Tillbridge Solar

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PEI Report Volume I Chapter 7: Climate Change

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7. Climate Change

7.1 Introduction

7.1.1 This chapter presents the findings of an assessment of the likely significant effects on the climate as a result of the Scheme and the resilience of the Scheme to the physical impacts of climate change associated with the Scheme. For more details about the Scheme, refer to **PEI Report Volume I Chapter 3: Scheme Description** of this Preliminary Environmental Information Report (PEI Report).

7.1.2 In line with the requirements of regulation 5(a) of the Infrastructure Planning (Environmental Impact Assessment) Regulations (2017) (Ref. 7-1), consideration has been given within this chapter to the following aspects of climate change assessment:

- **Lifecycle greenhouse gas (GHG) impact assessment** – the impact of GHG emissions arising over the lifetime of the Scheme on the climate; and
- **Climate change risk assessment (CCRA)** – the resilience of the Scheme to projected future climate change impacts, including damage to the Scheme caused by accidents resulting from climate change.
- **In-combination climate change impact assessment (ICCI)** - An in-combination climate change impact (ICCI) assessment identifies how the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Scheme. Where relevant In-combination Climate Change Impacts will be covered in the separate disciplines chapters.

7.2 Legislation and Planning Policy

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

Legislation

Climate Change Act 2008

7.2.2 The Climate Change Act 2008 (7-36Ref. 7-2) sets a target for the year 2050 for the reduction of targeted greenhouse gas emissions and to provide for a system of carbon budgeting.

Climate Change Act 2008 (2050 Target Amendment) Order 2019

7.2.3 The Climate Change Act 2008 (2050 Target Amendment) Order 2019 (Ref. 7-3) amended the 2050 target in the Climate Change Act 2008 to “net zero”, i.e. that the net UK carbon account, in terms of carbon dioxide and other targeted greenhouse gases, for the year 2050 is at least 100% lower than the relevant baseline year.

Carbon Budget Orders

7.2.4 The Carbon Budgets Order (2009) (Ref. 7-4), Carbon Budget Order (2011) (Ref. 7-5), Carbon Budget Order (2016) (Ref. 7-6) and the Carbon Budget Order (2021) (Ref. 7-7) set the carbon budgets for relevant budgetary periods. The Carbon Budgets provide legally binding caps on the volume of GHG emissions the UK emit during fixed five year periods. The Sixth Carbon Budget is the latest to be legislated for covering the period 2033 to 2037. It is the first carbon budget to align with the trajectory to net zero by 2050.

National Planning Policy

7.2.5 As outlined in **PEI Report Volume I Chapter 1: Introduction**, the EIA for the Scheme must have regard to the relevant policies of the National Planning Policy Framework (NPPF) and relevant National Policy Statement (NPS). Key aspects of the NPPF and relevant NPS and draft NPS, which have been considered during the development of this chapter, are outlined below.

National Planning Statement for Energy (NPS EN-1)

7.2.6 NPS EN-1 (Ref. 7-8) provides policy context for reducing greenhouse gas emissions from the energy generation sector through the transition from fossil fuels generated energy to an increased uptake of low carbon energy generation sources. It also sets out a requirement for applicants to take the effects of climate change into account when developing and consenting infrastructure. Particular reference is made to paragraphs 2.2.9 and 4.8.2 in relation to climate impacts and adaptation; paragraphs 4.1.3 to 4.1.4 in relation to adverse effects and benefits; paragraphs 4.2.1, 4.2.3, 4.2.4, 4.2.8 to 4.2.10 and 5.1.2 in relation to EIA and ES requirements; paragraphs 4.5.3 and 4.8.1 to 4.8.12 in relation to adaptation measures in response to climate projections; and paragraphs 5.7.1 to 5.7.2 in relation to climate projections, flood risk and the importance of relevant mitigation.

Draft National Policy Statement for Energy (EN-1)

EN-1 (Ref. 7-8) sets out the overarching planning framework for all energy infrastructure and the policy context for the Secretary of State's decision making on all energy infrastructure Nationally Significant Infrastructure Projects (NSIPs). Draft EN-1 reflects the significant policy changes which have occurred since the existing EN-1 was published in 2011, including the UK Government's commitment to reduce the use of fossil fuels in order to reach its net zero target.

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

7.2.7 NPS EN-3 (Ref. 7-10) defines the primary basis for decision making on applications for nationally significant renewable energy infrastructure. The initial publication of EN-3 did not include solar energy. Particular reference is made to paragraph 2.3.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.3.5 in relation to ES requirements regarding climate change resilience.

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

7.2.8 The draft version of NPS EN-3 (Ref. 7-11), now includes consideration for solar energy when providing a basis for decision making on nationally significant renewable energy infrastructure.

National Policy Statement for Electricity Networks Infrastructure (NPS EN-5)

7.2.9 NPS EN-5 (Ref. 7-12) focuses on application for electricity networks infrastructure – paragraph 2.4.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.4.2 in relation to ES requirements regarding climate change resilience.

Draft National Policy Statement for Electricity Networks Infrastructure (NPS EN-5)

7.2.10 Draft of NPS EN-5 (Ref. 7-13) contains all information from the previous iteration while adding a more robust section on Assessment and Technology Specific information.

National Planning Policy Framework (NPPF)

7.2.11 NPPF (Ref. 7-14) sets out planning requirements for developments to address the impacts of climate change. It seeks development to demonstrate how it reduces GHG emissions and is designed to be resilient to the impacts of climate change – paragraphs 8, 20 and 149 in relation to adaptation, mitigation and climate change resilience; paragraphs 148 and 157 in relation to flood risk and damage to property and people; paragraphs 150 and 153 in relation to reduction of carbon dioxide (CO2) emissions through design and reduced energy consumption; and paragraphs 155 to 165 in relation to climate projections, associated flood risk and adaptation.

National Guidance

7.2.12 The following guidance has been followed when undertaking the assessment of climate change impacts. The guidance sets out a methodology for assessing the impacts and significance of greenhouse gases on the climate and the impact of climate change on the Scheme.

- Institute of Environmental Management and Assessment (IEMA) Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref. 7-15).
- Institute of Environmental Management and Assessment (IEMA) Climate Change Resilience and adaptation (Ref. 7-16).
- World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol guidelines (Ref. 7-25).
- Planning Practice Guidance for Climate Change (March 2019) (Ref. 7-26).

Local Planning Policy

7.2.13 The following local planning policy has been taken into consideration when undertaking the assessment presented in this chapter.

