Longfield Solar Farm

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6. Climate Change

6.1 Introduction

6.1.1 This chapter provides an assessment of the potential effects of the Scheme on the climate during construction, operation (and maintenance), and decommissioning. It also considers the resilience of the Scheme to the physical impacts of climate change.

6.1.2 In line with the requirements of The Infrastructure Planning (Environmental Impact Assessment) Regulations (2017) (Ref 6-1), consideration has been given within this chapter to the following aspects of climate change assessment:

a. **Lifecycle greenhouse gas (GHG) impact assessment** – the impact of GHG emissions arising over the lifetime of the Scheme on the climate; and

b. **Climate change resilience (CCR) review** – the resilience of the Scheme to projected future climate change impacts, including damage to the Scheme caused by accidents resulting from climate change.

6.1.3 An in-combination climate change impact (ICCI) assessment identifies how the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Scheme. This has been scoped out of this climate assessment (refer to ***Appendix 1A: Scoping Report*** of the Environmental Statement (ES) **[EN010118/APP/6.2]** as the combined impacts have been assessed in other topics (e.g., the combined impact of the Scheme and an increase in heavy precipitation events on flood risk has been assessed in ***Chapter 9: Water Environment*** of the ES **[EN010118/APP/6.1]).**

6.2 Legislation and Planning Policy

6.2.1 This section lists the legislation and planning policy relevant to the assessment methodology for climate change. These comprise:

a. Climate Change Act 2008 (Ref 6-2) 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);

b. Climate Change Act 2008 (2050 Target Amendment) Order 2019 (Ref 6-3) 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

c. Carbon Budgets Order (2009) (Ref 6-4), Carbon Budget Order (2011) (Ref 6-5), Carbon Budget Order (2016) (Ref 6-6) and the Carbon Budget Order (2021) (Ref 6-7) which set the carbon budgets for relevant budgetary periods.

National Planning Policy

d. National Policy Statement (NPS) EN-1 (Ref 6-8), with particular reference to paragraphs 2.2.9 and 4.8.2 in relation to climate impacts and adaptation; paragraphs 4.1.3 to 4.1.4 in relation to adverse effects and benefits; paragraphs 4.2.1, 4.2.3, 4.2.4, 4.2.8 to 4.2.10 and 5.1.2 in relation to EIA and Environmental Statement (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. A revised NPS EN-1 is currently under consultation: paragraph 4.9.8 of the draft would require applicants to assess the impacts on and from proposed energy projects across a range of climate change scenarios, while paragraph 5.3.4 would require all proposals for energy infrastructure projects to include a carbon assessment as part of their ES. NPS EN-3 (Ref 6-9) – paragraph 2.3.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.3.5 in relation to ES requirements regarding climate change resilience. A revised NPS EN-3 is currently under consultation;

e. NPS EN-5 (Ref 6-10) – 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. A revised NPS EN-5 is currently under consultation; and

f. National Planning Policy Framework (NPPF) (Ref 6-11) – paragraphs 8 and 20 in relation to adaptation, mitigation and climate change resilience; paragraphs 153 to 158 in relation to planning for climate change; and paragraphs 159 to 169 in relation to planning and flood risk.

National Guidance

g. Planning Practice Guidance for Climate Change (March 2019) (Ref 6-12).

Local Planning Policy

h. Essex County Council – Net Zero: Making Essex Carbon Neutral, the report of the Essex Climate Action Commission (2021) (Ref 6-38). The report states that: "We want our residents and businesses to be supplied by 100 per cent renewable energy and we want to see Essex produce enough renewable energy within the county to meet its own needs by 2040. Solar generation photovoltaics (Solar PV) will be important because it is more affordable and can be installed more quickly compared to other technologies and also because it performs well …". The report goes on to recommend that Essex should produce enough renewable energy within the county to meet its own needs by 2040, and that 1.43 GW of large-scale solar panels should be built on available land without compromising current agricultural land by 2030.

i. Essex County Council Adapting to Climate Change Action Plan (2011) (Ref 6-13), particularly in relation to identifying future climate change risks, assessing their potential impact and delivering adaptation measures where appropriate;

j. Essex and Southend-on-Sea Waste Local Plan (adopted July 2017) (Ref 6-14), with particular reference to Strategic Objective 6 (SO6) regarding reducing GHG emissions by minimising waste to landfill;

k. Chelmsford Local Plan 2013-2036 (adopted May 2020) (Ref 6-15), particularly the following policies in relation to climate change mitigation and adaption:

   i. Strategic Policy S2 – Addressing Climate Change and Flood Risk, which pledges to encourage new development that provides opportunities for renewable and low carbon energy technologies and schemes, minimises impact on flooding, and utilises design and construction techniques which contribute to climate change mitigation and adaptation (amongst others).

