Proposed Solar PV Development

Preliminary Environmental Information Report Chapter 5 Climate Change

Byers Gill Solar

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5.1 Introduction

5.1.1 This chapter presents the findings of the preliminary assessment of the likely significant effects arising from the construction, operation and decommissioning of the Proposed Development on climate change and the impact of the climate on the construction, operation and decommissioning of the Proposed Development.

5.1.2 This chapter details the methodology followed for the assessment, summarises the regulatory and policy framework, and describes the existing environment in the area surrounding the Proposed Development. Following this, the design, mitigation, and residual effects of the Proposed Development are discussed, along with the limitations of the assessment.

5.1.3 Climate change aspects considered within the chapter for the Proposed Development include:

- Greenhouse Gas (GHG) Emissions Impact Assessment – the impact of GHG emissions arising over the lifetime of the Proposed Development on the climate; and
- Climate Change Resilience (CCR) Assessment – the resilience of the Proposed Development to extreme weather and projected future climate change impacts.

5.1.4 The term 'carbon' is used as a shorthand to refer to all GHG emissions. This chapter is supported by Appendix 5.1 CCR Assessment.

5.1.5 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 Proposed Development. This has been scoped out of this climate assessment (refer to Appendix 4.1 Environmental Impact Assessment (EIA) Scoping Report and Appendix 4.2 EIA Scoping Opinion).

5.2 Competent expert advice

5.2.1 Jessica Lauren Postance (Climate Change and Carbon Specialist) is a Chartered Engineer (CEng), a Chartered Environmentalist (CEnv) and Chartered Water and Environmental Manager (CWEM). Jessica has a MEng (Hons) degree in Environmental and Earth Resources Engineering from Imperial College London (2002).

5.2.2 Dan Cole is an environmental consultant with 5.5 years' experience across a wide range of projects including Development Consent Order (DCO) applications, Town and Country Planning Act applications and permitted development projects. Dan has specialised in EIA climate change chapters assessing GHG emissions, CCR and applying industry guidance to embed mitigation within the design. Using knowledge gained in

this area has allowed Dan to become a decarbonisation and net zero advisor across Arup.

5.3 Legislative and policy framework

5.3.1 The relevant legislation, planning policy and guidelines which underpin the assessment methodology for this chapter and inform the scope of the assessment are outlined in this section.

Legislation

International

5.3.2 Adopted in 1997, the Kyoto Protocol [1] to the United National Framework Convention on Climate Change (UNFCCC). This provides legally binding limits on carbon emissions for 37 countries, including the United Kingdom (UK).

5.3.3 The Paris Agreement which builds upon the United Nations Framework Convention on Climate Change (UNFCCC). Countries who signed on to the agreement have agreed to keep the rise in average global temperature this century well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5°C. The UK's response to meeting its commitments under the Paris Agreement resulted in the Climate Change Act 2008 (2050 Target Amendment) Order 2019.

5.3.4 EIA Directives 2011/92/EU and 2014/52/EU. At the European level, the EIA Directive 2011/92/EU places a requirement upon projects which have the potential for significant effects on the surrounding environment and communities to make a formal assessment of these effects. The amended Directive 2014/52/EU, under Part 1 Regulation 5(2)(c), identifies the important role that the EIA process can play in assessing climate change impacts.

National

5.3.5 The legislation of relevance includes:

- Climate Change Act 2008 [2] which sets a target for the year 2050 for the reduction of targeted greenhouse gas emissions and to provide for a system of carbon budgeting (amongst others);
- Climate Change Act 2008 (2050 Target Amendment) Order 2019 [3] which 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; and
- Carbon Budgets Order 2009 [4], Carbon Budget Order 2011 [5], Carbon Budget Order 2016 [6] and the Carbon Budget Order 2021 [7] set the carbon budgets for each relevant budgetary periods. The sixth Carbon Budget (covering the period from 2033 to 2037), set

out in the Carbon Budget Order 2021, is the first budget to take account of the UK Government's 2050 net zero target.

Table 5-1 UK carbon budgets, as legislated by the Climate Change Act 2008

Carbon budget	5 year period	Carbon budget level (tonnes of carbon dioxide equivalent (tCO_2e))	Reduction below 1990 levels
Fourth	2023-2027	1,950,000,000	50% by 2025
Fifth	2028-2032	1,725,000,000	68% by 2030*
Sixth	2033-2037	965,000,000	78% by 2035

* Originally 57% when Fifth Carbon Budget was enshrined in law, has recently been increased to 68% as the UK's Nationally Determined Contribution ahead of the United Nations' COP26 in November 2021.

Policy

5.3.6 The following national and local policies of relevance have been considered:

National

5.3.7 The national policies of relevance include:

- National Policy Statement (NPS) EN-1 [8], with particular reference to paragraphs 2.1 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 EU Directive 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.
- NPS EN-5 [9], 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 EN-1 NPS and EN-3 [10] March 2023, (draft) NPS's for Energy were published for consultation. The consultation builds on the previous versions of the draft NPS published in September 2021 and seeks views specifically on the role of offshore wind and the role of strategic planning on networks. Section 3.3 of EN-1 reaffirms the government's commitment to delivering the British Energy Security Strategy and EN-3 Section 2.10 reaffirm commitments to sustained growth in solar capacity to align with the UK's net zero ambitions.
- National Planning Policy Framework (NPPF) [11]. The NPPF sets out the government's planning policies for England and how these should be applied. Whilst the policies set may be relevant to the assessment, the NPPF does not form the basis for a decision on a Nationally Significant Infrastructure Project (NSIP). Paragraphs 153 and 154 require developments to "*take a proactive approach to adapting to climate change*". Section 14, emphasises the planning system's pivotal role in sustainable development through "*minimising vulnerability and improving resilience to the impacts of climate change*".

- UK Third Climate Change Risk Assessment 2022 [12]; The Climate Change Act 2008 includes a requirement for UK Government to undertake a CCR Assessment every five year period and to develop a programme for adaptation action in response to identified risks. The UK CCR Assessment 2022 was published in January 2022. The third CCR Assessment makes clear the risks of failing to act on climate change, and the UK's world leading approach to net zero must include action on adaptation to ensure resilience to climate change in the future. This includes building on the 'home grown' renewable energy sector.
- The UK's Net Zero Strategy [13]: The 2021 Report to Parliament: Progress in Reducing Emissions highlighted that whilst the UK Government has made historic climate promises, it has been too slow to follow these with delivery. The Strategy includes policies and proposals for decarbonising all sectors of the UK economy to meet net zero by 2050.
- Climate Change: second national adaptation programme (2018 – 2023) [14]; The Climate Change: second national adaptation programme (2018 – 2023) (NAP) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and launched in 2018.
- The UK Clean Growth Strategy [15]; in 2017 the UK Government published the Clean Growth Strategy, which is a plan for meeting the legislated carbon budgets as set out in the Carbon Budget Order 2016. The Strategy sets out polices to improve the route to market for renewable technologies.
- UK Nationally Determined Contribution (NDC) [16] is a policy that outlines the country's commitments to reducing greenhouse gas emissions under the Paris Agreement on climate change by committing to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels. One aspect of the NDC relates to the development of solar energy as a means of reducing the country's reliance on fossil fuels and decreasing its carbon footprint.

Local

5.3.8 The Proposed Development lies within the administrative boundaries of Darlington Borough Council, Stockton-on-Tees Borough Council and Durham County Council. Planning policy of relevance to the assessment which would be considered includes:

- Darlington Local Plan 2016-2036 [17] sets out aims and objectives for the Local Authority. Aim 5 Design, Climate Change and Construction states new buildings and public spaces should seek to enhance the local character and distinctiveness of the area, whilst also reducing energy consumption and carbon emissions. Policy DC 1 - Sustainable Design Principles and Climate Change states that. Aim 6 within The Plan - Responding to Climate Change and Reducing Energy Consumption, outlines how Darlington Local Authority will support the national commitment for net zero carbon and greenhouse gas emissions by 2050 through the continued move towards a net zero carbon community by encouraging efficient use of resources, good design and well-located development, whilst increasing resilience to impacts from climate change. To achieve this Aim, Darlington Borough need to maximise opportunities to generate and use renewable energy in all developments.
- Stockton-on-Tees Local Plan's 2017 – 2032 [18] Strategic Priority 10 is to achieve a healthy, vibrant and successful low carbon community, resilient to the challenges of climate change and resource pressures. Policy ENV 1 – Energy Efficiency states the council will promote zero carbon development such as renewable energy of heat and electricity from solar, wind, biomass, hydro and geothermal sources. Policy ENV 2 - Renewable and Low

Carbon Energy Generation adds to this by encouraging and supporting the local production of energy from renewable and low carbon sources to help to reduce carbon emissions and contribute towards the achievement of renewable energy targets.

