Proposed Solar PV Development

Byers Gill Solar
EN010139

6.2.5 Environmental Statement Chapter 5 Climate Change

Planning Act 2008

APFP Regulation 5(2)(a)

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

Volume 6

February 2024

Revision C01

RWE
14 Bird Street
London
W1U 1BU
United Kingdom

Table of Contents

Table of Plates

Table of Tables

Appendices

5. Climate Change

5.1 Introduction

5.1.1 This Environmental Statement (ES) chapter presents the impact assessment and likely significant effects of Byers Gill Solar (the Proposed Development) on climate change.

5.1.2 The chapter considers the potential effects and any required measures to address potential impacts on climate change during construction, operation and decommissioning. It also identifies the impact of climate change on the Proposed Development.

5.1.3 The Environmental Impact Assessment (EIA) Scoping Report (ES Appendix 4.1) (Document Reference 6.4.4.1) sets out the scope of the Climate Change assessment. In summary, the following have been scoped in and assessed in this ES:

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

5.1.4 This ES chapter sets out:

- The requirements of principal legislation, policy and guidance relevant to this assessment;
- The methodology followed for the assessment, and any associated assumptions and limitations;
- The existing environment surrounding the Proposed Development;
- The potential effects of the Proposed Development on climate change, and the potential impacts of climate change on the Proposed Development, and
- Mitigation measures required where necessary.

5.1.5 This ES chapter is supported by the following appendices:

- ES Appendix 5.1 GHG assessment (Document Reference 6.4.5.1); and
- ES Appendix 5.2 CCR assessment (Document Reference 6.4.5.2).

5.1.6 Potential cumulative effects are considered in greater detail in ES Chapter 13 Cumulative Effects (Document Reference 6.2.13).

5.1.7 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. An assessment of the impacts of the Proposed

Development on climate factors such as sea level rise, and wind impacts from climate change and impacts from flooding, have been scoped out of the assessment. For further information, see Section 5.3 Scoping and Consultation, of this ES Chapter.

5.1.8 This ES chapter and the supporting ES Appendices and ES Figures have been prepared by competent experts at Arup. Full details of these competent experts are provided in ES Appendix 1.1 Competent Expert Evidence (Document Reference 6.4.1.1).

5.2 Legislative and policy framework

5.2.1 This section identifies the key legislation, planning policy and guidelines relevant to the scope and methodology for the Climate Change assessments.

Legislation

International

5.2.2 The following key international legislation is applicable to the assessment:

- The Kyoto Protocol *[1]* to the United National Framework Convention on Climate Change (UNFCCC). Adopted in 1997, this provides legally binding limits on carbon emissions for 37 countries, including the United Kingdom (UK).
- The Paris Agreement *[2]* 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.
- EIA Directives 2011/92/EU and 2014/52/EU *[3]*. 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. EIA Directive 2014/52/EU provides an update to include climate change (both mitigation of GHGs and adaptation/vulnerability of projects) within assessment and decision-making processes.
  The regulations implementing this directive were transposed into UK legislation in May 2017 by way of, inter alia, the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

National

5.2.3 The following key national legislation is applicable to the assessment:

- Climate Change Act 2008 sets a legally binding target for the UK to reduce its greenhouse gas emissions from 1990 levels by at least 80% from a 1990 baseline by the year 2050 and provides for a system of legally binding five-year carbon budgets

which restricts the amount of GHG emissions the UK can legally emit (amongst others);

- Climate Change Act 2008 (2050 Target Amendment) Order 2019 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 of 1990; and
- Carbon Budgets Order 2009, Carbon Budget Order 2011 and Carbon Budget Order 2016 and the Carbon Budget Order 2021. These orders 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 and was increased to 68% as the UK's Nationally Determined Contribution ahead of the United Nations' COP26 in November 2021.

Policy

National

5.2.4 Under Section 104 of the Planning Act 2008 (the Act), the Secretary of State (SoS) is directed to determine a Development Consent Order (DCO) application with regard to the relevant National Policy Statement (NPS), the local impact report, matters prescribed in relation to the Proposed Development, and any other matters regarded by the SoS as important and relevant. Following their designation on 17 January 2024, there are three NPSs which are considered to be 'relevant NPS' under Section 104 of the Act:

- Overarching NPS for energy (NPS EN-1)
- NPS for renewable energy infrastructure (NPS EN-3)
- NPS for electricity networks infrastructure (NPS EN-5)

5.2.5 It is considered that other national and local planning policy will be regarded by the SoS as 'important and relevant' to the Proposed Development. A detailed account of the planning policy framework relevant to the Proposed Development is provided in the Planning Statement (Document Reference 7.1). The Policy Compliance Document

(Document Reference 7.1.1) evidences how the assessment of climate change has been informed by and is in compliance with the NPSs and relevant national and local planning policies. It provides specific reference to relevant sections of the ES which address requirements set out in policy.

5.2.6 The following national strategies and programmes of relevance have also been considered:

- UK Third Climate Change Risk Assessment 2022 *[4]*; 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 *[5]*: 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) *[6]*; The national adaptation programme (NAP) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and launched in 2018.
- The UK Clean Growth Strategy *[7]*; 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) *[8]* 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.