   ii. Policy DM19 – Renewable and Low Carbon Energy, which states planning permission will be granted for renewable or low carbon energy developments provided that they *"can demonstrate no adverse effect on the natural environment including designated sites"*, among other requirements.

l. Chelmsford City Council Making Places Draft Supplementary Planning Document (SPD) (2020) (Ref 6-16); the draft SPD seeks to *"promote and secure high-quality new development … provide good practice examples on how development can go beyond planning policy requirements to create the most sustainable and environmentally friendly development possible."*

m. Chelmsford City Council Climate and Ecological Emergency Action Plan (2020) (Ref 6-17); and

n. Braintree District Council Draft Local Plan 2013-2033 Section 2 (2017) (Ref 6-18), with particular reference to Policy LPP 74 Climate Change, which states *"planning permission will only be granted for proposals that demonstrate the principles of climate change mitigation and adaptation into the development"*.

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

6.2.3 Local planning policies identify the need to consider GHG emissions at all stages of a development's lifecycle. New development should aim for reduced or zero carbon development by incorporating renewable or low carbon energy sources and maximising energy and water efficiency where practicable. In addition, new development should contribute towards the establishment, enhancement, and ongoing management of green infrastructure (Ref 6-15 and Ref 6-18).

6.3 Assessment Assumptions and Limitations

Scheme Parameters Assessed

6.3.1 The climate assessment has been based on the Design Principles, which are the maximum parameters allowed by the application, supplemented with additional information needed to assess the embodied carbon associated with the Battery Energy Storage System (BESS).

6.3.2 A review of the Design Principles has confirmed that constructing and operating the Scheme in other ways allowed by the Rochdale Envelope principles would not result in a greater impact to overall lifetime GHG emissions or climate change risk than is presented in this chapter.

6.3.3 The assessment of embodied carbon is a special case within the chapter, as it is based on an assumed number of battery cubes which is not fixed by the Design Principles. This part of the assessment is therefore based on a BESS that is able to supply the grid at an assumed 400 MW for four hours, for a total capacity of 1,600 MWh, which is the chosen capacity illustrated in the Concept Design. The BESS capacity is not limited by the Design Principles but increasing the peak power capacity of the BESS would reduce the number of battery cubes and increase the number of inverters and transformers within the BESS compound, which (due to the amount of embodied carbon in each component) would in turn lower the embodied emissions. It is therefore not expected that there would be a worse scenario than the battery arrangement that has been assessed in the chapter; other configurations are expected to have the same or lower embodied carbon.

Supply of components and materials

6.3.4 The largest single source of GHG emissions from the Scheme is likely to result from the manufacture and transport of solar photovoltaic (PV) Panels and BESS. The infrastructure manufacturer has not been selected yet and therefore for the purposes of estimating the GHG impact of the Scheme, a conservative estimate is to assume that the PV panels will be sourced from China (or a country of similar distance from the UK) as this will increase the embodied and transport emissions compared to panels being sourced from Europe.

6.3.5 Indicative information on the number and size of the PV panels likely to be installed is available, and analysis of an Environmental Product Declaration (EPD) for broadly comparable PV panels manufactured in China (taken as an example country) allows an estimate of the embodied carbon of the PV panels to be installed within the Order limits.

6.3.6 The EPD used as a reference for embodied carbon from the manufacture and supply of PV panels is for the Jolywood JW-HD144N-166 panel rated at 470 Watts (W) (Ref 6-19). The EPD was published in November 2020, prepared in accordance with ISO 14025 and EN 15804 and subject to independent third-party verification. The EPD includes data on embodied carbon in kilograms carbon dioxide equivalent per kilowatt hour (kg CO_2e/kWh) of electricity generated for various lifecycle stages including supply of raw materials, manufacture, and transport to a solar farm in China.

6.3.7 The EPD shows upstream manufacturing with an embodied carbon figure of 0.00748 kg CO_2e/kWh, but the generation data is from an actual site in southern China with 22% higher yield than anticipated at the Order limits. When a correction is made for the lower anticipated generation at the Order limits, the embodied carbon figure rises to 0.00912kg CO_2e/kWh generated over the development's operational lifetime.

6.3.8 Yields at the Order limits are assumed to be 970 kilowatt hours per year per kilowatt peak (kWh/yr/kWp), with the output of the PV panels assumed to degrade by 2% in the first year and by 0.45% per year thereafter (Ref 6-20). For an installation rated at 390 MWp operating for 40 years, lifetime generation is estimated at 13,599 gigawatt hours (GWh) of electricity.

6.3.9 The PV Panels have a total mass of 25,529 tonnes, and it is assumed that these will be transported by sea from Shanghai via Suez to Tilbury on the Thames Estuary, a total distance of 10,463 nautical miles (Ref 6-21) or 19,377km. An emissions factor of 0.01267 kg CO_2e/tonne.km was applied for a large (8000 TEU+) container ship (Ref 6-22).