- County Durham Plan 2016 - 2035 [19] seeks to guide the future development of County Durham. Objective 16 Adaptation to Climate Change requires adaptation to the impacts of climate change and extreme weather conditions by promoting appropriate sustainable urban drainage systems (SUDs) in new developments, promoting sustainable land management and conservation including protecting habitats such as woodland and peatland, ensuring that new development is located away from areas of flood risk. Objective 17 Low Carbon requires the reduction of the causes of climate change and support the transition to a low carbon economy by encouraging and enabling the use of low and zero carbon technologies, supporting the development of appropriate renewable energy sources and sustainable and active transport.

Guidance

5.3.9 The following good practice guidance will be used to assess the impact of GHG emissions from the Proposed Development as part of the EIA:

- Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance [20];
- The Publicly Available Specification 2080 (PAS 2080:2023) on carbon management in infrastructure [21];
- Power Lines: Demonstrating compliance with electric and magnetic fields (EMF) public exposure guidelines, A Voluntary Code of Practice (2012) [22]; and
- Royal Institute of Chartered Surveyors (RICS) Whole life carbon assessment for the built environment [[23].

5.3.10 The following good practice guidance will be used to assess the vulnerability of the Proposed Development to climate change:

- Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation [24]; and
- National Planning Policy Guidance on climate change [25].

5.4 Assessment Methodology

Assessment of effects

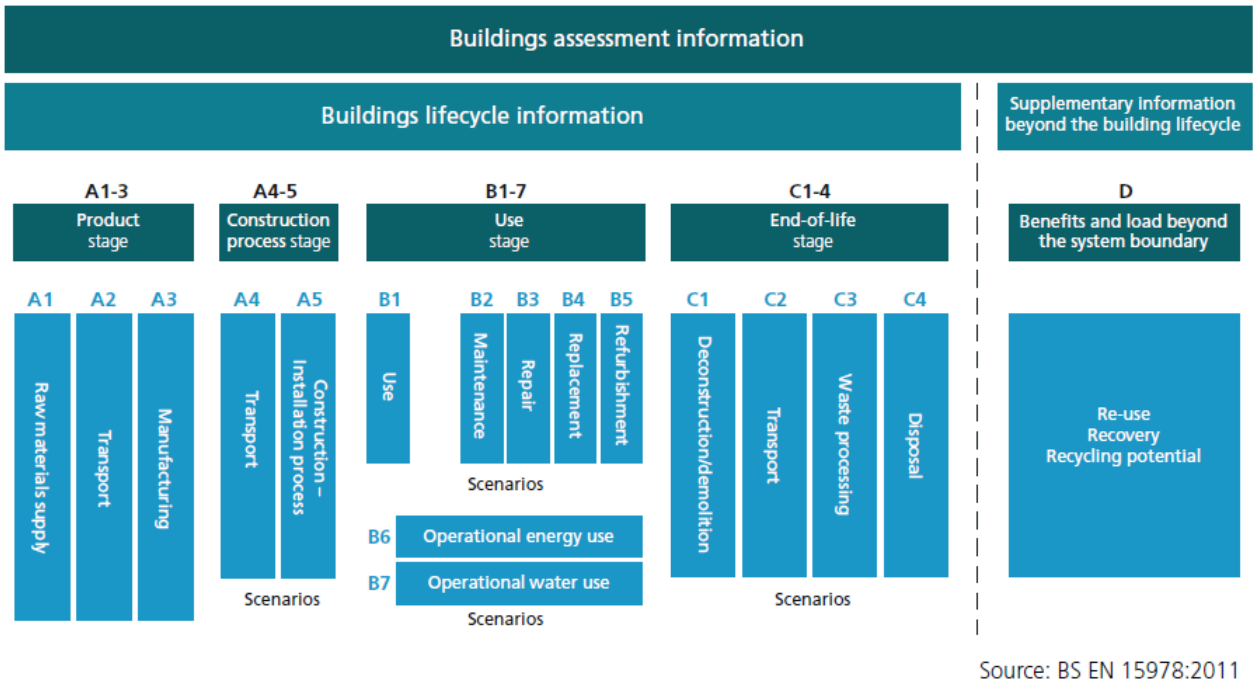
GHG Impact Assessment

5.4.1 This PEIR chapter provides preliminary information to inform a qualitative GHG Impact Assessment based on limited data available at the time of writing. The ES will provide a detailed GHG Impact Assessment. Where data gaps remain in the ES, these will be clearly stated, and a qualitative approach to addressing GHG impacts will be followed, in line with IEMA guidance.

5.4.2 The preliminary GHG Impact Assessment has followed a project lifecycle approach to calculate estimated GHG emissions arising from the construction, operation and decommissioning of the Proposed Development in tCO_2e (tonnes CO_2 equivalent). and to identify GHG 'hot spots' (i.e. emissions sources likely to generate the largest amount of GHG emissions). This enables the identification of priority areas for mitigation in line with the principles set out in IEMA guidance.

5.4.3 The lifecycle stages included within the preliminary GHG Impact Assessment are defined in Plate 5-1 [21] and include: the before use stage (A), hereafter referred to as the 'construction phase', the use stage (B), referred to as the 'operational phase', and end of life stage (C).

Plate 5-1 The GHG emissions assessment scope includes the before use stage (A), the use stage (B) and end of life stage (C)



Source: BS EN 15978:2011

5.4.4 Table 5-2 summarises the key anticipated GHG emissions sources associated with the Proposed Development.

Table 5-2 Potential sources of GHG emissions

Lifecycle stage	Activity	Primary emission sources
Product stage (A1-A3)	Raw material extraction and manufacturing of products required to build the equipment for the Proposed Development. Due to the complexity of the manufacturing processes and design of the equipment, and the use of materials with high embodied carbon, this stage is expected to make a large contribution to overall GHG emissions. e.g. PV Panels and associated supporting equipment and underground cabling Transportation of materials for manufacturing.	Embodied GHG emissions from energy use in extraction and production. GHG emissions from vehicle use.

Lifecycle stage	Activity	Primary emission sources
Construction Phase (A4-A5)	On-site construction activity including emissions from construction compounds. Transportation of construction materials (where these are not included in embodied GHG emissions). Due to the nature of the equipment required, this could require shipment of certain aspects over large distances. Transportation of construction workers.	Energy (electricity, fuel, etc.) consumption from plant and vehicles, generators on-site, and construction worker commuting. Fuel consumption from transportation of materials to site (where these are not included in embodied GHG emissions). GHG emissions from transportation of workers to site.
	Disposal of any waste generated by the construction processes. Land use change. Water use.	GHG emissions from disposal and transportation of waste. Provision of potable water, and treatment of wastewater
Operation Phase (B)	Operation of the Proposed Development. Maintenance of the Proposed Development.	GHG emissions from energy consumption, provision of potable water, and treatment of wastewater. These operational aspects are expected to be negligible in the context of overall GHG emissions. GHG emissions from energy consumption, material use and waste generation as a result of site maintenance. Maintenance is generally expected to be insignificant.
Decommissioning Stage (C)	On-site decommissioning activity. Transportation and disposal of waste materials. Transportation of workers.	Energy (electricity, fuel, etc.) consumption from plant, vehicles, and generators on site. GHG emissions from disposal and transportation of waste. GHG emissions from transportation of workers to site.

5.4.5 For the detailed GHG Impact Assessment, produced to support the Environment Statement, the GHG emissions associated with the current baseline and each lifecycle stage, will be calculated by converting 'activity data' into GHG emissions through application of widely used and reference emission conversion factors in line with the GHG Protocol [26]:

- *Activity data x GHG emissions factor = GHG emissions*

5.4.6 The key emissions factors which will be used in the GHG Impact Assessment are from the following sources:

- Greenhouse Gas Reporting: Conversion Factors [27]; and

- Inventory of Carbon & Energy (ICE) database [28].