City of Lincoln Council Decarbonisation Strategy and Action Plan Responding to the Climate Emergency (2021-2030) (Ref. 7-18)

7.2.14 This strategy sets out Lincoln Council's aspiration to ensure that development approach reduces the carbon footprint. Solar power has also been highlighted as an opportunity for decarbonisation of electricity and the Council is supporting projects to expand this.

Providing for Lincolnshire's Future (Ref. 7-19) – A Sustainability Framework incorporating Environmental Stewardship Strategy

7.2.15 A key objective under the sustainability vision is to effectively protect the environment which will take into consideration impacts to global climate from greenhouse gas emissions.

Central Lincolnshire Local Plan (Ref. 7-20)

7.2.16 Objective 11 on climate change effects and energy includes mimimising the effects of climate change by developing renewable and low carbon energy and heat to reduce greenhouse gas emissions from the area. Section 3.6 explores climate change and the need for climate adaptation in design.

Lincolnshire County Council Carbon Management Plan (Ref. 7-21)

7.2.17 Chapter 2 considering the importance of carbon management and drivers for tackling climate change. Chapter 4 identifies carbon management projects and the importance of prioritising opportunities for carbon emissions savings across the County.

West Lindsey District Council (WLDC) Carbon Action Plan 2021-2026 (Ref. 7-22)

7.2.18 WLDC is committed to reducing its carbon footprint to net-zero by 2050 at the latest. The District Council's Carbon Action Plan 2021-2026 (Ref. 7-22) sets out a number of recommendations that WLDC should work towards in order to achieve their carbon reduction target.

The Bassetlaw Local Plan 2020-2038 Publication Version Second Addendum of May 2022 (Ref. 7-23)

7.2.19 The Local Plan proposes the vision for Bassetlaw in 2038, which includes 'a secure, reliable, affordable net-zero and low carbon energy mix' and 'significant new renewable energy infrastructure'.

Policy Summary

7.2.20 The national planning policies identify the requirement for consideration of climate change resilience. Climate projections should be analysed, and appropriate climate change adaptation measures considered throughout the design process. Specific climate change risks identified within these policies include flooding, drought, coastal change, rising temperatures and associated damage to property and people.

7.2.21 Local planning policies identify the importance of tackling climate change by reducing greenhouse gas emissions and highlight the need to consider and, where appropriate, mitigate GHG emissions associated with new development. New development should aim for reduced or zero-carbon development by incorporating renewable or low-carbon energy sources and maximising energy efficiency where practicable, and should build in resilience

to projected climate change impacts. Local policy clearly supports development of new renewable projects to help reduce the use of fossil fuels.

7.3 Assessment Assumptions and Limitations

7.3.1 This chapter forms a preliminary assessment which has been based on available information at the time of preparing the PEI Report. A final assessment will be undertaken as part of the EIA and will be reported in the ES that will be submitted with the Development Consent Order (DCO) submission, taking into account comments received on this PEI Report as part of the consultation process.

7.3.2 Due to the early stage in the design process, limited data was available to be able to undertake a fully quantifiable GHG impact assessment of the Scheme. The GHG impact assessment presented in this PEI Report chapter has relied on comparisons with other large scale solar schemes being brought forward in the UK. This includes assumptions on the replacement rates for MWh of BESS, the replacement rate of solar PV panels, and the total MW and MWh of BESS. The benchmarked schemes are the solar NSIPS submitted to PINS which have been assessed and verified by AECOM. Although a detailed GHG assessment has not been carried out, potential GHG mitigation measures based on similar schemes have been provisionally identified. These assumptions from similar schemes will be replaced with project-specific data for the submission of the ES.

7.3.3 Likewise, due to the early stage of the Scheme design, a full assessment of the climate change risks to the Scheme has not been possible. This PEI Report presents an assessment of climate change risk based on experience from other similar schemes, while making an allowance for the specific location of the Scheme. Worst-case scenarios have been used, for example RCP8.5 in the future baseline projections for the CCRA, to ensure a robust assessment.

7.3.4 The GHG and CCRA will be updated for the ES Chapter based on updated Scheme information and data.

7.3.5 The ICCI assessment has been scoped into the climate chapter, with climate parameters being considered the other environmental disciplines at the ES stage. The sensitive receptors for the ICCI assessment are those identified by each discipline in their assessment. The Study Area for the ICCI assessment is therefore as identified by each discipline for their individual assessments.

7.4 Assessment Methodology

GHG Assessment

Study area

7.2.1 The Study Area for the GHG impact assessment covers all direct GHG emissions arising from activities undertaken at the Site during the construction, operation and maintenance, and decommissioning of the Site. It also includes indirect emissions embedded within the construction materials arising as a result of the energy used for their production, as well

as emissions arising from the transportation of materials, waste and construction workers.

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

7.2.3 The environmental impact associated with GHG emissions is a national and global issue. Consequently, the potential significance of the proposed Scheme's lifecycle GHG emissions will be assessed by comparing the estimated GHG emissions from the Scheme against the reduction targets defined in the Climate Change Act 2008 (2050 Target Amendment) Order 2019, associated five year, legally binding carbon budgets and the UK's forecast trajectory towards net zero.

7.4.1 As it is not known where construction materials will be sourced from at this stage in the process, the study area for indirect emissions is assumed to be global as a worst case scenario.

Sources of information

7.4.2 Where available, data required to undertake the lifecycle GHG impact assessment was provided by the project design team and analysed using the methodology outlined below in this section. Where data was unavailable, reasonable assumptions have been made based on professional judgement, further details of which are outlined in Section 7.3.

Impact Assessment Methodology

Methodology for Determining Baseline Conditions and Sensitive Receptors

7.4.3 The receptor for GHG emissions is the global climate; as the effects of GHG emissions are not geographically constrained. All GHG emissions have the potential to result in a cumulative effect in the atmosphere.

7.4.4 For the GHG assessment, the baseline is a 'business as usual' scenario where the Scheme is not implemented. The baseline typically consists of GHG emissions from the existing site operations and the existing carbon stock within the soil and the above and below-ground vegetation within the Scheme Boundary.

7.4.5 The GHG baseline also considers the impact of grid electricity generation if the Scheme was not built.

Methodology for Determining Demolition, Construction and Operation Effects

7.4.6 The assessment has adopted a project lifecycle approach to identify 'hot spots' of GHG emissions (i.e. the project stage(s) likely to generate the largest amount of GHG emissions) and enable priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA guidance (Ref. 7-15) and PAS: 2080 (Ref. 7-24).