6.3.10 Upstream carbon data from the EPD includes transport by road from the production facility to a solar farm within China, so this part of the journey has been omitted to avoid double counting of emissions. Heavy Goods Vehicle (HGV) transport from Tilbury to the Order limits has been included, for a round trip distance of 70 miles. A 50% laden emissions factor of 0.25377kg CO_2e/tonne.km has been applied for a rigid HGV of between 7.5 and 17 tonnes (Ref 6-22).

6.3.11 The Scheme includes a BESS which will ultimately be able to supply the grid at an assumed 400 MW for four hours, for a total capacity of 1,600 MWh. Estimates of the embodied carbon associated with the manufacture of battery systems and other electrical hardware are subject to a significant degree of uncertainty. For the purposes of this assessment, a literature study indicates a range of embodied carbon values from 59 to 119 kg CO_2e per kWh of battery capacity, with a midpoint of 89 kg CO_2e/kWh (Ref 6-23). For the purposes of the GHG assessment, this midpoint value has been applied. As 150% of the cells in the battery storage system are expected to be replaced during the operational life of the Scheme, when substantial decarbonisation of supply chains is anticipated to have occurred, this value is considered to be a conservative figure.

6.3.12 The literature review suggests that battery storage systems have a typical energy density of up to 200 Wh/kg (Ref 6-24). For a BESS with total capacity of 1,600 MWh, this would equate to a total mass of 8,000 tonnes. Transport for the BESS is assumed to be similar to that for the PV Panels, i.e. by sea from Shanghai to Tilbury via Suez, then by road from Tilbury to the Order limits.

6.3.13 The final BESS arrangement has not been fixed for the DCO application. Rochdale Envelope principles have therefore been applied to ensure that maximum and worst-case parameters have been assessed. For climate this is based on the maximum Scheme energy generation and for the BESS the maximum number of battery cubes; increasing the peak power capacity of the BESS would reduce the number of battery cubes and increase the number of inverters and transformers within the BESS, which would lower the embodied emissions. The worst-case BESS parameters have therefore been assessed, which allow for iterations at detailed design stage that may contain the same or lower embodied carbon.

6.3.14 The Scheme, including the extension to National Grid's Bulls Lodge Substation, will also require other components and materials during the construction phase, including PV inverters, BESS inverters, cables, a steel framework to support the PV Panels, concrete and aggregates. Emissions factors for each of these have been derived from a literature review (PV and BESS inverters) or standard factors (cables, steel framework and building materials).

Transport of components and materials

6.3.15 Emissions from the transportation of components and materials to site have been calculated based on assumed transport modes and distances for all materials and components. Information on materials and components required for the construction of the Scheme, together with all other information as provided by the Applicant and relevant emissions factors, are detailed in Appendix 6A: Climate Change - Technical Appendix of the ES [EN010118/APP/6.2]. Building materials such as concrete and aggregate are assumed to be sourced relatively locally and transported by HGV a maximum of 50km. PV and BESS inverters are assumed to be manufactured in Germany and transported to site by HGV and ship. All other components and materials are assumed to originate in east Asia (China or South Korea) and will be transported by ship and then HGV. Due to widespread local availability of building materials, it is assumed they will be transported by HGV a maximum of 50km.

Waste management

6.3.16 Emissions from the disposal of construction waste assume standard wastage rates for materials (5% for concrete and aggregate; 2.5% for steel, aluminium and plastics). Volumes of packaging waste have been estimated on a pro-rata basis of installed capacity from other, similar, schemes. The proportions of waste going to landfill or recycling varies depending on the materials in question: for concrete and aggregate, it has been assumed that 50% goes to landfill and 50% will be recycled. For plastics and wood the assumed ratio is 75%:25% recycling: landfill. For steel and aluminium, it is assumed that all waste will be recycled. Emissions factors for waste disposal are taken from the UK Government conversion factors for company reporting (Ref 6-22). Transport emissions from the disposal of waste assume that all disposal will take place within a 100km radius of the Order limits.

Use of plant and machinery

6.3.17 Emissions from the use of plant and machinery have been calculated based on a stated assumption that consumption of diesel for running machinery will average 5,000 litres per week. Additionally, the use of generators is assumed to consume 16.5 litres of diesel per hour, running for six hours per day. The emissions factors for diesel was taken from the 2021 conversion factors for company reporting published by the UK Government (Ref 6-22).

Consumption of water

6.3.18 Consumption of water during the construction phase assumes that each worker on site utilises 90 litres per day, and that construction activities account for a further 33% over and above consumption by workers. Water consumption figures, monthly worker numbers and working days per month have been provided by the Applicant's design team. Emissions factors for water supply and wastewater treatment are taken from the 2021 conversion factors for company reporting (Ref 6-22); as a conservative estimate, it is assumed that all water supplied is removed for treatment via the wastewater network.