5.4.7 Due to the nature of the Proposed Development, energy generated during the operational phase has been considered within this preliminary GHG Impact Assessment. GHG emissions associated with energy unit generation have be calculated based upon initial internal modelling provided by the Applicant and compared with carbon per energy unit of fossil fuel generation to provide a comparison against a gas fired Combined Cycle Gas Turbine (CCGT) generating facility, currently the most carbon-efficient fossil-fuelled technology available.

5.4.8 Following IEMA guidance and PAS 2080, activities that do not significantly change the result of the assessment can be excluded where expected emissions are less than 1% of total emissions, and where all such exclusions total a maximum of 5% of total emissions.

Climate Change Resilience Assessment

5.4.9 This section outlines the methodology employed for assessing the likely significant effects of climate change on the construction and operation of the Proposed Development. In line with IEMA guidance, a qualitative assessment has been undertaken based on professional expertise and judgment.

5.4.10 The approach and methodology for the CCR assessment is as follows:

- analysis of relevant climate change and weather data, emissions scenarios and probability levels;
- identification of climate hazards and potential risks from these climate hazards to the assets and occupants of the Proposed Development;
- assessment of likelihood and consequences - scored by the project designers using a qualitative five-point scale, as set out in Table 5-3 andTable 5-4 respectively;
- assessment of sensitivity;
- consideration of the resilience of the Proposed Development within the context of any incorporated mitigation measures, including resilience measures which are embedded within the design due to regulations and design guidelines; and
- identification of need for any further resilience measures to protect the Proposed Development against the effects of climate change.

Significance criteria

GHG Impact Assessment

5.4.11 In line with IEMA guidance, the sensitivity of the receptor (global climate) to increases in GHG emissions is always defined as ‘high’. This reflects the severe consequences of global climate change and the cumulative contributions of all GHG emission sources.

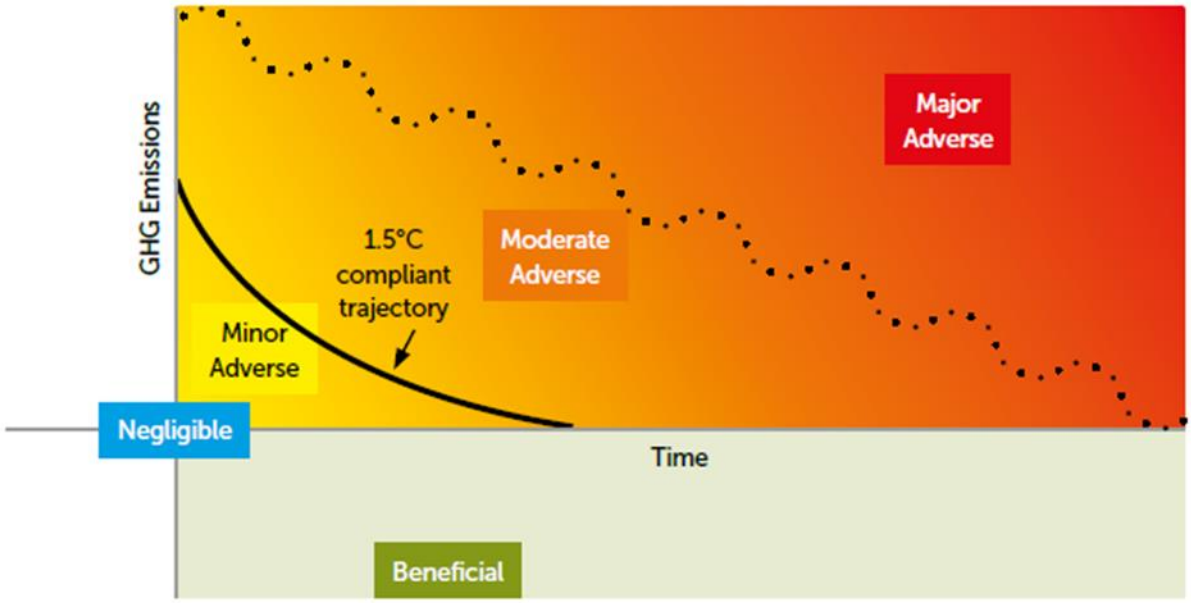
Any additional GHG emissions could compromise the UK's ability to reduce its GHG emissions and therefore meet its future 5 year carbon budgets.

5.4.12 The IEMA guidance has also been adopted for assessing the significance of the Proposed Development's GHG emissions, in addition to GHG accounting and reporting principles. The guidance describes five 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*":

- A development 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;
- A development that is compatible with the budgeted, science based 1.5°C trajectory (in terms of rate of emissions reduction) and which complies with up-to-date policy and 'good practice' reduction measures to achieve that has a minor adverse effect that is not significant. It may have residual emissions but is doing enough to align with and contribute to the relevant 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;
- A development that achieves emissions mitigation that goes substantially beyond the reduction trajectory, or substantially beyond existing and emerging policy compatible with that trajectory, and has minimal residual emissions, is assessed as having a negligible effect that is not significant; and
- A development that causes GHG emissions to be avoided or removed from the atmosphere has a beneficial effect that is significant. Only developments that actively reverse (rather than only reduce) the risk of severe climate change can be judged as having a beneficial effect.

5.4.13 The guidance also states that professional judgement should be used to determine how best to contextualise a project's GHG impact and assign the level of significance. Plate 5-2 describes the level of GHG emission significance in relation to the UK's net zero targets.

Plate 5-2 Different levels of significance plotted against the UK's net zero compatible trajectory [20]



5.4.14 To contextualise GHG emissions of the Proposed Development, the detailed GHG Impact Assessment will provide a comparison against UK Carbon Budgets (Table 5-1). The main reference periods for assessing emissions, cover 2025-2037 (Fourth, Fifth and Sixth Carbon Budgets). As the Carbon Budgets have been set up to 2037, and the operational phase of the Proposed Development extends beyond this, any emissions released after that period will be measured against the Sixth Carbon Budget.

5.4.15 The eventual emissions from the Proposed Development will be affected by the wider response across the UK to meeting the net zero by 2050 target. Linked to this is uncertainty in the future carbon intensity of energy generation and emissions from transport, and these are increasingly unclear in the longer term towards 2050.

Climate Change Resilience Assessment

5.4.16 The climate change resilience of the Proposed Development is measured against the likelihood of occurrence and the impact of that hazard occurring (consequence). The scales of these are described in Tables 5-3 and Tables 5-4.

Table 5-3 Qualitative five-point scale of likelihood of hazard impact

Likelihood Descriptor	Description
Very unlikely	The event may occur once during the lifetime of the project (40 years).
Unlikely	The event occurs during the lifetime of the project (40 years), e.g. once in 40 years.
As likely as not	The event occurs limited times during the lifetime of the project (40 years), e.g. approximately once every 15 years, typically 2 events.
Likely	The event occurs several times during the lifetime of the project (40 years), e.g. approximately once every five years, typically 3 events.
Very likely	The event occurs multiple times during the lifetime of the project (40 years), e.g. approximately annually, typically 27 events.

Table 5-4 Qualitative five-point scale of consequences of hazard impact

Descriptor	Description
Negligible	▪ Minor cuts/abrasions requiring minimal treatment; ▪ Causing minimal work interruption; ▪ No financial loss or costs; ▪ No environmental consequence.
Slight	▪ Injury requiring first aid treatment; ▪ Causing interruption of work for 3 days or less; ▪ Slight financial loss or cost; ▪ Slight environmental consequence.
Moderate	▪ 4 - 14 day lost-time injury(s). Medical treatment required; ▪ Substantial work interruption; ▪ Considerable financial loss; ▪ Moderate environmental implications.
Major	▪ Major injuries, including permanent disabling injuries of over 14 days; ▪ Major work interruption; ▪ Serious financial loss; ▪ Severe environmental implications.
Catastrophic	▪ Single or multiple deaths involving any persons; ▪ Disastrous work interruption; ▪ Huge financial loss; ▪ Devastating environmental implications.

5.4.17 Issues related to vulnerability to climate change predominantly concern the operational phase and how buildings and infrastructure will be designed and developed to integrate resilience to a changing climate. Extreme weather events are however a feature of the baseline climate and projected climate at the time of construction and therefore it is expected that an Outline Environmental Management Plan (EMP) would be prepared by the appointed contractor and implemented during the construction period. The Outline EMP, which will be submitted with the DCO application, will include measures such as ensuring construction materials are covered when stored, and pro-active planning undertaken that accounts for the possibility of extreme weather events, including the use of extreme weather alert systems.