7.4.7 In line with the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol guidelines (Ref. 7-25), the lifecycle GHG impact assessment has been reported as tonnes of carbon

dioxide equivalent (tCO_2e) and has considered the seven Kyoto Protocol gases:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Sulphur hexafluoride (SF_6);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Nitrogen Trifluoride (NF_3).

7.4.8 Where data is available, GHG emissions arising from construction activities, embodied carbon in materials and operational emissions of the Scheme have been quantified using a calculation-based methodology as per the following equation and aligned with the GHG Protocol (Ref. 7-25):

Activity data x GHG emissions factor = GHG emissions

7.4.9 A set of standard data quality principles have been applied so that the results from the GHG assessment are as accurate and representative as possible. This has included the selection of emission factors that are representative of the UK construction industry.

7.4.10 The Department for Business, Energy and Industrial Strategy (BEIS) 2021 emissions factors (Ref. 7-27) and embodied carbon data from the Inventory of Carbon and Energy V3.0 (ICE) (Ref. 7-28) have been used as the source of emissions factors for calculating GHG emissions. The resulting carbon footprint has been compared to the existing baseline condition, to identify the impact of the Scheme.

7.4.11 Where relevant GHG activity data was unavailable, assumptions and estimations have been developed based on similar schemes, industry benchmarks and professional judgement. Any assumptions, inclusions and exclusions that inform the GHG emissions calculation have been clearly described in the sections below.

7.4.12 In order to assess the potential impacts of GHG emissions arising from the Scheme, likely activities and their associated GHG emissions sources have been estimated. Potential activities related to the Scheme that could cause GHG emission impacts are presented Table 7-1.

Table 7-1: Potential sources of GHG emissions

Lifecycle Stage	Activity	Primary Emission Sources
Pre-construction (including demolition)	On-site pre-construction activity i.e. enabling works, etc.	GHG emissions from fuel consumption by construction plant and vehicles, generators on-site, and worker commuting

Lifecycle Stage	Activity	Primary Emission Sources
	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
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 Site
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
	Landscaping	Changes in GHG emissions/sinks from landscaping and re-vegetation
Decommissioning	Removal and / or renewal of the Scheme	GHG emissions arising from fuel consumption for plant and vehicles and disposal of materials

Assessment Criteria

7.4.13 This preliminary environmental assessment has been undertaken following relevant guidance, namely IEMA Guidance for Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref. 7-15)

Sensitivity of receptor

7.4.14 The receptor for the GHG assessment is the global climate. Due to the nature of GHG emissions, and their cumulative impact on the global climate, IEMA considers that all GHG emissions contribute to climate change.

Magnitude of impact

7.4.15 Under the revised IEMA guidance on assessing the impact of GHG emissions the significance of the impact is no longer based on whether a project emits GHG emissions, or the magnitude of these emissions, but how a project contributes to reducing GHG emissions compared to a defined baseline.

Significance of Impact

7.4.16 The IEMA guidance (Ref. 7-15) 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. It is suggested that sectoral, local, or national carbon budgets can be used, as available and appropriate, to contextualise a project's GHG impact and determine the level of significance. The approach adopted for the purposes of this assessment is outlined below.

7.4.17 Where available, UK national carbon budgets (Table 7-2) have been used for the purposes of this assessment to represent future emissions inventory scenarios for the UK. These legally binding targets, which outline the total amount of GHGs that the UK can emit over a 5-year period, are currently available to the 6th carbon budget period (2033-2037) which became legislation on 24 June 2021. The UK is currently in the 3rd carbon budget period, which runs from 2018 to 2022. The 3rd, 4th and 5th Carbon Budgets reflect the previous 80% reduction target by 2050. The 6th carbon budget aligns with the legislated 2050 net zero commitment.

7.4.18 In order to illustrate the Scheme trajectory towards net-zero by 2050, the Climate Change Committee's (CCC) balanced net zero pathway is utilised post-2037, in the absence of any nationally legally binding Carbon Budgets after using the subsequent 6th Carbon Budget.

7.4.19 The CCC balanced net-zero pathway is divided into 5-year periods post-2037 to match the previous 1-6 legally binding UK carbon budgets pre-2037. The proposed Carbon Budget periods derived from the net-zero pathway encompass the 7th, 8th and 9th indicative budget periods up to 2050 in line with the UK's 1.5-degree trajectory.

7.4.20 However, it should be explicitly noted that the supplementary Carbon Budgets beyond 2037 have not been formally adopted by the government or ratified by parliament and can only be used as an indicative measure to contextualise the Scheme's progress toward the national net-zero trajectory.

7.4.21 It is noted that the contribution of most individual projects to national-level budgets will be small and so the UK context will have limited value. This GHG emissions assessment therefore uses the IEMA guidance to assess the significance of effects (Table 7-4), with the UK carbon budgets being used to provide context to the GHG emissions (Table 7-2).

Table 7-2: UK Carbon Budgets and indicative carbon budgets

Carbon Budget Period	Carbon Budget (MtCO2e)	Indicative Carbon Budget totals based upon the CCC's Balanced Net Zero Pathway (MtCO2e)*
3rd (2018-2022)	2,544	
4th (2023-2027)	1,950	
5th (2028-2032)	1,725	
6th (2033-2037	965	
7th (2038-2042)		526
8th (2043-2047)		195
9th (2048-2050)		17

7.4.22 The Sixth Carbon Budget includes sector specific decarbonisation targets. Table 7-3 presents these as further context to the GHG emissions, however, it should be noted that these are not ratified like the national-level budgets. The carbon budget periods begin in 2020 as this is the earliest year available in the Sixth Carbon Budget Dataset.

Table 7-3: Electricity generation carbon budgets based upon the CCC's Balanced Net Zero Pathway

Carbon budget period	Recommended Carbon Budget ($MtCO_2e$)
2020 - 2022	105.45
2023 - 2027	189.16
2028 - 2032	92.56
2033 - 2037	35.74
2038 - 2042	23.22
2043 - 2047	12.36
2048 - 2050	4.03

7.4.23 According to the IEMA guidance on assessing GHG emissions in EIA (Ref. 7-15), *"GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant".*

7.4.24 The 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.

7.4.25 Table 7-4 presents the different significance levels as per the latest version of IEMA guidance. 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."* Moderate and Major adverse impacts and Beneficial impacts are considered to be significant, while all other significance levels are deemed to be not significant.