Worker travel

6.3.19 Emissions from construction worker travel have been calculated on the basis of information provided by the Applicant's design team. This provides estimates of worker numbers on site for each month, and an assumption that workers travel by car with an average occupancy level of 1.35 people per vehicle. It has further been assumed that each worker travels a maximum of 30km each way. An emissions factor for a typical car of unknown fuel has been applied, taken from the 2021 conversion factors for company reporting published by the UK Government (Ref 6-22).

Land use change

6.3.20 The climate change impact of any change in land use has been assessed by comparing the vegetation cover characteristics of areas of land to be converted from the existing land use for the operational lifetime of the Scheme. Most land use change has been applied to existing arable land, with a smaller area being converted from grassland to scrubland. For each land use type converted for the design life of the Scheme, estimated values of soil and vegetation carbon have been calculated using representative factors taken from European Commission guidelines for the calculation of land carbon stocks (Ref 6-25).

6.3.21 A key assumption is that the areas of land within the Order limits will be returned to their current land use (i.e. largely arable) at the end of the Scheme's design life, with the exception of proposed changes to new woodland or new hedgerows which will be permanent. Any carbon sequestered in these areas would remain in the ground following decommissioning. All other areas of land use change are assumed to return to the current land use, with any carbon stored in soil or vegetation re-released to the atmosphere.

6.3.22 As noted in Chapter 2: The Scheme of this ES [EN010118/APP/6.1], the construction period is expected to be 24 months. This is expected to be a realistic worst-case assumption for this assessment, as it represents the expected minimum build time and therefore the most intense emissions during a calendar year. Should the build period be a longer duration, the annual emissions would be lower. This principle also applies to the BESS, which may be constructed over two phases, with the first part built alongside the solar PV and the second phase an estimated five years after commencing operation; it has been assessed as a single phase for the purpose of this assessment.

Operational phase

6.3.23 Operational energy consumption data has been provided by the client's design team. It is assumed that the on-site warehouse will have a constant power demand of 10kW, and that this will be supplied from the grid. Projections of future grid carbon intensities are taken from data published by the UK Government (Ref 6-26).

6.3.24 Operational energy generation data has also been provided by the Applicant. This data accounts for efficiency losses of the PV Panels over time based on an initial degradation factor of 2.5% for the first year, and 0.55% degradation for each subsequent year to the end of the warranty of the panels (30 years). In order to model efficiency losses over the entire lifetime of 40 years, this 0.55% degradation rate will also be applied to the final ten years of the operational lifetime.

6.3.25 Operational maintenance from the replacement of components during the design lifetime of the Scheme are based on replacement rates provided by the Applicant's design team. It is assumed that 5% of transformers and 10% of PV Panels will require replacement during the Scheme's design life. All the inverters and BESS cells are assumed to require replacement once, with a further 50% requiring replacement twice, during the design life.

6.3.26 Operational worker travel data has been estimated based on an assumption of five workers on site every day over the design life of the scheme. Workers are assumed to travel alone by car a maximum of 30km each way. An emissions factor for an average car of unknown fuel has been applied. These emissions are likely to be a worst-case scenario, as private cars are increasingly likely to be powered by electricity rather than by internal combustion engines.

6.3.27 Sulphur hexafluoride (SF6) is a powerful greenhouse gas with a global warming potential of 23,900. Fugitive emissions of SF6 from certain electrical items such as gas insulated switchgear have historically been a significant source of emissions. Manufacturers of such equipment are now increasingly able to offer SF6-free components, and those that do continue to use SF6 are sealed-for-life with extremely low leakage rates. For this reason, it is assumed that emissions of SF6 from this Scheme will be minimal and not material to this GHG assessment.

Decommissioning phase

6.3.28 Emissions from the decommissioning process at the end of the design life are extremely difficult to estimate due to the substantial uncertainty surrounding decommissioning methodologies and approaches so far into the future. Following discussion with the Applicant's design team, it has been assumed that the resources and effort required for decommissioning will be 0.5 times those required for construction. This is likely to be a worst-case scenario.

6.3.29 Emissions from the disposal of materials and components at the end of the design life are also subject to significant uncertainty. For the purposes of this assessment, emissions factors for recycling of different categories of products and materials have been taken from the conversion factors for company reporting published by the UK Government. It is assumed that all materials and components will be recycled at end of life, with nothing going to landfill.