5.4.18 Flood risk will be assessed within the Flood Risk Assessment (FRA) which will accompany the DCO application. This assessment considers the impact of climate change to flood risk, coastal change and water supply; the full assessment with assumptions and methodology can be found in Chapter 10 Hydrology.

Significance criteria for the Climate Change Resilience Assessment

5.4.19 IEMA guidance states that professional judgement should be used to determine whether an effect is significant.

5.4.20 The significance of the climate risks identified in the CCR Assessment will be evaluated based on the likelihood of a hazard having an impact on the Proposed Development and the consequence of the impact as set out in Table 5-5. Where a risk is identified as medium, high or very high this has been deemed to be significant.

Table 5-5 Significance matrix

		Measure of consequence				
		Negligible	**Slight**	**Moderate**	**Major**	**Catastrophic**
Measure of likelihood	**Very likely**	Medium	Medium	High	Very high	Very high
	Likely	Low	Medium	Medium	Very high	Very high
	As likely as not	Low	Low	Medium	High	High
	Unlikely	Very low	Very low	Low	Medium	Medium
	Very unlikely	Very low	Very low	Low	Low	Medium

5.5 Scoping and Consultation

Scoping

5.5.1 An EIA Scoping Report was submitted to PINS on 27 October 2022 with an EIA Scoping Opinion received on 6 December 2022. Table 5-6 includes a summary of how this chapter of the PEIR has responded to each scoping opinion comment.

Table 5-6 Response to the Scoping Opinion

ID	Reference	Stakeholder	Comment	Response
3.1.1	Table 5-3	Planning Inspectorate (PINS)	Temperature changes are not anticipated to be exacerbated by the Proposed Development; the Inspectorate is content to scope this matter out on this basis.	Noted. No further action required.
3.1.2	Table 5-3		Impacts to and from sea level rise - Since the Proposed Development is not identified as being located in an area with potential to be impacted by or to exacerbate impacts from sea level rise therefore, the Inspectorate agrees that this matter can be scoped out.	Noted. No further action required.
3.1.3	Table 5-3		Precipitation change - The Inspectorate is content to scope this matter out on the basis that precipitation changes are not anticipated to be exacerbated by the Proposed Development; it is noted and agreed that impacts to the Proposed Development from increased frequency and duration of precipitation events is scoped in.	The in-combination climate change (ICCI) impacts will not be assessed, as agreed. As stated in Table 5.3, impacts of increased precipitation will be assessed as part of the CCR Assessment.
3.1.4	Table 5-3		Wind impacts from climate change are not anticipated to be exacerbated by the Proposed Development; the Inspectorate is content to scope this matter out on this basis. It is noted and agreed that impacts to the Proposed Development from an increase in strong wind events is scoped in.	The in-combination climate change (ICCI) impacts will not be assessed, as agreed. As stated in Table 5.3, impacts of wind will be assessed as part of the CCR Assessment.
3.1.5	Paragraph 5.7.2.2 and Table 5.7		The Inspectorate agrees that this can be scoped out of the assessment on the basis that impacts from flooding will be assessed in the Flood Risk Chapter and that mitigation measures to manage potential extreme weather events, including use of weather alert systems and appropriate storage of materials, will be implemented.	Noted. No further action required.
3.1.6	Paragraph 5.5.7		Scoping Report paragraph 5.5.7 states that the future climate change scenario is 2040 to 2059 as this best represents the future baseline, however, on the premise that construction is likely to start at the earliest in 2023 and therefore complete in 2024, the lifetime of the development will exceed 2059. The Inspectorate considers that the future climate change scenario should either be fully justified or changed to reflect the extent of the Proposed Development's lifetime.	Agreed, the UKCP18 modelling data dates will be extended to 2070 to capture the entire lifecycle of the Proposed Development.

5.6 Assessment Assumptions and Limitations

5.6.1 This PEIR provides preliminary information based on data and information available at the time of assessment. Some of the information gathered will be supplemented and provided in full and final form within the ES. Information gaps at the PEIR stage, for example GHG emission data, will be addressed as part of the ES. More specific mitigation measures will also be considered at the ES stage.

5.6.2 The PEIR is intended to inform consultation responses and a more detailed assessment of the identified direct effects and potential indirect amenity effects on identified sensitive receptors will be undertaken at the ES stage, drawing on the further assessment work of other disciplines.

GHG Impact Assessment

5.6.3 A preliminary qualitative GHG Impact Assessment has been undertaken on the basis of the information available at the time of assessment. The GHG Impact Assessment to be produced as part of the ES, will use appropriate industry benchmarks, and conservative assumptions on materials, design, assembly, earthworks and use of components to provide a robust assessment of likely GHG emissions.

5.6.4 Assumptions/judgements to support the preliminary GHG Impact Assessment and detailed GHG Impact Assessment are made from either:

- emerging design detail;
- engineering specialist knowledge;
- environmental specialist knowledge;
- climate change/carbon specialist knowledge; manufacturer specifications; or
- proxy data from previous comparable projects and publicly available information from solar PV NSIP projects e.g. amount of steel, aggregates, aluminium.

5.6.5 The following principal assumptions have been used at this PEIR stage:

- Construction phase: It has been assumed that the solar PV modules and PV framework will be delivered via sea and HGV from China, whereas the rest of the materials are assumed to be sourced more locally.
- Construction phase: Fuel will be consumed on site during construction, both in generators and in plant and machinery. It is assumed that generators will run for 6 hours a day, 26 days a month over the 12 month construction period.
- Construction phase: preliminary assessment of embodied carbon in materials is based upon initial internal modelling provided by the Applicant. The indicative size and weight of PV cells has been sourced from comparable supplier product information manufactured in China. This will be revisited in the ES Chapter assessment when further data becomes available.

- Construction and operational phase: waste generation: 5% of the total concrete and aggregates used will be wasted; and 2.5% of the total steel, aluminium and plastics will be wasted.
- Construction and operational phase: waste disposal:
    - For concrete and aggregate, it has been assumed that 50% goes to landfill and 50% will be recycled;
    - For plastics the assumed ratio is 75%:25% recycling: landfill;
    - For steel and aluminium, it is assumed that all waste will be recycled; and
    - It is assumed that a licensed landfill site is within a 100 km radius and each HGV can carry a load 10 tonne per trip.
- Operational phase: the Applicant has provided the following assumptions for maintenance and replacement of parts:
    - Solar PV modules – will be replaced depending on efficiency. It is expected to replace 10% of these over the lifetime of the Proposed Development;
    - All the inverters and BESS cells are assumed to require replacement once, with a further 50% requiring replacement twice, during the design life;
    - Transformers – 5% of these are anticipated to be replaced over the lifetime of the Proposed Development;
    - Structures – Anticipated that these will not need replacing during the proposed design life; an; and
    - Cables - Anticipated that these will not need replacing during the proposed design life.
- Construction, operational and decommissioning phase: sulphur hexafluoride (SF6) (from its use in certain electric components such as gas-insulated switchgears and transformers during production, operation through leakage, and dismantling) is a potential source of GHG emissions over the lifetime of the Proposed Development however it is not possible to accurately quantify the small level of fugitive emissions from the leakage of SF6 due to insufficient data. Manufacturers of electrical switchgear and transformers are increasingly able to provide equipment that either does not contain any SF6, or is sealed for life with extremely low leakage rates [30]. This will therefore not be considered further in the assessment.
- Decommissioning phase: decommissioning emissions from the use of plant, worker travel, water and wastewater consumption would be 50% of the corresponding emissions during the construction phase. This is considered to be a conservative estimate given the UK's net zero commitments.

Climate Change Resilience Assessment

5.6.6 The CCR assessment has been informed by the following principle assumptions:

- the assessment has assumed that mitigation measures relevant to different assets would be implemented effectively; and
- the assessment is affected by assumptions associated with climate modelling and climate change projections, incorporated in UKCP18.

5.6.7 The CCR assessment has the following limitations:

- the assessment is largely qualitative, with the exception of assessments relevant to drainage assets and flood risk;
- there is limited methodological guidance on the assessment of individual risks;
- there is inherent uncertainty in climate change projections. This study has been quantified using UKCP18, the latest set of probabilistic climate projections for the UK; and
- there is often uncertainty in the relationship between changes in climate hazards and the respective response in terms of asset performance. This uncertainty has been assessed qualitatively.