Guidance

5.2.7 The following good practice guidance has informed this assessment:

- Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance *[9]*;
- The Publicly Available Specification 2080 (PAS 2080:2023) on carbon management in infrastructure *[10]*; and

- Royal Institute of Chartered Surveyors (RICS) Whole life carbon assessment for the built environment [*[11]*.
- IEMA Climate Change Adaptation Practitioner Guidance *[12]*; and
- National Planning Policy Guidance on climate change *[13]*.

5.3 Scoping and Consultation

5.3.1 This section describes the scope of this Climate Change assessment, including how the assessment has responded to the Scoping Opinion. A description of the consultation and engagement undertaken with relevant technical stakeholders to develop and agree this scope is also provided.

Scoping

5.3.2 The EIA Scoping Report set out the proposed scope and assessment methodologies to be employed in the EIA and is provided in ES Appendix 4.1 EIA Scoping Report (Document Reference 6.4.4.1).

5.3.3 In response to the EIA Scoping Report, a Scoping Opinion was received from the Planning Inspectorate (PINS) on 6 December 2022 and is provided in ES Appendix 4.2 EIA Scoping Opinion (Document Reference 6.4.4.2)

5.3.4 ES Appendix 4.3 EIA Scoping Opinion Response Matrix (Document Reference 6.4.4.3) contains a table that outlines all matters identified by PINS in the EIA Scoping Opinion and how these have been addressed in the ES or other DCO application documentation.

Consultation

5.3.5 PINS and the Local Authorities provided comment on the climate change assessment as part of the formal scoping process. There are no further statutory consultees of relevance to the topic and therefore no further, specific engagement has taken place to inform the scope or approach to assessment.

5.3.6 The Consultation Report (Document Reference 5.1) submitted alongside the DCO application contains a full account of the previous statutory consultation process and issues raised in feedback.

5.4 Assessment Methodology

5.4.1 This section outlines the methodology employed for assessing the likely significant effects on, and from, climate change from the construction, operation and decommissioning phases of the Proposed Development.

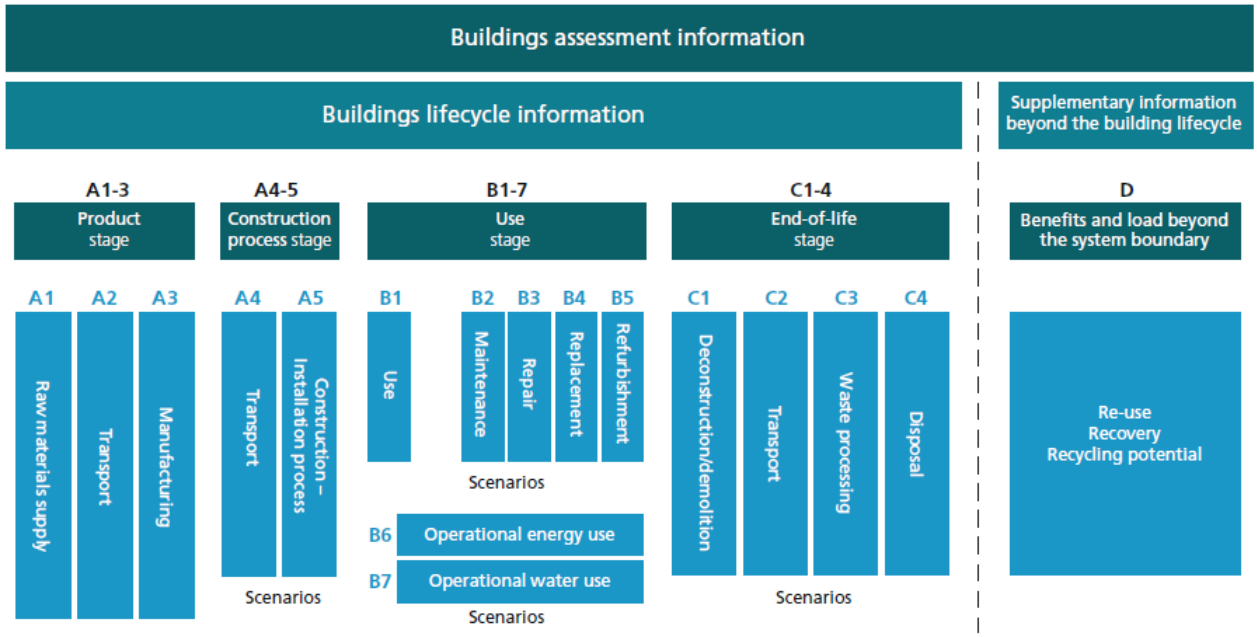
Assessment of effects

GHG Impact Assessment

5.4.2 The GHG Impact Assessment has followed a project lifecycle approach to calculate estimated GHG emissions arising from the construction, operation and decommissioning phases 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 GHG Impact Assessment are defined in Plate 5-1 [10] 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, referred to as 'decommissioning phase' (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 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. Also included is steel for storage containers, a substation, security fencing, concrete for foundations and type 1 for access roads. Transportation of materials for manufacturing.	Embodied GHG emissions from energy use in extraction and production. GHG emissions from vehicle use.
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.