7.4.26 A 'minor adverse' or 'negligible' non-significant effect conclusion does not necessarily refer to the magnitude of GHG emissions being carbon neutral (i.e. zero on balance) but refers to the likelihood of avoiding severe climate change, aligning project emissions with a science-based 1.5°C compatible trajectory and achieving Net Zero by 2050.

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

Table 7-4: Definition of levels of significance (Ref. 7-31)

Effects	Significance Level	Description	Example in the guidance
Significant adverse	Major adverse	A project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area based transition targets. It is down to the practitioner to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects.	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.
	Moderate adverse		The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy

Effects	Significance Level	Description	Example in the guidance
			requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero.
Not significant	Minor adverse	A project that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that. It may have residual emissions but is doing enough to align with and contribute to the relevant transition scenario, keeping the UK on track towards net zero by 2050 with at least a 78% reduction by 2035 and thereby potentially avoiding significant adverse effects.	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero.
	Negligible	A project that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory and has minimal residual emissions. This project is playing a part in achieving the rate of transition required by nationally set policy commitments.	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the

Effects	Significance Level	Description	Example in the guidance
			curve' for the trajectory towards net zero and has minimal residual emissions.
Beneficial	Beneficial	A project that causes GHG emissions to be avoided or removed from the atmosphere. Only projects that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

Climate Change Risk Assessment (CCRA)

Study Area

7.4.28 The Study Area for the CCRA is the land within the Scheme Boundary, i.e. it covers the construction, operation (including maintenance) and decommissioning of all assets and infrastructure which constitute the Scheme.

Sources of information

7.4.29 Historic climate data obtained from the Met Office website (Ref. 7-32) and UK Climate Projections 2018 (UKCP18) (Ref. 7-33) data were used to determine the historic and future baseline conditions.

Impact Assessment Methodology

Methodology for Determining Baseline Conditions and Sensitive Receptors

7.4.30 The receptor for the CCRA is the Scheme itself, including workers and infrastructure.

7.4.31 The current baseline has been established by understanding the historic/current climate in the location of the Scheme by reviewing historic climate data obtained from the Met Office website (Ref. 7-20). The climate baseline has been developed using historic Met Office data obtained from the meteorological station closest to the Overall Site (Scampton), located approximately 12km south-south east of the Scheme (Ref. 7-34).

7.4.32 The future baseline has been established using UKCP18 (Ref. 7-33). UKCP18 data for the 25km grid cell where the Scheme is located have been used to examine future climate parameters. This climate projection data provides a probabilistic indication of how global climate change is likely to affect the site of the Scheme using defined climate variables and time periods.

7.4.33 The EIA Regulations require the inclusion of information on the vulnerability of the Scheme to climate change. Consequently, a review of climate change risk for the Scheme has been conducted which identifies potential climate change impacts. It is noted that this has previously been referred to as the Climate Change Resilience Review, but terminology has been updated to reflect the latest IEMA guidance (Ref 7-16).

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

7.4.35 The review of potential impacts and the Scheme's vulnerability considers the embedded mitigation measures that have been designed into the Scheme, discussed in Section 7.7.

7.4.36 The assessment has considered Climate Projections over a 60-year period from the Scheme's completion.

7.4.37 Climate parameters to be considered in the CCRA during the demolition, construction and operation of the Scheme include the following:

- Extreme weather events;
- Flood risk;
- Sea level rise (SLR);
- Temperature change; and
- Rainfall change.

7.4.38 The CCRA has been undertaken for the Scheme to identify potential climate change impacts on the Scheme and associated receptors, and to consider their potential consequence and likelihood of occurrence, taking account of the adaption measures embedded into the design of the Scheme (Section 7.7).

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

- Climate risk – a weather or climate related event, which has potential to do harm to environmental or community receptors or assets, for example, increased winter precipitation;
- Climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and
- Consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

Methodology for Determining Demolition, Construction and Operation Effects

7.4.40 The CCRA has qualitatively reviewed climate change risks to the Scheme. This has been completed with consideration to a typical solar Scheme and by considering the UKCP18 projections (Ref. 7-33) for the geographical location and timeframe of the Scheme.

7.4.41 Climate change projections for the Site during the enabling works and construction phase have been examined against receptors (during this stage). Construction phase receptors of the Scheme include the workforce, plant, machinery and materials.

7.4.42 As the enabling works and construction phase is likely to last for a minimum of 24 months and expected to occur in the relatively near future, it is not anticipated that there will be any significant impacts during the enabling works and construction. The CCRA therefore focusses on the operational phase.

7.4.43 For the operational phase of the Scheme, potential climate change impacts have been identified using relevant projections from UKCP18 (Ref. 7-33). The CCRA considers their potential consequence to receptors and likelihood of occurrence, taking account of the measures incorporated into the design of the Scheme. Receptors when the Scheme is complete may include the Scheme assets and their operation, maintenance and refurbishment.

Sensitivity of receptor

7.4.44 The Scheme itself is the receptor for the purpose of the CCRA . The sensitivity of the receptor has not been defined for the CCRA as only a review of the impacts is required in line with IEMA guidance (Ref. 7-16), rather than an assessment of the significance.

Assessment Criteria

7.4.45 A stepped approach is used to assess the impacts of climate change on the Scheme.

- Identify likelihood of climate hazard;
- Identify likelihood of climate impact occurring;
- Identify consequence of impact on the Scheme; and
- Identify significance of impact (likelihood of impact occurring x consequence of impact)

Likelihood of Climate Impact Occurring and Description of Consequences

7.4.46 Following identification of climate hazards, the likelihood and consequences have been assessed according to Table 7-5 and Table 7-6 respectively. The categories and descriptions provided below are based on the IEMA climate change resilience and adaptation guidance (Ref. 7-16).

7.4.47 The ES will present mitigation measures to demonstrate how the Scheme will be adapted to increase its resilience to future climate conditions

Table 7-5 Categories for the likelihood of the climate-related impact occurring

Likelihood category	Description
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.
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.

7.4.48 Table 7-6 sets out criteria for assessing the consequence of the climate impacts.

Table 7-6: Description of consequences of the climate impacts

Consequence of impact	Description
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.

Significance of Impact

7.4.49 The significance in the CCRA is determined as a function of the likelihood of a climate change hazard occurring and the consequence to the receptor if the hazard occurs. This is detailed in Table 7-7, where N = negligible, L = Low, M = Moderate, and H = High. The significance is then detailed in Table 7-8. The assessment takes into account confirmed design and mitigation measures (referred to as embedded mitigation as set out in Section 7.7).