5.7 Study Area

GHG Impact Assessment

5.7.1 Following the latest IEMA guidance, the study area for the assessment of GHG emissions is considered to be the global climate.

5.7.2 The project lifecycle approach has been adopted to capture both direct GHG emissions arising from activities within the Site Area, as shown in Figure 1.2, and indirect carbon emissions arising as a result of the Proposed Development (for example, emissions arising during the transportation of materials to the Site Area and embodied carbon within construction materials).

5.7.3 The GHG Impact Assessment takes into account the expected 40 year lifespan of the Proposed Development.

Climate Change Resilience Assessment

5.7.4 The study area for the CCR Assessment is based on the construction footprint and includes temporary and permanent works within the Site Area i.e., it covers all assets and infrastructure which constitute the Proposed Development, during construction, operation, and decommissioning.

5.7.5 The CCR Assessment takes into account the construction period of the Proposed Development (12 months) and the proposed lifetime (at least 40 years).

5.8 Baseline Conditions

GHG Impact Assessment

5.8.1 This section describes the baseline environmental characteristics for the Proposed Development and surrounding areas with specific reference to GHG emissions.

5.8.2 The GHG emissions baseline has been taken as the current situation, a 'business as usual' scenario whereby the Proposed Development is not implemented. The baseline

comprises existing carbon stock and sources of GHG emissions within the boundary of the existing activities on-site.

5.8.3 The current land use of the Site Area comprises arable land, managed hedgerows and trees, which are likely to have high capacity for carbon sequestration and storage. Baseline agricultural GHG emissions are dependent on soil and vegetation types present, and fuel use for the operation of onsite vehicles and machinery.

5.8.4 Baseline emissions will also include emissions that may be avoided as a result of the Proposed Development, i.e. existing emissions from the generation of grid electricity if the Proposed Development does not go ahead. This will be a cumulative total of all emissions avoided over the lifetime of the Proposed Development, assuming 100% of the energy generated by the Proposed Development is displacing energy generated by fossil fuels.

Climate Change Resilience Assessment

Current and future baselines

5.8.5 This section presents the current baseline and future projected climate conditions and extreme weather events in the study area of the Proposed Development.

Existing baseline

5.8.6 The Met Office generates climatologies for different areas of the UK, known as climate regions, including historical regional climate information. The meteorological station closest to the Proposed Development is Hartburn Grange in Stockton-on-Tees. Data from this station for the periods 1981 – 2010 has been used to provide a baseline for this assessment [31].

Future baseline

5.8.7 As part of the CCR Assessment, future projected climate conditions and extreme weather events for the area encompassing the Proposed Development area are provided for the time periods 2020s to 2070s, covering the construction period following the discharge of the DCO Conditions and an operational period of at least 40 years.

5.8.8 Climate projections take into account uncertainty due to natural variability and an incomplete understanding of the climate system and its imperfect representation in models. The projections do this by giving the probabilities of a range of possible outcomes, as estimated by scientific methodology.

5.8.9 Using the historical baseline data, two methods were implemented to establish the future climate baseline:

- The changes in average climate conditions were obtained from the UKCP18 probabilistic projections of climate change[1]; and
- The changes in extreme weather events were obtained using UKCP18 regional projections[2].

5.8.10 The probabilistic projections in the UKCP18 provide local low, central and high changes across the UK, corresponding to various probability levels (e.g. 10 %, 50 % and 90 %). There are also a number of Representative Concentrations Pathways (RCPs) available for UKCP18 with each pathway resulting in a different range of global mean temperature increases over the 21st century.

5.8.11 Climate change projections for a range of meteorological parameters are presented for different probability levels within the Representative Concentration Pathways 8.5 (RCP8.5) high emission scenario for the near-term and long-term future time periods. IEMA guidance states that using the higher emissions scenario (RCP8.5 in the latest UKCP18 projections) at the 50th percentile, for the 2080s timelines is best practice, unless a substantiated case can be made for not doing this (e.g. anticipated lifespan of the project is shorter than 2080s).

5.8.12 Table 5-7 presents changes in extreme weather events for the 2020 to 2079, such as number of heavy rain days and Table 5-8 presents expected changes in climate conditions, such as mean temperature and precipitation for the 2020s to 2079.

5.8.13 Temperatures in the area are projected to increase in both winter and summer. The largest increase is projected to be in the mean daily maximum temperature in summer, which is expected to increase by 2.7°C to 17.6°C in the time-period 2050-2079, relative to the baseline in the high emissions scenario.

5.8.14 Mean precipitation rates in the region are anticipated to change significantly throughout the century, increasing by 3.4% - 8.8% in the winter and decreasing by 4.2% - 17.3% in summer during the time periods 2020-2049 and 2050-2079.

5.8.15 The mean number of hot days, when the maximum temperature in above 25°C, is anticipated to increase from 5.6 to 29.6 days per year in the time-period 2050-2079 for the high emissions scenario. The average number of days in a given year when the mean daily temperature is below 0°C, is anticipated to decrease from 58.8 to 22.5 in the time period 2050-2079 under the high emissions scenario.

[1] The Met Office provides information on observed and future climate change relative to the baseline period of 1961-1990, based on the latest scientific understanding UKCP18. UKCP provides probabilistic projections for the whole of the UK, at regional level and at local level.

[2] The Regional (12 kilometre) projections are downscaled versions of the Global (60 kilometre) projections providing information on local climate effects.

Table 5-7 UKCP18 climate change projections for extreme weather events for the local area (12-kilometre grid square) for the time periods; 2020-2049 and 2050-2079 (under the RCP 8.5 high emission scenario)

Parameter		Observed Baseline 1981- 2010	2020-2049			2050-2079		
			RCP 8.5 Min	RCP8.5 Mean	RCP 8.5 Max	RCP 8.5 Min	RCP8.5 Mean	RCP 8.5 Max
Temperature	Number of frost days (daily minimum temperature equal or lower than 0°C)	58.8	38.9	35.9	33.0	28.7	22.5	16.3
	Heatwaves (3 days with maximum temperature higher than 25°C)	0.9	1.3	2.1	4.5	2.9	6.3	10.7
	Number of hot days (daily maximum temperature higher than 25°C)	5.6	10.0	11.1	12.2	26.5	29.6	32.8
Precipitation	Dry spells (10 days or more with no precipitation)	2.7	2.6	2.8	2.9	3.3	3.3	3.4
	Annual number of days per year when precipitation is greater than 25mm per day (Met Office definition of 'heavy rain')	1.3	0.7	0.8	1.1	1.0	1.3	1.5

Table 5-8 UKCP18 climate change projections for average climate variables for the local area (25km grid square) for the time periods; 2020-2049 and 2050-2079 (under the RCP 8.5 high emissions scenario)

Parameter		Observed Baseline 1981- 2010	2020-2049			2050-2079		
			RCP 8.5 10%	RCP8.5 50%	RCP8.5 90%	RCP 8.5 10%	RCP8.5 50%	RCP 8.5 90%
Temperature	Winter mean temperature	9.2	9.22	10	10.8	9.8	11.1	12.4
	Summer mean temperature	14.9	15.2	16	16.8	16.1	17.6	19.3
	Winter mean daily minimum temperature	0.9	0.8	1.7	2.7	1.4	2.9	4.6
	Summer mean daily maximum temperature	19.6	19.8	20.7	21.7	20.6	22.5	24.5
Precipitation	Winter mean precipitation rate [mm/day]	1.6	1.56	1.69	1.84	1.54	1.74	2.00
	Summer mean precipitation rate [mm/day]	2	1.64	1.92	2.20	1.28	1.65	2.03

Summary of sensitive receptors

GHG Impact Assessment

5.8.16 The global climate is the receptor for the GHG Impact assessment and is considered to be 'high' in line with the IEMA guidance, which highlights the importance of mitigating GHG emissions to reduce the impacts of climate change.

Climate Change Resilience Assessment

5.8.17 The Proposed Development is the receptor for the CCR Assessment. This includes proposed infrastructure, assets (equipment, materials), human health receptors (including workers on site during construction, operation, and decommissioning) and environmental receptors (including landscape features).