Lifecycle stage	Activity	Primary emission sources
Decommissioning Phase (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 ES, the GHG emissions associated with the current baseline and each lifecycle stage, were calculated by converting 'activity data' into GHG emissions through application of widely used and reference GHG emission conversion factors in line with the GHG Protocol [14]:

- Activity data – a measure of the quantity of an activity. Activity data depends on the specific activity being assessed and the way they are quantified, for example, fuel consumption is typically quantified in litres or tonnes; construction materials and waste are quantified in m3 or tonnes; and
- GHG factor – a measure of the GHG emissions per unit of activity. GHG factors are drawn from national and international sources.
- Activity data x GHG emissions factor = GHG emissions

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

- Greenhouse Gas Reporting: Conversion Factors *[15]*; and
- Inventory of Carbon & Energy (ICE) database *[16]*.

5.4.7 Due to the nature of the Proposed Development, energy generated during the operational phase has been considered within this GHG Impact Assessment. GHG emissions associated with energy unit generation have been 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, activities from the Proposed Development that do not significantly change the result of the assessment can be excluded from the GHG assessment. The IEMA guidance states that *"Where expected emissions are less than 1% of total emissions, and where all such exclusions total a maximum of 5% of total emissions; all exclusions should be clearly stated"*. In GHG accounting, it is also common practice to consider exclusion of GHG emission sources that are less than 1% of a given emissions inventory, based on 'de minimis' contribution.

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, operational and decommissioning phases of the Proposed Development. The assessment includes potential climate hazards for infrastructure and assets associated with the Proposed Development. In line with IEMA guidance, a qualitative assessment has been undertaken based on professional expertise and judgment.

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

5.4.11 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.

5.4.12 Met Office UK climate projections 2018 (UKCP18) are the most recent and comprehensive climate change projections for the UK. In addition to projections for future climate they also contain a comprehensive set of observed historical climate observations. 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].

5.4.13 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.

5.4.14 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

[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.

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).

5.4.15 The methodology and approach to assessing significance 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 (e.g. heatwaves, flooding, droughts);
- assessment of likelihood and consequences - scored by using a qualitative five-point scale, as set out in Table 5-3 and
- Table *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

5.4.16 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.

5.4.17 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 (highlighted below) "*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*":

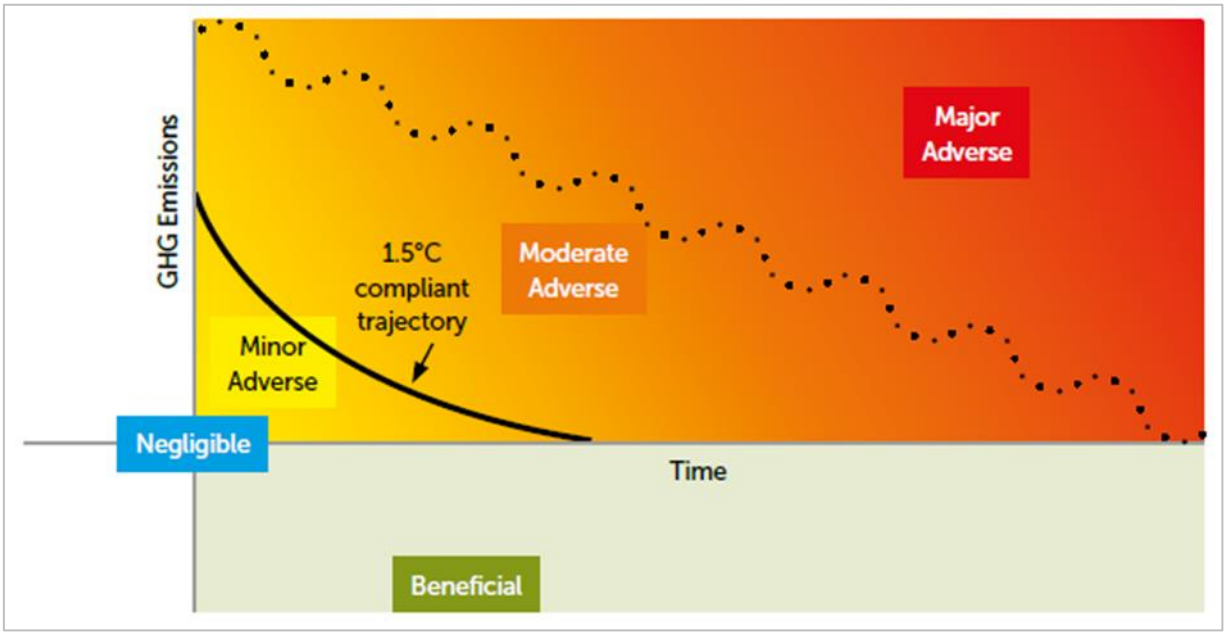
- A development that follows a '**business-as-usual'** or '**do minimum'** approach and is not compatible with the UK's net zero trajectory, or accepted aligned practice or area based transition targets, results in a significant adverse effect. It is down to the practitioner to differentiate between 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.