6.3.30 Emissions from the transport of materials and components away from site at the end of design life have been estimated on the assumption that all recycling, landfilling etc will take place in the UK at a maximum distance of 50km for concrete and aggregate, and no more than 200km for other materials. These distances have been assumed on the basis of the proximity principle, and after discussion with waste management specialists. Transport is assumed to be by HGV and applies the most recent emissions factor from the conversion factors for company reporting published by the UK Government (Ref 6-22). As HGV transport is very likely to be decarbonised, these emissions are almost certainly an overestimate.

6.3 Stakeholder Engagement

6.3.1 Stakeholders for the Scheme include statutory consultees, land managers, landowners, heritage interest groups, academics, and local communities.

6.3.2 Consultation responses to the Scoping Report are outlined in **Table 6-1.**

Table 6-1: Main Matters Raised During Consultation: Scoping

Consultee	*Main matter raised*	*How has the concern been addressed*	*Location of response in chapter*
Planning Inspectorate	The ES should include a description and assessment (where relevant) of the likely significant effects the Scheme has on climate and the vulnerability of the project to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Scheme.	This is the approach taken throughout this chapter.	See Section 6.1, Section 6.8 and Section 6.9
Planning Inspectorate	The Scoping Report states that *"Where carbon budgets are not available for certain assessment periods, a qualitative approach will be taken"*. Any assumptions made around future carbon budgets should be clearly set out and justified in the ES.	This is the approach taken within this chapter.	Section 6.4.21
Chelmsford City Council	Relevant Planning Policies - Reference should be made to the Draft Making Place Supplementary Planning Document (SPD) October 2020, particularly in Chapter 6 Climate Change.	Included in local planning policies.	Section 6.2.1

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Chelmsford City Council	Relevant Planning Policies - Chapter 12, the correct title for reference (Ref.166) is The Chelmsford Climate and Ecological Emergency Action Plan (2020). This chapter should also include reference to Strategic Policy S10 Securing infrastructure and impact mitigation.	Included in local planning policies.	Section 6.2.1
Terling and Fairstead Parish Council	The section on climate change impact must include, analyse and establish to scrutinise the loss of land covered by crops and grassland will have as a Carbon Sink.	Moving from arable farmland to grassland or scrub is likely to increase the carbon sink potential of the land.	Sections 6.3.10 and 6.3.11
Hatfield Peverel Parish Council	The section on climate change impact (Chapter 6) should include the loss of carbon sink capability of the land as currently covered by crops and grassland.	Moving from arable farmland to grassland or scrub is likely to increase the carbon sink potential of the land.	Sections 6.3.10 and 6.3.11
Natural England	The England Biodiversity Strategy published by Defra establishes principles for the consideration of biodiversity and the effects of climate change. The ES should reflect these principles and identify how the development's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained. The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF Para 109), which should be demonstrated through the ES.	This is included within Section 8.8 of ***Chapter 8: Ecology*** of this ES **[EN010118.6.1]**.	Section 8.8 in ***Chapter 8: Ecology*** of this ES.

6.3.3 Consultation responses to the PEI Report are outlined in **Table 6-2.**

Table 6-2: Main Matters Raised During Consultation: Preliminary Environmental Information Report

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Chelmsford City Council	More information would be welcomed regarding the net reduction in carbon emissions overall throughout the lifetime of the project	This information is available in section 6.8	Section 6.8.27
Chelmsford City Council	A balance sheet reviewing the environmental costs and benefits of producing solar panels against the comparison with different types of energy both renewable and fossil fuels would be helpful.	Data showing the comparable carbon impact of the manufacture of solar panels and other energy generation technology is not available. A comparison of lifetime carbon intensity compared with the intensity of comparable fossil fuel capacity is provided in section 6.8	Section 6.8.27

6.4 Assessment Methodology

Study Area

Lifecycle GHG Impact Assessment

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

Climate Change Resilience (CCR) Review

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

Sources of Information

Lifecycle GHG Impact Assessment

6.4.3 The data required to undertake the lifecycle GHG impact assessment were provided by the Applicant and analysed using the methodology outlined below. Details of information provided by the Applicant, and the emissions factors used to convert this activity data to GHG emissions, are included in Appendix 6A: Climate Change – Technical Appendix of the ES.

Climate Change Resilience Review

6.4.4 Historic climate data obtained from the Met Office website (Ref 6-27) and UK Climate Projections 2018 (UKCP18) (Ref 6-28) data were also obtained to determine the historic and future baseline conditions.

CCR measures that have been built into the Scheme design were determined through liaison with the project design team and relevant environmental discipline leads. These are detailed in Section 6.7.

Impact Assessment Methodology

Lifecycle GHG Impact Assessment

6.4.5 This assessment is based on baseline and Scheme design information relating to the DCO.

6.4.6 The potential effects of the Scheme on the climate during construction have been calculated in line with the GHG Protocol (Ref 6-29) and the GHG 'hot spots' (i.e. materials and activities likely to generate the largest amount of GHG emissions) have been identified. This will enable priority areas for mitigation to be identified. This approach is consistent with the principles set out by the Institute for Environmental Management and Assessment (IEMA) document 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance' (Ref 6-30).