5.9 Potential effects

GHG Impact Assessment

Construction

5.9.1 During the construction phase, the Proposed Development will require sourcing materials, manufacturing components, transporting to the Site Area and installation of materials which will account for the GHG emissions associated with this stage of the Proposed Development. The embodied emissions associated with the processes within these activities are for example plant machinery and vehicles using fuel, manufacturing and construction equipment and facilities powered by non-renewables sources and the embodied GHG emissions within the manufacturing of materials which make up elements of the Proposed Development.

Operation

5.9.2 When operational, the Proposed Development will generate electricity from a renewable source and export to the National Grid. The Proposed Development is anticipated to have an installed generation capacity of more than 50MW. The preliminary GHG Impact Assessment has been based on an initial power output based on initial internal modelling provided by the Applicant. This will be revisited in the ES Chapter assessment when further data becomes available.

5.9.3 During the operational phase, the Proposed Development will not emit substantial gases to the atmosphere, and hence not adversely contribute to climate change. The GHG emissions associated with the operational phase are assessed to be primarily associated with the provision of potable water, wastewater treatment and material and waste associated with maintenance procedures.

5.9.4 The Proposed Development is considered to contribute towards the UK achieving the forecasted decarbonised grid mix by contributing to the increase of required renewable energy capacity.

Decommissioning

5.9.5 Decommissioning of the Proposed Development will involve removing components, the reinstatement of land and transporting components away from the Site Area. The GHG emissions associated with the decommissioning phase are associated with the consumption of energy from plant which may be sourced, at least partly depending on grid decarbonisation, from non-renewables sources, vehicles and machinery using non-renewable sources, the disposal and transportation of waste and the transportation of staff using transport measures powered by non-renewable sources.

Climate Change Resilience Assessment

Construction

5.9.6 During the construction phase, there is the potential for adverse weather conditions to impact the Proposed Development. Extreme high temperatures could result in overheating of electrical construction equipment, damage to materials, or increased risks associated with workers overheating.

5.9.7 Extreme precipitation could result in lowering the viability of, and access to, the site (such as heavy rain resulting in surface water flooding of local roads, sources of power supply or inundation of sites).

Operation

5.9.8 During the operational phase, there is the potential for adverse weather conditions to impact the Proposed Development. There are risks associated with increased frequency and intensity of extreme weather events, like strong winds causing damage to the Proposed Development.

Decommissioning

5.9.9 Climate risks associated with decommissioning are likely to be similar to those presented for the construction phase, however the risks are likely to exacerbated given the predicted higher temperatures, increased precipitation and increased frequency of extreme weather events such as storms and heatwaves.

5.10 Design, mitigation and enhancements

5.10.1 This section outlines the embedded mitigation for the Proposed Development for GHG emissions and climate change resilience during construction and operation.

Embedded design measures

GHG emissions

5.10.2 This embedded mitigation will be implemented to reduce the GHG impact of the Proposed Development. Specific embedded mitigation measures include:

- An Outline Environmental Management Plan (EMP), will be provided as part of the ES, will include measures that are considered standard good practice to be implemented by the contractor to reduce the likelihood of impacts or their magnitude, if they were to occur. These measures, are outlined below.
    - Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable;
    - Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Proposed Development by employing good industry practice measures;
    - Designing, constructing and implementing the Proposed Development in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content where feasible;
    - Reusing suitable infrastructure and resources already available in the Site Area where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements or storing, preserving and restoring top soil);
    - Encouraging the use of lower carbon modes of transport by identifying and communicating local bus connections and pedestrian and cycle access routes to/ from the Proposed Development to all construction staff, and providing appropriate facilities for the safe storage of cycles;
    - Liaising with construction personnel for the potential to implement staff minibuses and car sharing options;
    - Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Proposed Development;
    - Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and
    - Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.

5.10.3 There is no embedded mitigation for the operation of the Proposed Development beyond regular maintenance to ensure optimal energy generation efficiency.

Climate Change Resilience

5.10.4 The PEIR and Appendix 5.1 CCR Assessment includes various climate change resilience measures during construction embedded within the Proposed Development. These

include various climate change resilience measures embedded within the Proposed Development. These include:

- Using equipment's cooling systems where necessary/adapting working practices and equipment used based on current weather conditions;
- Protecting workers and resources from extreme weather conditions; and
- Monitoring weather forecasts and the news for Environment Agency flood warnings, relevant weather warnings, and water levels of the local waterways.

5.10.5 The PEIR and Appendix 5.1 CCR Assessment also includes various climate change resilience measures during operation embedded within the Proposed Development. These include:

- Battery Energy Storage System (BESS) systems would include heating, ventilation and cooling (HVAC) systems and these would be contained within the individual equipment containers. These measures will be outlined in the Outline Battery Safety Management Plan;
- All key infrastructure is located outside of the Flood Zones, and there are no permanent buildings on site;
- The FRA will include a number of adaptation measures that would be considered in the detailed design and operations management.
- There will be an 8m easement around all mapped watercourses that cross the site;
- Monitoring weather forecasts and the news for Environment Agency flood warnings, relevant weather warnings, and water levels of the local waterways; and
- A detailed Landscape Environmental Management Plan (LEMP) will be provided at the ES stage and will reflect any required mitigation for landscape and habitat features impacted by low rainfall.

Construction mitigation

5.10.6 No additional construction mitigation has been considered.

Operation mitigation

5.10.7 No additional operational mitigation has been considered.

Enhancement

5.10.8 The design contains no additional enhancements.

5.11 Assessment of likely significant effects

GHG Impact Assessment

5.11.1 The impacts and effects (both beneficial and adverse) associated with the construction, operation, and decommissioning of the Proposed Development are outlined in the

sections below. The assessments have been based on a preliminary GHG assessment which used available design information, comparisons with similar proposed developments and industry benchmarks.

Construction

5.11.2 GHG emissions sources from construction emissions include emissions from construction compounds and transportation of construction materials. The greatest proportion of GHG emissions during the construction phase are anticipated to come from the manufacture of the solar PV panels and manufacture of the PV framework (steel). It is anticipated that manufacture of PV inverters, PV framework (steel) and BESS inverters will contribute to GHG emissions, and a smaller proportion associated with transformers, cables, concrete and aggregate.

5.11.3 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 site, transportation of construction workers to and from the site and the transportation and disposal of waste.

Operation

5.11.4 GHG emissions sources from operational emissions include operational energy and water use (i.e. for auxiliary services and standby power) and maintenance activities (including embodied carbon in replacement parts, plant and machinery requirements, fuel and water use during maintenance activities, transportation of materials and waste to and from the Site Area, and waste management activities).

5.11.5 The current primary land use of the site is arable land with surrounding hedgerows and woodland. These contain sequestered carbon which is likely to be partially disrupted during construction of the Proposed Development. The Proposed Development will also be enhancing existing hedgerows and woodlands and planting additional plots of these habitats. As these habitats mature more carbon will be sequestered over time. A small increase in carbon sink from land use change is predicted on the assumption that the land area of PV Panels will be converted from its current use of primarily arable land to a combination of grassland, scrubland, woodland and hedgerows during operation. Land use change to grassland and scrubland is assumed to be temporary and only for the design life of the Scheme. Land use change to woodland or hedgerows is assumed to be permanent.

5.11.6 Given the nature of the Proposed Development, renewable energy generation during the first year of operation is estimated to be 332.4 GWh, 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. Panels may be gradually replaced through the life of project and after 20 years of operation whereby the efficiency is restored and the degradation factors outlined are reset. This will result in an estimated total

energy generation figure of around 12,167.6 GWh over the anticipated 40-year lifetime. Dividing this lifetime generation figure into the estimated lifetime emissions total gives a total carbon intensity value of 25.2 gCO_2e/kWh.

5.11.7 For a meaningful comparison to be made between the Proposed Development and the UK grid, the operational carbon intensity of the Proposed Development must only include emissions from the ongoing operations of the Proposed Development and exclude emissions from construction and decommissioning. Combining lifetime generation figures and operational emissions figures gives an operational carbon intensity value of 4.3g CO_2e/kWh.

5.11.8 Comparing the Proposed Development against a gas fired CCGT generating facility, currently the most carbon-efficient fossil-fuelled technology available, a representative figure for the carbon intensity of a CCGT is 354g CO_2e/kWh [32]. The operational carbon intensity of the Proposed Development is therefore 98.8% lower than that of the counterfactual CCGT. Each kilowatt hour of electricity generated by the Proposed Development will emit 349.7g CO_2e less than if it was generated by a gas fired CCGT generating facility. Combining this figure with the estimated lifetime output from the Proposed Development indicates an overall lifetime carbon reduction, relative to the counterfactual CCGT, of approximately 4 million tonnes CO_2e.