5.4.18 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. On this basis, a development that is considered to follow business-as-usual or do-minimum approach is considered have a significant adverse effect. In addition to the overall evaluation of significance, in line with IEMA guidance: "*Any increase in carbon emissions alone is not a reason to refuse development consent, unless the increase in carbon emissions resulting from the project is so significant that it would have a material impact on the ability of Government to meet its carbon reduction targets, including carbon budgets*".

5.4.19 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 [9]



5.4.20 To contextualise GHG emissions of the Proposed Development, the detailed GHG Impact Assessment provides a comparison against UK Carbon Budgets (Table 5-1). The main reference periods for assessing GHG emissions for the Proposed Development, 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 have been measured against the Sixth Carbon Budget.

5.4.21 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

5.4.22 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 (at least 40 years).
Unlikely	The event occurs during the lifetime of the project (at least 40 years), e.g. once in 40 years.
As likely as not	The event occurs limited times during the lifetime of the project (at least 40 years), e.g. approximately once every 20 years, typically 2 events.

Likelihood Descriptor	Description
Likely	The event occurs several times during the lifetime of the project (at least 40 years), e.g. approximately once every ten years, typically 4 events.
Very likely	The event occurs multiple times during the lifetime of the project (at least 40 years), e.g. approximately annually, typically 40 events.

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

Descriptor	Description
Minimal	Minor cuts/abrasions requiring minimal treatment; Causing minimal work interruption; No financial loss or costs; No environmental consequence.
Minor	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.

5.4.23 Issues related to vulnerability to climate change predominantly concern the operational phase and how the infrastructure has been 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 a Construction Environmental Management Plan (CEMP) will prepared by the Principal Contractor (PC) and will be implemented during the construction phase. ES Appendix 2.6 Outline CEMP (Document Reference 6.4.2.6) includes 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. Measures within the Outline CEMP will be secured as a requirement within the DCO.

5.4.24 Flood risk has been assessed within ES Appendix 10.1 Flood Risk Assessment (FRA) and Drainage Strategy (Document Reference 6.4.10.1). 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 ES Chapter 10 Hydrology and Flood Risk (Document Reference 6.2.10).

Significance criteria for the Climate Change Resilience Assessment

5.4.25 The significance of the climate risks identified in the CCR Assessment has been 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.

5.4.26 IEMA guidance states that professional judgement should be used to determine whether an effect is significant. 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				
		Minimal	**Minor**	**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 Assessment Assumptions and Limitations

GHG Impact Assessment

5.5.1 A GHG Impact Assessment has been undertaken on the basis of the information available at the time of assessment. The GHG Impact Assessment uses appropriate industry benchmarks, and conservative assumptions on materials, design, assembly, earthworks and use of components to provide a robust assessment of likely GHG emissions.

5.5.2 The following principal assumptions have been used:

- Construction phase: It has been assumed that the solar PV modules and PV framework will be delivered via sea and Heavy Goods Vehicles (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 18 month construction phase.
- Construction phase: emissions from traveling to site from workers and water use on-site have been calculated based on 300 workers on-site for 18 months. It is assumed each worker travels 30km to and from site, which is a conservative

estimate, as where possible workers will be located within 30km of the proposed development and require 90L of water per day.

- Construction phase: assessment of embodied carbon in materials is based upon 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.
- Construction 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 it is assumed that all waste will be recycled; and
  - It is assumed that a licensed landfill site is within a 100km radius and each HGV can carry a load of 10 tonnes per trip.
- Operational phase: the Applicant has provided the following assumptions for maintenance and replacement of parts:
  - Key operational energy requirements are understood to be motion responsive security fence lighting and CCTV. The associated carbon emissions are deemed to be negligible.
  - As there are no permanent buildings on-site during the operational phase or associated requirements for water use. The associated carbon emissions has been deemed to be negligible.
  - Solar PV modules – will be replaced depending on efficiency. It is expected to replace 10% of these over the lifetime of the Proposed Development.
  - Cables - Anticipated that these will not need replacing during the proposed design life.
  - All the supporting equipment is assumed to require replacement once, with a further 50% requiring replacement twice, during the design life.
  - All Battery Energy Storage Systems (BESS) cells are assumed to require replacement once, with a further 50% requiring replacement twice, during the design life.

5.5.3 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 [17]. This will therefore not be considered further in the assessment.

5.5.4 GHG emissions created within decommissioning phase have been assessed using the same benchmarks as construction. GHG emission calculations are therefore considered to be an overestimation given the UK's commitment to reduce domestic emissions to net zero by 2050. It is expected that GHG emissions will continue to decline due to a combination of national government carbon budgets, local carbon reduction targets and decarbonisation of industry, energy supply and transportation. In the absence of any reliable data surrounding the circumstances or impacts of decommissioning the scheme at the end of its design life, it is assumed that all other decommissioning-related emissions (worker commuting, plant use, water use) will be 50% of the value from the construction phase.