Table 7-7: Level of effect criteria for climate change risk assessment

	Likelihood of climate-related impact occurring			
	High	**Moderate**	**Low**	**Negligible**
High	H	H	M	L

Level of consequence of a climate risk occurring	**Moderate**	H	M	L	L
	Low	M	L	L	L
	Negligible	L	L	L	N

Table 7-8: Significance of effect matrix (where 'S' is significant and 'NS' is not significant)

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

7.5 Stakeholder Engagement

7.5.1 A request for an EIA Scoping Opinion was sought from the Secretary of State through the Planning Inspectorate in 2022 as part of the EIA Scoping Process, and was received on 4 November 2022.

7.5.2 Consultation undertaken to date in relation to climate change is outlined in Table 7-9.

Table 7-9: Engagement Undertaken

Summary of matter raised	**How has the matter been addresses**	**Location of response in the chapter**
Planning Inspectorate		
Scoping out of an in combination climate assessment (ICCI). The Inspectorate disagrees	An In-combination Climate Change Assessment will be included as part of the assessment.	To be included in the climate chapter within the ES. An assessment of both future climate change, for example increased precipitation rates, and the impact of the Scheme on surrounding sensitive receptors will be carried out by the technical disciplines and presented in the climate chapter.
Scoping out increased wind as a climate variable in the climate risk assessment.	Point is noted	No response required.

Summary of matter raised	How has the matter been addresses	Location of response in the chapter
The Inspectorate Agrees.		
The scoping out of precipitation as a variable in the climate risk assessment. The Inspectorate disagrees.	Climate precipitation changes is scoped into the PEI Report and will be assessed in the climate change risk assessment (CCRA). Embedded climate precipitation change mitigation measures will be assessed in the CCRA. If required, supplementary mitigation measures will be recommended to reduce the Scheme's residual risk to precipitation hazards to an acceptable level. In addition, relevant chapters such as **PEI Report Volume I Chapter 10: Flood Risk, Drainage and Surface Water** considers climate change as part of the drainage strategy, which informs the Scheme's risk of flooding from drainage. The drainage strategy will evaluate embedded flooding drainage measures within the Scheme, and if required, supplementary measures will be recommended to reduce residual flooding risk to an acceptable level. An ICCI assessment has been scoped into the climate chapter, summarising any identified in-combination climate change impacts from other technical disciplines in the EIA.	Included in Section 7.6, assessing the future baseline in terms of mean annual, summer, and winter precipitation.
Clarity of which forms of electricity will be displaced by energy generated by the Scheme.	The assessment for GHG emissions from the Scheme will include an comparison of the operational carbon intensity of the Scheme against the operational carbon intensity of the counterfactual 'business-as-usual' baseline – assumed to be a gas-fired Combined Cycle Gas Turbine (CCGT).	A summary of how current NSIP Schemes compare to CCGT carbon intensity is presented in Section 7.8. A full comparative assessment will be undertaken for the ES as the design of the Scheme progresses.
This assessment should include a description and assessment of any likely significant effects resulting from the vulnerability of the Scheme to climate change.	The climate change risk assessment will assess the significant effects of climate change impacts on the Scheme. Measures to adapt the Scheme to	An initial assessment for climate change risk impacts is presented within Section 7.8. An updated assessment will

Summary of matter raised	How has the matter been addresses	Location of response in the chapter
Where relevant, it should describe and assess the adaptive capacity that has been incorporated into the design of the Scheme.	climate impacts have been identified. Adaptive capacity will be considered where necessary.	be presented in the ES as the design of the Scheme progresses.
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 Policy DM10 from the Bassetlaw Core Strategy.	The GHG assessment will identify measures to mitigate the impact of greenhouse gas emissions from the Scheme.	Section 7.7 includes mitigation measures currently under consideration.
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 impact and contribution of the Scheme to the UK meeting its net zero by 2050 GHG targets and how the Scheme aligns with Government Policy on a transition to a low carbon economy.	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 in materials, their transportation to site and construction activities.	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.

7.6.2 The baseline conditions described in this section are the same for both the Principal Site and the Cable Route Corridor.

Existing Baseline

GHG Assessment

7.6.3 The baseline for the GHG assessment is a business as usual position where the Scheme does not go ahead. The baseline comprises existing carbon stock and sources of GHG emissions within the boundary of the existing activities on-site, as well as the emissions that may be avoided as a result of the Scheme, i.e. future emissions from the generation of grid electricity if the Scheme does not go ahead. The baseline data available at this stage of the Scheme's development is limited. A full assessment of the baseline 'no-development' scenario will be undertaken within the ES.

7.6.4 The Principal Site is primarily arable land interspersed with access tracks. Data is not available to calculate GHG emissions from the operation of the existing land, but it is assumed that these emissions will not be material in the context of the overall Scheme. There will be some emissions from the use of machinery on the land. Arable land has a low sequestration value and therefore little sequestration ability will be lost. However, for the purposes of the lifecycle GHG impact assessment, a conservative GHG emissions baseline of zero is applied, which represents a robust worst-case approach.

CCRA

7.6.5 The current baseline for the CCRA is the climate in the location of the Scheme for the 30-year period of 1981 – 2010 (the standard baseline for climate data). Historic climate data obtained from the Met Office website (Ref. 7-34) recorded by the closest meteorological station to the Scheme (Scampton) for the 30-year climate period of 1981-2010 is summarised in Table 7-10 below.

Table 7-10: Historic Climate Data

Climatic Factor	Month	Figure
Average annual maximum daily temperature (°C)	-	13.44
Warmest month on average (°C)	July	21.32
Coldest month on average (°C)	January	6.59
Mean annual rainfall levels (mm)	-	613.15
Wettest month on average (mm)	June	60.48
Driest month on average (mm)	February	35.93

7.6.6 The Met Office historic 10-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) is summarised in Table 7-11.

Table 7-11: Historic 10-year averages for the England North and East region

Climate Period	Climate Variables	
	Mean maximum annual temperatures (degrees)	Mean annual rainfall (mm)
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

GHG Assessment

7.6.7 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 that these will not be material in the context of the overall Scheme.

7.6.8 Therefore, for the purpose of the GHG assessment, embodied GHG emissions are considered zero in the future baseline. The future baseline for the GHG assessment is considered to be zero.

CCRA

7.6.9 The future baseline is expected to differ from the present-day baseline 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 purpose of the assessment, UKCP18 probabilistic projections for pre-defined 20-year periods for the following average climate variables have been obtained and will be further analysed and reported in the ES for the Scheme:

- Mean annual temperature;
- Mean summer temperature;
- Mean winter temperature;
- Maximum summer temperature;
- Minimum winter temperature;
- Mean annual precipitation;
- Mean summer precipitation; and
- Mean winter precipitation.