Decommissioning

5.11.9 GHG emissions from the Proposed Development during decommissioning are subject to a high degree of uncertainty, as the conditions that will apply over four decades into the future cannot be described with any confidence.

5.11.10 Upon decommissioning, it is estimated that some of the sequestered CO_2e will be rereleased to the atmosphere as grassland and scrubland are returned to arable farming. Land use change to woodland or hedgerows is assumed to be permanent, with additional carbon stocks in soil and vegetation in these areas remaining sequestered.

Significance of Effect (Construction)

5.11.11 GHG emissions from construction have been assessed against the relevant carbon budget periods during which they arise in order to identify the significance of their impacts. Construction emissions will fall under the Fourth UK carbon budget.

5.11.12 Based on the nature of the Proposed Development and experience with similar projects, it is not expected that annual emissions from the construction of the Proposed Development will contribute to equal to or more than 1% of the annualised Fourth UK carbon budget. GHG emissions from the construction of the Proposed Development are therefore anticipated to have a minor adverse effect on the climate, which is not significant.

Significance of Effect (Operation)

5.11.13 The Proposed Development will be operational from no earlier than 2026, and 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. Based on the nature of the Proposed Development and experience with similar projects, it is not anticipated that operational emissions to 2037 will contribute to be equal to or more than 1% of the annualised 4th, 5th or 6th carbon budgets. The magnitude of effect is therefore considered low.

5.11.14 Beyond 2037, it is anticipated that direct operational emissions will decrease over time as a result of continuing grid decarbonisation, and of machinery and vehicle electrification, in line with the UK's net-zero carbon emissions 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 Proposed Development over its lifetime.

5.11.15 GHG emissions from the operation of the Proposed Development are therefore anticipated to have a major beneficial effect on the climate, which is significant, both for the years up to and including 2037 and from 2038 onwards.

Significance of Effect (Decommissioning)

5.11.16 While there will be GHG emissions associated with the decommissioning phase of the Proposed Development, actual emissions are anticipated to be lower due to the UK's net zero commitments and associated decarbonisation trajectory. Also, the overall GHG reductions achieved by the Proposed Development are considered to offset and outweigh any GHG impacts associated with the decommissioning phase of the Proposed Development. Therefore, the magnitude of impact is considered to be low.

5.11.17 GHG emissions from the decommissioning phase are therefore anticipated to have a minor adverse effect on the climate, which is not significant.

Climate Change Resilience Assessment

5.11.18 Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in Table 5-9. Potential climate risks to the operational phase, the likelihood, consequence and significance are detailed in Table 5-10. Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in Table 5-11.

Table 5-9 Construction - Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
High temperatures	Increase in annual temperature	All receptors	Overheating of electrical equipment. Damage to materials. Risk of overheating to workers.	Detailed in the CEMP implemented by the contractor. The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Risk reduced through mitigation	Unlikely	Minor	Very Low
High temperatures	Increase in summer temperature	Plant and vehicles, physical structures, materials, and access routes to sites and access routes to sites	Overheating of electrical equipment. Damage to materials. Risk of overheating to workers.	Detailed in the CEMP implemented by the contractor. The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Risk reduced through mitigation	Unlikely	Minor	Very Low
High temperatures	Increase in heat waves	Staff, visitors onsite	Increased heat stress/ heat exhaustion for workers.	The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather. Equipment has cooling systems where necessary.	Risk reduced through mitigation and resilience incorporated into the design	As likely as not	Minor	Low
High temperatures	Increase in heat waves	Plant and vehicles, physical structures, materials,	Overheating of electrical equipment. Damage to materials	The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather.	Risk reduced through mitigation and resilience incorporated into the design	As likely as not	Minor	Low

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
				Equipment has cooling systems where necessary.				
High precipitation	Increase to winter rainfall	Plant and vehicles, physical structures, materials, and access routes to sites and access routes to sites.	Viability of and access to sites (such as heavy rain resulting in surface water flooding of local roads, sources of power supply or inundation of sites).	Detailed in the Outline CEMP. The contractors will monitor weather forecasts and receive Environment Agency's (EA) flood alerts and plan works accordingly, protecting workers and resources from any extreme weather conditions such as storms, flooding. Infrastructure flood resilience detailed in the FRA.	Risk reduced through mitigation	As likely as not	Minor	Low
Low precipitation	Decrease in summer rainfall	All receptors	None considered	None required	N/A	N/A	N/A	N/A
Increase in storm intensity	Stronger winds, heatwaves, heavy precipitation	Plant and vehicles, physical structures, materials, and access routes to sites	Damage to structures / materials / equipment and resulting in delays to programme and associated costs and/or unacceptable safety risks. May include high winds increasing dust (and other debris), storm surge and coastal erosion.	The Contractor will monitor weather forecasts and receive Environment Agency flood warnings and alerts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Risk reduced through extreme weather working policy detailed in the Outline CEMP	Unlikely	Moderate	Low

Table 5-10 Operation - Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
High temperatures	Increase in summer temperature	All receptors (infrastructure, buildings, staff and workers)	Increase in air conditioning requirements. Overheating of electrical equipment.	BESS systems would include HVAC systems and these would be contained within the individual equipment containers. An Outline Battery Safety Management Plan will be in place during the operation phase.	Risk reduced through design	Unlikely	Moderate	Low
High temperatures	Increase in heat waves	All receptors (infrastructure, buildings, staff and workers)	Increase in air conditioning requirements. Overheating of electrical equipment.	BESS systems would include HVAC systems and these would be contained within the individual equipment containers. An Outline Battery Safety Management Plan will be in place during the operation phase.	Risk reduced through design	Unlikely	Moderate	Low
High precipitation	Increase to annual rainfall	All receptors	Surface water flooding and standing waters. Deterioration of structures or foundations due to increase in soil moisture levels. Damage to building surfaces/ exposed utilities from increased drying/wetting and increase frost penetration	All key infrastructure is located outside of the Flood Zones, and there are no permanent buildings on site. All panels are being raised above the mean flood level, or moved. In addition. there will be an 8m easement around the watercourses that crosses the site.	Risk reduced through design	Very unlikely	Moderate	Low
High precipitation	Increase to winter rainfall	All receptors (infrastructure,	Surface water flooding and standing waters.	All key infrastructure is located outside of the Flood	Risk reduced through design	As likely as not	Minor	Low

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
		buildings, staff and workers)	Deterioration of structures or foundations due to increase in soil moisture levels. Damage to building surfaces / exposed utilities from increased drying / wetting and increase frost penetration.	Zones, and there are no permanent buildings on site. All panels are being raised above the mean flood level, or moved. In addition. there will be an 8m easement around the watercourses that crosses the site as well.				
Low precipitation	Decrease in summer rainfall	All receptors (infrastructure, habitat mitigation, buildings, staff and workers)	Water shortages. Deterioration of structures or foundations due to decrease in soil moisture levels. Deterioration of habitat mitigation.	A detailed LEMP will be provided at the ES stage and will reflect any required mitigation for landscape and habitat features impacted by low rainfall.	Risk reduced through mitigation measure	As likely as not	Minor	Low
Increase in storm intensity	Stronger winds, heatwaves, heavy precipitation	Built terrestrial assets, staff facilities and access	Surface water flooding and standing waters. Deterioration of structures or foundations due to increase in soil moisture levels. Damage to building surfaces/ exposed utilities from increased	The FRA includes a number of adaptation measures that would be considered in the detailed design and operations management. Design takes into account potential falling trees and will be designed with stronger winds accounted for.	Risk reduced through design	As likely as not	Minor	Low

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
			drying/wetting and increase frost penetration or tree falls. Strong winds damaging structures directly or via falling trees and debris.					