Climate Change Resilience Assessment

5.5.5 The CCR assessment has been informed by the following principal 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.

5.5.6 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.

5.6 Study Area

GHG Impact Assessment

5.6.1 The spatial study area for the GHG emissions assessment includes sources and removals of GHG emissions arising from construction, operation and decommissioning phases of the Proposed Development. A project lifecycle approach has been adopted for the GHG Impact Assessment to capture both direct GHG emissions arising from activities within the Order Limits, as shown in ES Figure 1.1 (Document Reference 6.3.1.1), and

indirect carbon emissions arising as a result of the Proposed Development (for example, emissions arising during the transportation of materials to the Proposed Development and embodied carbon within construction materials).

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

Climate Change Resilience Assessment

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

5.6.4 The CCR Assessment takes into account the construction phase of the Proposed Development (up to 18 months) and the proposed lifetime (at least 40 years).

Summary of sensitive receptors

GHG Impact Assessment

5.6.5 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

5.6.6 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).

5.7 Baseline Conditions

GHG Impact Assessment

Existing conditions and future baseline

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

5.7.2 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.

5.7.3 The current land use of the Order Limits comprises arable land, managed hedgerows and trees, all of which sequester and store carbon. Baseline agricultural GHG emissions

are dependent on soil and vegetation types present, and fuel use for the operation of on-site vehicles and machinery.

5.7.4 Baseline emissions 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 is 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

Existing conditions and future baseline

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

Existing conditions

5.7.6 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, as set out below [18].

Future baseline

5.7.7 Table 5-6 presents changes in extreme weather events for the 2020 to 2079, such as number of heavy rain days and

5.7.9 Table 5-7 presents expected changes in climate conditions, such as mean temperature and precipitation for the 2020s to 2079.

5.7.10 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.

5.7.11 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.

5.7.12 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 relative to the baseline. 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.

Table 5-6 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 5-7 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

5.8 Potential impacts

5.8.1 Based on the design of the Proposed Development during operation and associated construction and decommissioning activities, the Proposed Development has the potential to impact on Climate Change during construction, operation and decommissioning.

5.8.2 Mitigation measures incorporated in the design and construction of the Proposed Development are reported as embedded mitigation in ES Chapter 2 The Proposed Development (Document Reference 6.2.2). Essential mitigation is reported in Section 5.9, design, mitigation and enhancement measures, of this ES chapter.

5.8.3 Potential impacts of the Proposed Development, prior to the implementation of the essential mitigation measures described in Section 5.9, are described in this section. The effects of the Proposed Development, accounting for this essential mitigation, are then described in Section 5.10.

GHG emissions

Construction

5.8.4 During the construction phase, the Proposed Development will require development materials, manufacturing components, transporting to the Proposed Development 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

5.8.5 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 GHG Impact Assessment has been based on a power output based on a confidential modelling provided by the Applicant as set out in Appendix 5.1: GHG Impact Assessment.

5.8.6 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.

5.8.7 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

5.8.8 Decommissioning of the Proposed Development will involve removing components, the reinstatement of land and transporting components away from the Order Limits. 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 Risk

Construction

5.8.9 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.

5.8.10 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

5.8.11 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

5.8.12 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.

5.9 Embedded mitigation

5.9.1 The Proposed Development has been designed to avoid and prevent adverse environmental effects on climate change through the process of design development and consideration of good design principles.

5.9.2 Mitigation measures incorporated in the design and construction of the Proposed Development, considering the potential impacts, are reported as embedded mitigation in ES Chapter 2 The Proposed Development (Document Reference 6.2.2). The effects of the Proposed Development are assessed considering embedded mitigation is in place and are reported in Section 5.10.

5.9.3 Where further mitigation is deemed required as a result of a potentially significant effect, this is termed essential mitigation. Essential mitigation is set out as part of the assessment of effects in Section 5.10.

5.9.4 A further definition of these classifications of mitigation and how they are considered in the EIA is provided in Section 4.5 in ES Chapter 4 Approach to EIA (Document Reference 6.2.4).

5.10 Assessment of likely significant effects

GHG Impact Assessment

5.10.1 This section presents the likely effects on climate change resulting from the construction, operation and decommissioning of the Proposed Development.

5.10.2 The assessment of effects takes into account the potential impacts to each receptor (as set out in Section 5.8) following the implementation of the embedded mitigation measures (as set out in 5.9). Where required to mitigate potentially significant effects, essential mitigation measures are outlined as part of the assessment, and the overall significance of residual effects set out.

Construction Phase

5.10.3 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 solar PV panels is estimated to account for 106,237 tCO2e, with the manufacture of the PV support infrastructure leading to a further 4,854 tCO2e. Table 5-8 summarises the emissions resulting from the manufacture of materials required for the construction of the Proposed Development. For details of methodology, activity data and emissions factors, refer to ES Appendix 5.1 GHG Impact Assessment (Document Reference 6.4.5.1).