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

6.4.8 Where activity data allows, expected GHG emissions arising from the construction, operation and maintenance, and decommissioning activities, and embodied carbon in materials of the Scheme, have been quantified using a calculation-based methodology as per the following equation as stated in the methodology paper accompanying the conversion factors for company reporting published by the UK Government (Ref 6-31):

Activity data x GHG emissions factor = GHG emissions value

6.4.9 In line with 'The GHG Protocol' (Ref 6-299), when defining potential impacts the seven Kyoto Protocol GHGs have been considered, specifically:

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

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

6.4.11 Where data are not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-30).

6.4.12 **Table 6-3** summarises the key anticipated GHG emissions sources associated with the Scheme.

Table 6-3: Potential sources of GHG emissions

Lifecycle stage	*Activity*	*Primary emission sources*
Product stage	Raw material extraction and manufacturing of products required to build the equipment for the Scheme. 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 significant contribution to overall GHG emissions. Transportation of materials for manufacturing.	Embodied GHG emissions from energy use in extraction and production. Emission of potent GHG emissions during manufacture, such as sulphur hexafluoride (SF_6). GHG emissions from vehicle use.
Construction process stage	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 significant 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 stage	Operation of the Scheme. Maintenance of the Scheme.	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

Lifecycle stage	Activity	Primary emission sources
		maintenance. Maintenance is generally expected to be insignificant.
Decommissioning stage	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.

Climate Change Resilience Review

6.5.3 The EIA Regulations require the inclusion of information on the vulnerability of the Scheme to climate change. Consequently, an assessment of climate change resilience for the Scheme has been conducted which identifies potential climate change impacts.

6.5.4 The review has included all infrastructure and assets associated with the Scheme. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UKCP18 projections (Ref 6-28).

6.5.5 The review of potential impacts and the Scheme's vulnerability considers the mitigation measures that have been designed into the Scheme, discussed in Section 6.7. Potential impacts considered include higher temperatures in the future, and more extreme rainfall events.

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

Significance Criteria

6.5.7 Due to the absence of any defined industry guidance for assessing the magnitude of GHG impacts for EIA, standard GHG accounting and reporting principles have been followed to assess impact magnitude. According to the IEMA guidance on assessing GHG emissions in EIA (Ref 6-30), "*GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant*".

6.5.8 The IEMA guidance (Ref 6-30) also states it is down to the professional judgement of the practitioner to determine how best to contextualise a project's GHG impact and assign the level of significance. It is suggested that sectoral, local, or national carbon budgets can be used, as available and appropriate, to contextualise a project's GHG impact and determine the level of significance. The approach adopted for the purposes of this assessment is outlined below.

6.5.9 In GHG accounting it is common practice to consider exclusion of emission sources that are <1% of a given emissions inventory on the basis of a *'de* *minimis'* contribution. Both Department of Energy and Climate Change (DECC) (Ref 6-32) and the Publicly Available Specification PAS 2050:2011 (Ref 6-33) allow emissions sources of <1% contribution to be excluded from emission inventories, and these inventories to still be considered complete for verification purposes.

6.5.10 Where available, UK national carbon budgets will be used for the purposes of this assessment to represent future emissions inventory scenarios for the UK. These legally binding targets outline the total amount of GHGs that the UK can emit over a five-year period.

6.5.11 UK National carbon budgets are currently available to 2037 (Ref 6-34). The Carbon Budget Order 2021, containing details of the 6th carbon budget for the period 2033-37 was signed into law in June 2021 (Ref 6-35). Therefore, a qualitative approach has been taken for assessing the significance of GHG emissions arising as a result of the Scheme for the years beyond 2037. A quantitative approach is not possible beyond 2037 as although the carbon budgets are set to decrease over time, there will still be permitted GHG emissions beyond 2050, but with offsetting measures in place to ensure net emissions are zero. The rate at which they will decrease is not known, so it is not possible to predict the quantity of emissions permitted within the carbon budgets beyond 2037.

6.5.12 It should be noted that the 1st to 5th carbon budgets were based on the previous UK Government target of an 80% reduction in GHG emissions by 2050, rather than the current net zero target for 2050 (Ref 6-3), with only the 6th carbon budget being based on the UK's net-zero target.

6.5.13 For the purposes of this assessment, a development with emissions of <1% of the relevant carbon budget would be considered not material and would therefore be unlikely to impact the UK's ability to meet its net zero carbon emissions target for 2050. Equally, if a development results in an annual reduction in GHG emissions, the beneficial impact will also be assessed using this 1% threshold.