7.6.10 Projected temperature and precipitation variables are presented in Table 7-12 and Table 7-13 respectively. UKCP18 probabilistic projections have been

analysed for the 25km^2 grid square within which the Scheme is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2010 baseline.

7.6.11 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.

7.6.12 As the anticipated life of the Scheme is at least 40 years, the CCRA has considered a scenario that reflects a high level of GHG emissions at the 10%, 50% and 90% probability levels up to 2079 to assess the impact of climate change over the assessed lifetime of the Scheme. It is noted that the UKCP18 data to cover this period runs to 2079, beyond the 40 year life however this approach is considered conservative to allow flexibility in the length of the Scheme's lifetime.

Table 7-12: Projected changes in temperature variables (°C)

Climate Variable	Time Period	
	2020-2039	2050-2079
Mean annual air temperature anomaly at 1.5 m (°C)	+1.1 (+0.5 to +1.6)	+2.3 (+1.3 to +3.5)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.3 (+0.4 to +2.1)	+2.9 (+1.4 to +4.5)
Mean winter air temperature anomaly at 1.5 m (°C)	+0.9 (+0.2 to +1.7)	+2.0 (+0.7 to +3.5)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.4 (+0.3 to +2.5)	+3.3 (+1.2 to +5.3)
Minimum winter air temperature anomaly at 1.5 m (°C)	+0.9 (+0.1 to +1.8)	+2.1 (+0.6 to +3.8)

Table 7-13: Projected changes in precipitation variables (%)

Climate Variable	Time Period	
	2020-2049	2050-2079
Annual precipitation rate anomaly (%)	+0.2 (+-6.6 to +6.8)	-2.3 (-11.5 to +6.9)

Summer precipitation rate anomaly (%)	-3.7 (-21.4 to +14.3)	-20.9 (-44.1 to +2.8)
Winter precipitation rate anomaly (%)	3.5 (-4.3 to +12.1)	+10.2 (-2.7 to +25.5)

7.7 Embedded Design Mitigation

GHG Assessment

7.7.1 A range of embedded mitigation is being considered for incorporation into the Scheme design to mitigate the impacts of the Scheme on the climate. These are the measures included in the Framework Construction Environmental Management Plan (refer to **PEI Report Volume I Appendix 3-1**):

- Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable;
- Designing, constructing and implementing the Scheme in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content where feasible;
- Reusing suitable infrastructure and resources where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements);
- Liaising with construction personnel for the potential to implement staff minibuses and car sharing options;
- Implementing a Travel Plan in the Construction Traffic Management Plan (CTMP) (refer to the Framework CTMP in **PEI Report Volume II Appendix 15-2**) 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 connections and pedestrian/cycle access routes to/ from the Scheme to all construction staff, and providing appropriate facilities for the safe storage of cycles;
- Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and
- Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.

7.7.2 The Framework CEMP will be reviewed, revised and updated as the Scheme progresses to ensure all potential impacts and residual effects are considered and addressed as far as practicable, in keeping with available good practice at that point in time.

CCRA

7.7.3 A range of embedded mitigation has been incorporated into the Scheme design to mitigate the impacts of climate change.

7.7.4 **PEI Report Volume I Chapter 10: Flood Risk, Drainage and Surface Water** presents a series of measures to mitigate flood risk. The CEMP will consider the management of activities within floodplain areas (i.e. kept to a minimum and with temporary land take required for construction to be located out of the floodplain as far as reasonably practicable.

7.7.5 The Framework CEMP will incorporate measures to prevent an increase in flood risk during the construction works, including the provision of temporary settlement and drainage measures.

7.7.6 The CEMP will incorporate measures aimed at preventing an increase in flood risk during the construction works. Measures that could be implemented include:

- 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 regulations, if required.
- Connectivity will be maintained between the floodplain and the adjacent watercourses, with no changes in ground levels within the floodplain as far as practicable.
- During the construction 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.
- The construction laydown area site office and supervisor will be notified of any potential flood occurring by use of the Floodline Warnings Direct or equivalent service.

7.7.7 To manage flood risk during construction and operation an Outline Surface Water Drainage Strategy will be submitted with the DCO Application which will provide for the attenuation of surface water runoff from the Scheme, whilst minimising flood risk to the Site and surrounding areas:

- All temporary construction compounds will be located outside of areas of fluvial flood zones 2.
- Additional attenuation in the form of SuDS will be incorporated to control any increase in the rate of flow towards receiving watercourses including allowances for climate change.

7.7.8 In **PEI Report Volume I Chapter 12: Landscape and Visual Amenity**, consideration of potential changes to vegetation e.g. tree longevity will provided, and cross referenced with the climate change assessment where appropriate.

7.8 Assessment of Likely Impacts and Effects

GHG 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 **PEI Report Volume I Chapter 3: Scheme Description** are outlined in the sections below. The assessments have been assessed using benchmarks based on other UK solar farm schemes.

Construction (2025 to 2027)

7.8.2 The greatest GHG impacts occur during the construction phase as a result of the manufacture of the materials and components required. The manufacture of the Battery Energy Storage System (BESS) along with the manufacture of solar PV panels will have the greatest embodied carbon impact. In the other solar schemes being used as a comparator, these components are assumed to be manufactured abroad and therefore also have associated transportation emissions reflective of this.

7.8.3 Other sources of emissions during construction within the scope of the GHG emissions assessment include water, energy, and fuel use for construction activities including fuel consumed by construction plant and machinery; fuel use for the transportation of construction materials to the Scheme Boundary; transportation of construction workers to and from the Scheme Boundary; and the transportation and disposal of waste.

7.8.4 A Biodiversity Net Gain (BNG) report will be prepared with the ES and submitted as part of the DCO application. The outputs of this report will be used to inform an assessment of the carbon impacts of land use change as part of the GHG assessment to be included in the ES.

7.8.5 Total GHG emissions from the construction phase of a number of solar NSIPs currently being brought forward are presented in Table 7-14. Annual construction emissions (tCO_2e) have been combined with opening year installed capacity (MWp) for each Scheme to establish an average of 0.44 tCO_2e MWh This benchmark has been applied to the Scheme to provide estimated construction emissions.