Table 5-8 Embodied emissions from the manufacture of materials and components (A1-A3)

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
PV Panels	106,237	60.2
Battery storage (BESS)	64,080	36.3
Supports	4,854	2.7
Storage containers	176	0.01
Steel containers	126	0.07
Substation	24	0.01
Fencing and gates (wire mesh fence)	163	0.09
Access tracks (type 1)	829	0.5
Underground Cables		
Copper	16.0	0.009
Tin	1.2	0.0007

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
Polyethylene	1.9	0.001
Polypropylene	4.3	0.002
Other plastics	68.0	0.04
Total	**176,590**	**100**

5.10.4 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 Proposed Development, transportation of construction workers to and from the Proposed Development and the transportation and disposal of waste from the Proposed Development. Table 5-9 below summarises overall construction emissions from various emissions sources. For details of methodology, activity data and emissions factors, refer to ES Appendix 5.1 GHG Impact Assessment (Document Reference 6.4.5.1).

Table 5-9 Emissions resulting from the construction phase (A4- A5)

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
Products and materials	176,590	74.6
Transportation of products and materials to Proposed Development	54,108	22.9
Water use	4092	1.7
Fuel use	1,121	0.5
Worker commuting	554	0.2
Waste (including transport)	128	0.05
Construction total	**236,597**	**100**

Operational Phase

5.10.5 GHG emissions sources within the scope of the 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 Proposed Development, and waste management activities). These are shown in Table 5-10.

5.10.6 The calculations and assumptions used can be seen within ES Appendix 5.1 GHG Impact Assessment (Document Reference 6.4.5.1).

5.10.7 If the replacement of inverters and BESS cells takes place mid-way through the Proposed Development's anticipated 40-year design life, it is extremely likely that by the time of replacement, the embodied carbon impact of manufacturing the replacement components will be much lower than the values that have been applied in this GHG Impact Assessment.

5.10.8 The current primary land use of the Order Limits 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 allocated for potential biodiversity enhancement. As these habitats mature, more carbon will be sequestered over time.

Table 5-10 Summarises operational emissions sources.

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
Materials (replacement components)	114,024	65,1
Transportation of materials	23,594	13.5
Land use change	37,492	21.4
Grid electricity	Negligible	0
Water/wastewater	Negligible	0
Operational Total	**175,110**	**100**

Decommissioning Phase

5.10.9 As set out in Section 5.5.4, GHG emissions from the Proposed Development during decommissioning are subject to a degree of uncertainty as they will occur far into the future. GHG emissions created within decommissioning have been assessed using the same benchmarks as construction and are therefore considered to be an overestimation.

5.10.10 At the end of the Proposed Development it is assumed that the woodland and hedgerows created will be permanent, with additional carbon stocks in soil and vegetation in these areas remaining sequestered. As stated in Appendix 2.7 Outline Decommissioning Environmental Management Plan (Document Reference 6.4.2.7), temporary disturbance of habitats is assumed however these will be mitigated through the decommissioning and therefore, any loss of carbon due to these disturbances are considered to be negligible.

5.10.11 Emissions from the disposal and recycling of materials and components at the end of the Proposed Development's design life have been estimated based on an assumption that all materials and components will be recycled at the end of life with no waste going to landfill, together with the most recent emissions factors for recycling published by the UK Government. Emissions from end of life disposal of all materials and products are estimated at 448 tCO_2e.

5.10.12 Emissions from the transportation of materials and products at end of life have been estimated on the assumption that concrete and aggregate will be disposed of within a 50km radius, while all other products will be disposed of within 200km. Applying the most recent emissions factor for HGV travel gives end of life transport emissions of 8,521 tonnes CO_2e. This is very likely to be a highly conservative estimate as HGV transport decarbonises in the future.

5.10.13 Worker commuting, plant use and water use emissions are calculated as 50% of the value from the construction phase. Total emissions are calculated at 2,884 tonnes CO_2e, respectively.

5.10.14 The assessment of GHG emissions arising from the decommissioning phase takes account of net land use change emissions. **Error! Not a valid bookmark self-reference.** summarises the estimated GHG emissions resulting from the decommissioning phase.

Table 5-11 Emissions resulting from the decommissioning phase

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
Recycling of material components	448	3.8
Transportation of materials (disposal)	8,521	71.9
Fuel use	560	4.7
Worker transport	278	2.3
Water use	2046	17.3
Land use change	N/A	0
Decommissioning Total	**11,854**	**100**

Overall Proposed Development lifetime emissions

5.10.15 The assessment shows 423,561 tCO_2e being emitted over the Proposed Development lifetime. This is prior to consideration of the CO_2e avoidance that can be attributed directly to the Proposed Development. These fall against the carbon budgets as shown in **Error! Not a valid bookmark self-reference.** Note that as the carbon budgets beyond 2037 are unknown, all emissions beyond 2037 have been measured against the 6th carbon budget.

Table 5-12 Emissions compared to their contribution to the Carbon Budgets [3].

Relevant UK Carbon budget period	Relevant UK Carbon budget total (MtCO2t)	Proposed Development's contribution per carbon budget (tCO2e)	% emissions against relevant emissions
4th Carbon Budget (2023-2027)	1,950	236,597	0.0121
5th Carbon Budget (2028-2032)	1,725	68,809	0.0051
6th Carbon Budget (2033-2037)	965	78,339	0.0103

Carbon intensity of the Proposed Development

5.10.16 Based on information provided by the client (Appendix 5.2 GHG Impact Assessment), a conservative 1% 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 9,402 GWh over the anticipated 40-year lifetime.