6.5.14 This approach has been used to assess the magnitude of the GHG impact associated with the Scheme and the associated criteria are outlined in **Table 6-4**. This differs from the standard criteria used in the EIA process by omitting the 'Very Low' and 'Medium' categories for magnitude. This is because the magnitude of the impact is determined by a boundary of less than, or equal to or more than, 1% of the carbon budgets.

Table 6-4: Magnitude Criteria for GHG Impact Assessment

Magnitude	*Magnitude criteria*
High	Annual GHG emissions, or GHG emissions reductions, represent equal to or more than 1% of the relevant annual National Carbon Budget.
Low	Annual GHG emissions, or GHG emissions reductions, represent less than 1% of the relevant annual National Carbon Budget.

6.5.15 The UK carbon budgets are in place to restrict the amount of greenhouse emissions the UK can legally emit in a five-year period (Ref 6-7). The UK is currently in the 3rd carbon budget period, which runs from 2018 to 2022.

6.5.16 The construction phase of the Scheme is estimated to commence not earlier than Q1 of 2024 and run for an estimated 24 months. Construction is therefore expected to fall within the period of the 4th UK national carbon budget which will run from 2023 to 2027.

6.5.17 Where possible, the operational phase of the Scheme (estimated to be not earlier than 2026) will be compared to the relevant and available carbon budgets within the design life of the Scheme: the 4th, 5th and 6th carbon budgets covering the periods 2023-27, 2028-32 and 2033-37, respectively. While the Scheme will be operational beyond this time, the budgets are only available to 2037. Therefore, beyond 2037, a qualitative approach has been adopted, using professional judgement to determine the significance of the impact of GHG emissions arising as a result of the Scheme.

6.5.18 **Table 6-5** shows the current and future UK carbon budgets up to 2037, which highlights a reduction in the amount of GHG the UK can legally emit in the future. This means that any source of emissions contributing to the UK's carbon inventory will have a greater impact on the UK carbon budgets in the future.

Table 6-5: Relevant Carbon Budgets for this Assessment

Carbon budget	*Total budget ($MtCO_2e$)*
3rd (2018-2022)	2,544
4th (2023-2027)	1,950
5th (2028-2032)	1,725
6th (2033-2037)	965

6.5.19 The significance of effects has been determined using the matrix in **Table 6-6**. The sensitivity of the receptor (global climate) to increases in GHG emissions is always considered 'High', and the magnitude of the impact is determined by a boundary of less than, or equal to or more than, 1% of the carbon budgets (i.e. minor or major).

6.5.20 This is in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-30) which states that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments. It is therefore considered that any emissions, or emissions reductions, as a result of the Scheme might be considered significant. For the purposes of this assessment, the magnitude of significance will be determined using the criteria outlined in **Table 6-6.**

Table 6-6: Significance of Effects Matrix for GHG Impact Assessment

Magnitude	*Significance*
Low (<1% of carbon budget)	Minor significance
High (≥1% of carbon budget)	Major significance

6.5.21 From 2050 onwards, the UK is legally obliged to offset any emissions in line with its net zero target for 2050. Until specific carbon budgets are set out to 2050 and beyond, the permitted quantity of emissions is not known, however it is anticipated to decrease over time. Therefore, over time, the level of impact of any emissions, or emissions reductions, could be considered to become more significant in the context of the UK meeting its carbon reduction target as the quantity of permitted emissions gets smaller.

6.5.22 The significance of CCR is determined as a function of the likelihood of a climate change risk occurring and the consequence to the receptor if the hazard occurs. This is detailed in **Table 6-7.** Where a risk is determined as High or Very high, this has been deemed significant.

Table 6-7: Level of effect criteria for climate change resilience impacts

		Likelihood of a climate impact occurring				
		Very unlikely	**Unlikely**	**Possible, about as likely as not**	**Likely**	**Very likely**
Consequence	**Catastrophic Adverse/ Substantial Beneficial**	**L**	**M**	**VH**	**VH**	**VH**
	Major	**L**	**M**	**H**	**H**	**VH**
	Considerable	**L**	**M**	**H**	**H**	**H**
	Moderate	**L**	**M**	**M**	**M**	**H**
	Minor	**L**	**L**	**L**	**M**	**M**
	Insignificant	**L**	**L**	**L**	**L**	**L**
	No change	**L**	**L**	**L**	**L**	**L**

VH = Very high effect, H = High effect, M = Moderate effect, L = Low effect

6.6 Baseline Conditions

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

Lifecycle GHG Impact Assessment

6.6.2 The land within the Solar PV Array Works Area consists mainly of arable land, managed hedgerows, and trees. Trees are present individually in some areas as well as rows of trees and small woodland areas. Also, the current use of the Solar PV Array Works Area has minor levels of associated GHG emissions as the land use is largely agricultural. Baseline agricultural GHG emissions are dependent on soil and vegetation types present, and fuel use for the operation of vehicles and machinery.