Table 5-11 Decommissioning - Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
High temperatures	Increase in annual temperature	All receptors	Damage to structures / materials / equipment and resulting in delays to programme and associated costs and/or unacceptable safety risks.	Prevention measures will be covered in the Decommissioning EMP (DEMP), likely to be similar to CEMP	Risk reduced through mitigation	Very unlikely	Minimal	Very Low
High temperatures	Increase in summer temperature	Staff, visitors on-site	Increased heat stress/ heat exhaustion for workers.	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	Unlikely	Minimal	Very Low
High temperatures	Increase in summer temperature	Built assets, materials, staff facilities and access routes to sites	Damage to structures / materials / equipment and resulting in delays to programme and associated costs and/or unacceptable safety risks.	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	Unlikely	Minimal	Very Low

Climate hazard	Potential Climate Change Impact	Receptor	Potential Climate Change Risk to Proposed Development	Existing or embedded mitigation measure	Result of mitigation measure on resilience	Likelihood	Consequence	Risk rating
High temperatures	Increase in heat waves	Staff, visitors onsite	Increased heat stress/ heat exhaustion for workers.	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	As likely as not	Minimal	Low
High temperatures	Increase in heat waves	Built assets, materials, staff facilities and access routes to sites	Damage to structures / materials / equipment and resulting in delays to programme and associated costs and/or unacceptable safety risks.	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	As likely as not	Minimal	Low
High precipitation	Increase to winter rainfall	Built assets, materials, staff facilities and access routes to sites	Viability of and access to sites (such as heavy rain resulting in surface water flooding of local roads, sources of power supply or inundation of sites).	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	Unlikely	Minimal	Very Low
Low precipitation	Decrease in summer rainfall	All receptors	None considered	None considered	N/A	N/A	N/A	N/A
Increase in storm intensity	Stronger winds, heatwaves, heavy precipitation	Built assets, materials, staff facilities and access routes to sites	Damage to structures / materials / equipment and resulting in delays to programme and associated costs and/or unacceptable safety risks. May include high winds increasing dust (and other debris), storm surge and coastal erosion.	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP	Risk reduced through mitigation	Unlikely	Minimal	Very Low

5.12 Monitoring

5.12.1 There is currently no monitoring proposed in relation to Climate Change during the construction, operation or decommissioning of the Proposed Development.

5.13 Summary

5.13.1 This chapter has considered:

- impact of GHG emissions arising over the lifetime of the Proposed Development on the climate; and
- the resilience of the Proposed Development to extreme weather and projected future climate change impacts.

GHG Impact Assessment

Preliminary Construction Assessment

5.13.2 Construction of the Proposed Development would have a minor adverse effect on GHG emissions, which is not significant.

Preliminary Operational Assessment

5.13.3 Operation of the Proposed Development would have a major beneficial effect on climate, which is significant, both for the years up to and including 2037 and from 2038 onwards.

5.13.4 The Proposed Development will be operational from no earlier than 2026, and therefore fall within the 4th, 5th and 6th carbon budgets. Based on the nature of the Proposed Development and experience with similar projects, it is not anticipated that operational emissions 1% of the annualised 4th, 5th or 6th carbon budgets. The magnitude of effect is therefore considered low.

5.13.5 Beyond 2037, it is anticipated that direct operational emissions will decrease over time as a result of continuing grid decarbonisation, and of machinery and vehicle electrification, in line with the UK's net-zero carbon emissions 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 Proposed Development over its lifetime.

Preliminary Decommissioning Assessment

5.13.6 Decommissioning of the Proposed Development would have a minor adverse effect on the climate from GHG emissions, which is not significant.

5.13.7 While there will be GHG emissions associated with the decommissioning phase of the Proposed Development, actual emissions are anticipated to be lower as the figures that will be estimated and presented in the PEIR will represent a worst case scenario. Also, the overall GHG reductions achieved by the Proposed Development are considered to offset and outweigh any GHG impacts associated with the decommissioning phase of the Proposed Development. Therefore, the magnitude of impact is considered to be low.

Climate Change Resilience Assessment

5.13.8 No significant residual effects for CCR impacts have been identified.

Table 5-12 Summary of effects

Receptor type	Description of potential impact	Embedded design, mitigation, and enhancement measures	Sensitivity of receptor	Duration and reversibility	Magnitude of impact	Significance of effect
Climate change	Release of GHG emissions during construction	▪ Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable; ▪ Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Proposed Development by employing good industry practice measures; ▪ Designing, constructing and implementing the Proposed Development in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content where feasible; ▪ Reusing suitable infrastructure and resources already available in the Site Area where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements or storing, preserving and restoring top soil); ▪ Encouraging the use of lower carbon modes of transport by identifying and communicating local bus connections and pedestrian and cycle access routes to/ from the Proposed Development to all construction staff, and providing	Medium	The construction period of the Proposed Development	Low	Minor

Receptor type	Description of potential impact	Embedded design, mitigation, and enhancement measures	Sensitivity of receptor	Duration and reversibility	Magnitude of impact	Significance of effect
		appropriate facilities for the safe storage of cycles; ▪ Liaising with construction personnel for the potential to implement staff minibuses and car sharing options; ▪ Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Proposed Development; ▪ Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and ▪ Conducting regular planned maintenance of the construction plant and machinery to optimise efficiency.				
Climate Change	Release of GHG emissions during decommissioning	The same as construction mitigation	Medium	End of design life	Low	Minor
Climate Change	Production of low carbon energy	Nothing beyond increasing efficiency of power generation	Medium	The lifetime of the Proposed Development	High	Major beneficial

Further work

5.13.9 Further assessment and development of mitigation measures will be undertaken as part of the ES and through the completion of the following assessments:

- A detailed GHG assessment, replacing assumptions and benchmarks with design data;
- Assessing water use through construction, operation and decommissioning based on worker numbers and maintenance practices;
- Assessing impacts of land use change throughout construction and decommissioning; and
- Assessing operational energy use.

Bibliography

[1] UNFCCC, 1997. [Online]. Available: https://unfccc.int/resource/docs/convkp/kpeng.pdf. [Accessed 27 March 2023].

[2] HM Government, *Climate Change Act,* 2008.

[3] HM Government, *Climate Change Act 2008 (2050 Target,* 2019.

[4] HM Government, *The Carbon Budgets Order 2009,* 2009.

[5] HM Government, *The Carbon Budgets Order 2011,* 2011.

[6] HM Government, *The Carbon Budgets Order 2016,* 2016.

[7] HM Government, *The Carbon Budgets Order 2021,* 2021.

[8] Department of Energy and Climate Change (DECC), *National Policy Statement for Energy (EN-1),* 2011.

[9] DECC, *National Policy Statement for Electricity Networks Infrastacture (EN-5),* 2011.

[10] BEIS, 2021. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1015233/en-1-draft-for-consultation.pdf. [Accessed 27 March 2023].

[11] Ministry of Housing, Communities and Local Government (MHCLG), *2021,* 2021.

[12] HM Government, *UK Third CLimate Change Risk Assessment,* 2022.

[13] BEIS, 2021. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf. [Accessed 27 March 2023].

[14] Department for Environment Food and Rural Affairs (DEFRA), *The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting Making the country resilient to a changing climate,* 2018.

[15] HM Government, *The Clean Growth Strategy Leading the way to a low carbon future,* 2017.

[16] HM Government, *UK's Nationally Determined Contribution, updated September 2022,* 2020.

[17] Darlington Borough Council, Adopted local plan 2016 - 2036, 2022.

[18] Stockton-on-Tees, Stockton-on-Tees Borough Council Local Plan, 2019.

[19] Durham County Council, County Durham Plan, 2020.

[20] Institution Of Environmental Management and Assessment (IEMA), *Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance,* 2022.

[21] British Standards Institution, *PAS 2080:2023 Carbon Management in Infrastructure,* 2023.

[22] DECC, *Power Lines: Demonstrating compliance with EMF public exposure guidelines, A Voluntary Code of Practice,* 2012.

[23] Royal Institution of Chartered Surveyors (RICS), *professional standards and guidance document on Whole life carbon assessment for the built environment (1st edition),* 2017.

[24] IEMA, *IEMA EIA Guide to: Climate Change Resilience and Adaptation,* 2020.

[25] HM Government, *National Planning Policy Guidance on climate change,* 2019.

[26] Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, 2015.

[27] Department for Business, Energy & Industrial Strategy, Greenhouse Gas Reporting: Conversion Factors, 2021.

[28] Circular Ecology, Embodied Carbon - The ICE Database v3, 2019.

[29] Planning Inspectorate, Scoping Opinion: Proposed Byers Gill Solar Farm. Case Reference: EN010139, 2022.

[30] Widger, P. and Haddad, A, Evaluation of SF6 Leakage from Gas Insulated Equipment on Electricity Networks in Great Britain, 2018.

[31] Met Office, Historic Climate Data, 2019.

[32] UK Parliament, Fossil fuelled power stations: carbon emissions, 2015.