5.10.17 Dividing this lifetime generation figure into the lifetime emissions total shown in The assessment shows 423,561 tCO_2e being emitted over the Proposed Development lifetime. This is prior to consideration of the CO_2e avoidance that can be attributed directly to the Proposed Development. These fall against the carbon budgets as shown in **Error! Not a valid bookmark self-reference.** Note that as the carbon budgets beyond 2037 are unknown, all emissions beyond 2037 have been measured against the 6th carbon budget.

5.10.18 Table 5-12 gives a total carbon intensity value of 45 gCO_2e/kWh. Lifetime emissions from the construction, operation and decommissioning of the Proposed Development are summarised in **Error! Not a valid bookmark self-reference.**.

Table 5-13 Emissions resulting over the lifetime of the Proposed Development

Emissions source	Embodied emissions (t CO2e)	Proportion of total embodied emissions (%)
Construction	236,597	55.9
Operation	175,110	41.3
Decommissioning	11,854	2.8
Total	**423,561**	**100**

5.10.19 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 18.6g CO_2e/kWh.

5.10.20 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 94.7% lower than that of the counterfactual CCGT. Each kilowatt hour of electricity generated by the Proposed Development will emit 335.4g CO_2e less than if it was generated by a gas fired CCGT generating facility.

5.10.21 Combining this figure with the estimated lifetime output from the Proposed Development indicates an overall lifetime carbon reduction, relative to the counterfactual CCGT, of over 2.9 million tonnes CO_2e.

Significance of Effect (Construction)

5.10.22 GHG emissions from construction have been assessed against the relevant carbon budget periods during which they arise, to identify the significance of their impacts.

Construction emissions will fall under the Fourth UK carbon budget (2023 – 2027), as seen in The assessment shows 423,561 tCO_2e being emitted over the Proposed Development lifetime. This is prior to consideration of the CO_2e avoidance that can be attributed directly to the Proposed Development. These fall against the carbon budgets as shown in **Error! Not a valid bookmark self-reference.** Note that as the carbon budgets beyond 2037 are unknown, all emissions beyond 2037 have been measured against the 6th carbon budget.

5.10.23 Table 5-12. The construction of the Proposed Development is expected to contribute 0.0121% of the UK's carbon budgets for 2023-2027.

5.10.24 Considering embedded mitigation, and based on the nature of the Proposed Development and experience with similar projects, it is not anticipated that annual emissions from the construction of the Proposed Development will impact the overall ability for the UK Government to meet climate targets and national carbon budgets. The magnitude of effect is therefore considered low.

5.10.25 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.

5.10.26 No essential mitigation is required and as such the residual effect remains as reported.

Significance of Effect (Operation)

5.10.27 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.

5.10.28 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.

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

5.10.30 No essential mitigation is required and as such the residual effect remains as reported.

Significance of Effect (Decommissioning)

5.10.31 The decommissioning of the Proposed Development will fall after the 6th carbon budget 2033-2037. Using the 6th carbon budget as contextualisation, decommissioning is expected to contribute 0.0103% of the UK's 6th carbon budget. Therefore, the magnitude of impact is considered to be low.

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

5.10.33 No essential mitigation is required and as such the residual effect remains as reported.

Climate Change Resilience Assessment

5.10.34 Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in Table 5-14. Potential climate risks to the operational phase, the likelihood, consequence and significance are detailed in

5.10.35 Table 5-15. Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in Table 5-16. As there are no climate risk ratings at moderate or above, the climate risks to the Proposed Development are assessed as minor which is not significant.

5.10.36 No essential mitigation is required and as such the residual effect remains as reported.

Table 5-14 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 Principal Contractor. The PC will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions. An Outline CEMP is provided with the DCO Application as ES Appendix 2.6 (Document Reference 6.4.2.6)	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 Principal Contractor. The PC will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions. An Outline CEMP is provided with the DCO Application as ES Appendix 2.6 (Document Reference 6.4.2.6)	Risk reduced through mitigation	Unlikely	Minor	Very Low
High temperatures	Increase in heat waves	Staff, visitors on-site	Increased heat stress/ heat exhaustion for workers.	The Principal 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 temperatures	Increase in heat waves	Plant and vehicles, physical structures, materials,	Overheating of electrical equipment. Damage to materials	The Principal 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 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 CEMP, implemented by the contractor. An Outline CEMP is provided with the DCO Application as ES Appendix 2.6 (Document Reference 6.4.2.6) The PC 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 (Document Reference 6.4.10.1).	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

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
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 Principal Contractor will monitor weather forecasts and receive EA 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 CEMP. An Outline CEMP is provided with the DCO Application as ES Appendix 2.6 (Document Reference 6.4.2.6)	Unlikely	Moderate	Low