Table 7-14: Construction GHG emissions

Project	Annual Construction Emissions (tCO_2e)	Opening Year MWh	Benchmark (tCO_2e/MWh)
Sunnica Energy Farm	226,008	643,361	0.35
Longfield Solar Farm	184,565	356,475	0.52
Average			**0.44**

7.8.6 The current specific yield for the Scheme is 1,130.4 kWh/kWp/year. There is an estimated capacity of 942.7 MWp. The Scheme is expected to produce 1,065,000 MWh annually, and hence the annual construction emissions from this Scheme have been estimated at 468,600 tCO_2e. As the construction period is expected to take around 2 years (2025-2027), total emissions from construction are estimated at 937,200 tCO_2e. A lengthening of the construction period would have a minimal effect on total construction emissions. This is due to the fact that the majority of construction emissions come from the embodied emissions of products and materials i.e. emissions from the manufacture of assets. Extending the time taken for construction, and therefore emissions sources like worker travel, would have an insignificant impact on total construction emissions.

Significance of Effect (Construction)

7.8.7 GHG emissions from construction have been assessed to identify the significance of their impact. Table 7-15 presents the estimated construction emissions against the carbon budget period during which they arise. Construction emissions will fall under the 4th UK carbon budget.

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

Table 7-15: UK carbon budgets relevant to construction period

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Annual Construction Emissions During Carbon Budget Period (tCO_2e)	Construction Emissions as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	927,025	0.24 %

7.8.9 Annual emissions from the construction of the Scheme are compared to the magnitude of impact and significance definitions outlined in Table 7-4 and are determined to represent a **minor adverse (not significant) effect**. This is based on the IEMA criteria which states that where a Scheme is compatible with the budgeted, science based 1.5 C trajectory toward net zero and complies with up to date policy then it has a minor adverse impact. The construction and operation of solar farms such as the Scheme plays a key role in Government policy to decarbonise the national grid and for the UK to meet its net zero emissions target by 2050.

Operation

7.8.10 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 Scheme; and maintenance activities (including embodied carbon in replacement parts including PV panels, replacement battery cells, plant and machinery requirements, fuel and

water use during maintenance activities, transportation of materials and waste to and from the Scheme Boundary, and waste management activities).

7.8.11 Total GHG emissions from the operational phase of a number of solar farms are presented in Table 7-16, along with their average annual MWh production. From these schemes, an annualised benchmark of 0.015 tCO_2e/MWh has been calculated.

7.8.12 The Scheme is expected to produce 1,065,000 MWh annually. On this basis annual operational emissions from the Scheme have been estimated at 16,222 tCO_2e. The operational lifetime of the Scheme is expected to be at least 40 years, hence the total operational GHG emissions are estimated at **648,868 tCO2e**.

Table 7-16: Operational GHG emissions

Project	Average Annual Operational Emissions (tCO2e)	Opening Year MWh	Benchmark (tCO2e/MWh)
Sunnica Energy Farm	5,220.2	643,361	0.008
Longfield Solar Farm	7,770	356,475	0.022
Average			**0.015**

7.8.13 While sulphur hexafluoride (SF_6) is a potential source of GHG emissions over the lifetime of the Scheme (i.e. derived from certain electric items such as gas-insulated switchgear and gas-insulated transformers during production, operation through leakage, and dismantling), it has not been possible to quantify fugitive emissions from the leakage of SF_6 due to insufficient research data being available on this topic. SF_6 is one of the seven GHGs identified by the Kyoto Protocol (7-38Ref. 7-35) due to its high Global Warming Potential (GWP) of 23,900.

7.8.14 It is not anticipated that SF_6 emissions will significantly affect the overall outcome of this assessment, however. For example, total annual SF_6 emissions from the National Grid Transmission Network in 2015-2016 equated to 216,645 tCO_2e (Widger and Haddad, 2018; Ref. 7-36), and are assumed to be similar each year. As the Scheme will provide less than 1% of total generation capacity to the National Grid Transmission Network, and as switchgear and transformers are not limited to power generation facilities but can be found all across the network, it is anticipated that the Scheme's contribution to this total will be minimal.

Significance of Effect (Operation)

7.8.15 The Scheme is expected to be operational by no earlier than 2027, therefore operational emissions up to 2037 (the end of the 6th carbon budget) will fall under the 4th, 5th and 6th UK carbon budgets, beyond which point no carbon

budgets have yet been published. Table 7-17 presents the estimated operational emissions against the carbon budget periods during which they arise.

Table 7-17: Average annual operational GHG emissions of the Scheme vs the relevant UK carbon budgets relevant to operation phase (up to 2037)

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO2e)	Average Annual Operational Emissions vs the Grid During Carbon Budget Period (tCO2e)	Operational Emissions as a Proportion of Carbon Budget
5th Carbon Budget (2028 to 2032)	353,000,000	72,420	0.02 %
6th Carbon Budget (2033 to 2037)	193,000,000	72,420	0.04 %

7.8.16 The Scheme's operational phase indirectly causes a reduction in atmospheric GHG concentration, compared to the without-project baseline. The GHG impact of the operational phase is considered to be a **significant (beneficial) effect** when compared to the counterfactual 'business-as-usual' scenario, described below. The Scheme directly supports the emerging policy environment of decarbonising electricity generation, as laid out in the CCC's Sixth Carbon Budget Advice. The National Grid cannot and will not decarbonise without investments in low carbon electricity generation projects like the Scheme.

Decommissioning

7.8.17 Sources of emissions during decommissioning within the scope of the GHG emissions assessment include water use for decommissioning activities; fuel use on-site; transportation of materials and waste; and waste disposal.

7.8.18 Total GHG emissions from the decommissioning phase of a number of solar farms are presented in Table 7-18, along with their average annual MWh production. From these schemes, an annualised benchmark of 0.018 tCO_2e/MWh has been calculated.

7.8.19 The Scheme is expected to produce 1,065,000 MWh annually, and hence the annual decommissioning emissions from the Scheme have been estimated at 63,900 tCO_2e. As the decommissioning phase of the Scheme is expected to take 2 years, total emissions from decommissioning are estimated at **127,800 tCO2e**.

Table 7-18: Decommissioning GHG emissions

Project	Average Annual Decommissioning Emissions (tCO_2e)	Opening Year MWh	Benchmark (tCO2e/MWh)

Sunnica Energy Farm	7,592	643,361	0.012
Longfield Solar Farm	50,473	356,475	0.142

7.8.20 As above for the operational phase, the decommissioning GHG footprint is considered to reflect a robust worst case as the calculations have been carried out using current emissions factors. By 2065, GHG emissions associated with energy generation, transportation, operation of plant and waste disposal throughout the supply chain are anticipated to be much lower as a result of grid decarbonisation and machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050.

