioning	Minor Adverse	Benefits of operational phase are considered to offset any emissions that occur during decommissioning.	Minor Adverse (not significant)
CCR Assessment				
Scheme	Refer to **Table 7-19: Climate Change Resilience Assessment**.			
ICCI Assessment				
Discipline Specific	See **Table 7-20: In-Combination Climate Change Risk Assessment**.			

7.11 Cumulative Assessment

7.11.1 An assessment of cumulative effects and interactions for the Scheme, including in relation to climate change, is provided in **Chapter 18: Cumulative Effects and Interactions** of this ES **[EN010142/APP/6.1]**.

7.12 References

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