Table 5-15 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. A Battery Fire Safety Management Plan will be in place during the operation phase. An Outline Battery Fire Safety Management Plan (oBFSMP) is provided with the DCO Application as ES Appendix 2.13 (Document Reference 6.4.2.13).	Risk reduced through mitigation measures	Unlikely	Moderate	Low
High temperatures	Increase in heat waves	All receptors (infrastructure,	Increase in air conditioning requirements.	BESS systems would include HVAC systems and these would	Risk reduced through design	Unlikely	Moderate	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)	Overheating of electrical equipment.	be contained within the individual equipment containers. A Battery Fire Safety Management Plan will be in place during the operation phase. An Outline Battery Fire Safety Management Plan (oBFSMP) is provided with the DCO Application as ES Appendix 2.13 (Document Reference 6.4.2.13).				
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. Deterioration to the access tracks and washing away of type 1 material. 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 out of the flood zone entirely. In addition. there will be an 8m buffer around the watercourses that crosses the site. Access tracks to be included within the maintenance schedule to avoid deterioration of access to site. Access tracks to be included within the maintenance schedule to avoid deterioration of access to site.	Risk reduced through design	Very unlikely	Moderate	Low
High precipitation	Increase to winter rainfall	All receptors (infrastructure, buildings, staff and workers)	Surface water flooding and standing waters. Deterioration of structures or foundations due to increase in soil moisture levels. Deterioration to the access tracks and washing away of type 1 material.	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 buffer around the watercourses that crosses the site as well.	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
			Damage to building surfaces / exposed utilities from increased drying / wetting and increase frost penetration.	Access tracks to be included within the maintenance schedule to avoid deterioration of access to site.				
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.	An Outline LEMP is provided with the DCO Application as ES Appendix 2.14 (Document Reference 6.4.2.14) which details the 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 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 drying/wetting and increase frost penetration or tree falls. Strong winds damaging structures directly or via falling trees and debris.	ES Appendix 10.1 FRA and Drainage Strategy (Document Reference 6.4.10.1) 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

Table 5-16 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 Environmental Management Plan (DEMP), likely to be similar to CEMP. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	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. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	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. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	Risk reduced through mitigation	Unlikely	Minimal	Very Low
High temperatures	Increase in heat waves	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. An Outline DEMP is provided with the DCO	Risk reduced through mitigation	As likely as not	Minimal	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
				Application as ES Appendix 2.7 (Document Reference 6.4.2.7)				
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. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	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. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	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. An Outline DEMP is provided with the DCO Application as ES Appendix 2.7 (Document Reference 6.4.2.7)	Risk reduced through mitigation	Unlikely	Minimal	Very Low

5.11 Monitoring

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

5.12 Summary

5.12.1 The below tables provides a summary of the identified impacts, mitigation and likely effects of the Proposed Development on greenhouse gases (Table 5-17) and climate change resilience (Table 5-18).

Table 5-17 Greenhouse gases assessment summary

Impact	Embedded/Essential Mitigation and how secured	Receptor Sensitivity	Significance of effect
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 Order Limits 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.	Medium	Minor Adverse, not significant

Impact	Embedded/Essential Mitigation and how secured	Receptor Sensitivity	Significance of effect
Production of low carbon energy during operation	Nothing beyond increasing efficiency of power generation	Medium	Beneficial, significant
Release of GHG emissions during decommissioning	The same as construction mitigation	Medium	Minor Adverse, not significant

Table 5-18 Climate resilience assessment summary

Impact	Embedded/Essential Mitigation and how secured	Likelihood	Consequence	Significance of effect
Impact of climate change on construction works	▪ The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions. ▪ Equipment has cooling systems where necessary. ▪ The contractors will monitor weather forecasts and receive 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 Flood Risk Assessment."	Very unlikely to As likely as not	Minimal to Moderate	Very low to Low – Not significant
Impact of climate change on the operation of the Proposed Development	▪ BESS systems would include Heating Ventilation and Air Conditioning systems and these would be contained within the individual equipment containers. ▪ 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 buffer around the Beck that crosses the site as well.	Very unlikely to As likely as not	Minor to Moderate	Low – Not significant

Impact	Embedded/Essential Mitigation and how secured	Likelihood	Consequence	Significance of effect
	▪ Access tracks to be included within the maintenance schedule to avoid deterioration of access to site." ▪ 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 buffer around the Beck that crosses the site as well. ▪ 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. ▪ The FRA includes a number of adaptation measures that would be considered in the detailed design and operations management. ▪ Strong winds are taken account of within the design. The infrastructure is also sufficient distance from potential falling trees.			
Impact of climate change on decommissioning works	Prevention measures will be covered in the DEMP and health and safety plans and likely to be similar to CEMP.	Unlikely to As likely as not	Minimal	Very low to Low – Not significant

References

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

[2] UNFCCC, "The Paris Agreement," 2015. [Online]. Available: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement. [Accessed 2023].

[3] "EIA Directive (2014/52/EU)," 2014. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0052 (Last accessed August 2022). [Accessed 2023].

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

[5] 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].

[6] 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.

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

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

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

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

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

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

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

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

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

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

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

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