Significance of Effect (Decommissioning)

7.8.21 While there will be GHG emissions associated with the decommissioning phase of the Scheme, actual emissions are anticipated to be lower as the figures presented in Table 7-18Table 7-18: Decommissioning GHG emissions represent a robust worst-case scenario, as discussed above. Also, the overall GHG reductions achieved by the Scheme are considered to offset and outweigh any GHG impacts associated with the decommissioning phase of the Scheme.

7.8.22 GHG emissions from the decommissioning phase are therefore considered to have a **minor adverse (not significant) effect** on climate change.

Overall GHG impact

7.8.23 The GHG impact of construction and decommissioning are anticipated to result in minor adverse, not significant effects on the climate, while the impact of operations is considered to have a beneficial (significant) effect.

7.8.24 Based on the other Schemes used as comparators in this assessment, the GHG intensity for similar NSIP solar schemes is anticipated to sit continually below the forecast grid average, therefore GHG emissions savings are expected to be achieved throughout the lifetime of such schemes. 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.

7.8.25 In accordance with IEMA significance criteria the Scheme causes GHG emissions to be avoided from the atmosphere. The Scheme is therefore anticipated to have a **beneficial (significant) effect** on the climate.

Carbon Intensity of the Scheme

7.8.26 At this stage, a quantitative assessment of the carbon intensity of the Scheme has not been possible. This will be updated for the ES as design and Scheme information develops.

7.8.27 However, it is possible to qualitatively assess the carbon intensity of the Scheme against the counterfactual 'business-as-usual' scenario. It is assumed that the electricity provided by the Scheme would otherwise be

generated by a gas-fired Combined Cycle Gas Turbine (CCGT), the most cabon-efficient fossil fuelled technology available. These operate at an average intensity of 354 gCO_2e/kWh. The expected intensity of electricity generated from solar power is significantly less, which will deliver carbon savings over the operational lifetime of the Scheme.

7.8.28 Additional savings, over and above that of electricity generation from solar rather than CCGT, are achieved through the use of the Battery Energy Storage System (BESS). Again, this will be quantified at the ES stage. Relatively fast response power sources such as battery storage have an important role to play in helping to balance supply and demand within the electricity grid. This grid balancing function is often performed using high-carbon intensity power sources such as open cycle gas turbines (OCGT), so the use of a battery charged from solar PV generation can deliver a direct carbon saving relative to an OCGT.

CCRA

7.8.29 Table 7-19 summarises the preliminary assessment of climate change risk to the Scheme. This assessment will be updated in the ES as the design of the Scheme develops and other assessments such as flood risk are completed.

Table 7-19: Preliminary climate change risk to the Scheme

Potential climate changes	Potential impacts on the Development	Proposed Adaptation / Resilience measures	Likelihood	Measure of Consequence	Significance Level
Increased frequency and severity of extreme weather events (such as heavy and/or prolonged precipitation, storm events and heatwaves)	Damage to utilities due to storm events or intense rainfall. Damage to drainage systems, gutters and downpipes due to flooding from intense rainfall. Flooding from drainage systems during intense or prolonged rainfall.	Minimise the duration of topsoil and construction material storage within the 1:100-year floodplain extent	Low	Low	Not Significant
Increased winter precipitation	Surface water flooding and standing waters. Deterioration of structures or foundations due to soil moisture levels.	To be confirmed in the ES.	Moderate	Low	Not Significant
Decreased summer precipitation	Reduced water supply for building users.	No additional measures required	Low	Low	Not Significant
Increased summer and winter temperatures	Increase in ambient temperature of buildings, leading to higher air conditioning requirements and	Ensure BESS have cooling systems installed	Moderate	Low	Not Significant

Potential climate changes	Potential impacts on the Development	Proposed Adaptation / Resilience measures	Likelihood	Measure of Consequence	Significance Level
	impacts on the thermal comfort of building users. Heat damage, deformation, cracking and thermal expansion of pavement surfaces and walls. Overheating of electrical equipment.				
	Increase snow/ice melt leading to flooding	Ensure consideration in Flood Risk Assessment.	Low	Low	Not Significant
Increased Sea Level Rise	Surface water flooding and standing waters. Damage to utilities and due to flooding. Damage to drainage systems due to flooding. Deterioration of structures or foundations due to soil moisture levels.	Ensure consideration in Flood Risk Assessment (and Drainage Strategy) and site location selection.	Low	Low	Not Significant

7.9 Residual Effects

7.9.1 This section identifies the residual effects, following the implementation of mitigation and monitoring measures, known as ‘residual effects’ that cannot be eliminated through design changes or the application of standard mitigation measures.

7.9.2 There will be unavoidable GHG emissions resulting from both the construction, operation and decommissioning phases of the Scheme as materials, energy and fuel use, and transport will be required. However, as the overall impact of the Scheme is major beneficial residual effects are considered minimal.

7.9.3 Residual effects from climate change risk impacts will be identified and presented in the ES once other full assessments have been undertaken. There are considered to be no significant residual effects for surface water, groundwater or flood risk during the construction, operation and decommissioning phases of the Scheme. The assessment will be reviewed and revised where necessary at the ES stage when further design detail is available and further consultation has been undertaken with statutory bodies.

Table 7-20: Summary of Residual Effects

Receptor	Description of impact	Significance of effect without mitigation	Embedded and additional mitigation measure	Residual effect after mitigation
GHG assessment				
Construction (2025 to 2027)	GHG emissions as a consequence of construction activities	Not significant	The overall beneficial impact of the Scheme itself is considered to offset any GHG emissions during construction	Minor Adverse, not significant
Operation	GHG emissions as a consequence of operational activities	Beneficial (significant)	No specific mitigation identified	Beneficial (significant)
Decommissioning	GHG emissions as a consequence of decommissioning activities	Not significant	The overall beneficial impact of the Scheme itself is considered to offset any GHG emissions	Minor Adverse, not significant
Climate change Risk				
Construction (2025 to 2027)	Climate change impacts on construction activities	Low/moderate	No extra measures proposed	Not significant
Operation	Climate change impacts on operational activities	Low/moderate	No extra measures proposed	Not significant
Decommissioning	Climate change impacts on decommissioning activities	Low/moderate	No extra measures proposed	Not significant

7.10 Cumulative Effects

7.10.1 An assessment of cumulative effects is provided in **PEI Report Volume I Chapter 17: Cumulative Effects**.

7.11 References

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