6.6.3 The lifecycle GHG impact assessment for the wider Order limits, comprising the Solar PV Array Works Area, Cable Routes, Longfield Substation and the Bulls Lodge Substation Extension are included in Section 6.7.29. Substations and cable routes were considered, but it is not anticipated that they will have a material effect on the overall assessment.

6.6.4 For the lifecycle GHG impact assessment, the future baseline is a 'business as usual' scenario whereby the Scheme is not implemented, for those lifecycle stages that have been scoped into the assessment, presented in **Table 6-3.** The future baseline comprises existing carbon stock and sources of GHG emissions within the Order limits from the existing activities on-site.

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

Climate Change Resilience Review

Current Baseline

6.6.6 The current baseline for the CCR Review is the current climate in the location of the Scheme. Historic climate data obtained from the Met Office website (Ref 6-27) recorded by the closest Met Office station to the Scheme (Cambridge) for the 30-year climate period of 1981-2010 (the standard baseline for climate data) is summarised in **Table 6-8** below.

Table 6-8: Historic climate data

Climatic Factor	*Month*	*Figure*
Average annual maximum daily temperature (°C)	-	14.44
Warmest month on average (°C)	July	22.77
Coldest month on average (°C)	February	1.26
Mean annual rainfall levels (mm)	-	566.5
Wettest month on average (mm)	October	59.04
Driest month on average (mm)	February	34.5

6.6.7 The Met Office historic 10-year averages for the East Anglia district identify gradual warming (although not uniformly so) between 1969 and 2018, with increased rainfall. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in **Table 6-9.**

Table 6-9: Historic 10-year averages for temperature and rainfall for the East Anglia region

Climate Period	*Climate Variables*	
	Mean maximum annual temperatures (°C)	*Mean annual rainfall (mm)*
1969-1978	13.5	567.1
1979-1988	13.3	629.5
1989-1998	14.3	579.7
1999-2008	14.7	663.9
2009-2018	14.7	610.7

6.6.8 A site-specific flood risk assessment has been prepared for the Scheme. This is presented within ***Appendix 9A: Flood Risk Assessment*** of this ES. Full details of the baseline flood risk can be found within ***Chapter 9: Water Environment*** of this ES.

Future Baseline

6.6.9 The future baseline is expected to differ from the present-day baseline described above. United Kingdom Climate Change Projections 2018 (UKCP18) (Ref 6-28) provides probabilistic climate change projections for pre-defined 30-year periods for annual, seasonal, and monthly changes to mean climatic conditions over land areas. For the purpose of the assessment, UKCP18 probabilistic projections for pre-defined 30-year periods for the following average climate variables have been obtained:

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

j. Mean summer cloud cover; and

k. Mean winter cloud cover.

6.6.10 Projected temperature, precipitation, and cloud cover variables are presented in **Table 6-10, Table 6-11**, and **Table 6-12** respectively. UKCP18 probabilistic projections have been analysed for the 25km^2 grid square within which the Scheme is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2000 baseline.

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

6.6.12 As the design life of the Scheme is expected to be at least 40 years, the CCR assessment has considered a scenario that reflects a high level of GHG emissions at the 10%, 50%, and 90% probability levels up to 2069 to assess the impact of climate change over the lifetime of the Scheme.

6.6.13 The tables below show projected changes in temperature (expected to increase), precipitation (expected to increase in winter and decrease in summer) and cloud cover (expected to increase in winter and decrease in summer). The climate projections do not take account of the Scheme.

Table 6-10: Projected changes in temperature variables (°C)

Climate Variable	*Time Period*	
	2020-2049	*2040-2069*
Mean annual air temperature anomaly at 1.5 m (°C)	+1.08 (+0.46 to +1.75)	+1.95 (+0.98 to +3.02)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.35 (+0.53 to +2.26)	+2.48 (+0.99 to +4.03)
Mean winter air temperature anomaly at 1.5 m (°C)	+0.94 (-0.08 to +2.00)	+1.71 (+0.5 to +2.98)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.51 (+0.5 to +2.65)	+2.83 (+0.97 to 4.81)
Minimum winter air temperature anomaly at 1.5 m (°C)	+0.90 (-0.13 to +1.99)	+1.68 (+0.42 to +3.16)

Table 6-11: Projected changes in precipitation variables (%)

Climate Variable	Time Period	
	2020-2039	2050-2069
Annual precipitation rate anomaly (%)	+0.25 (-3.89 to +4.64)	-2.52 (-7.93 to +3.13)
Summer precipitation rate anomaly (%)	-11.25 (-31.77 to +8.19)	-21.53 (-46.23 to +1.85)
Winter precipitation rate anomaly (%)	+6.54 (-3.82 to +16.87)	+9.76 (-4.63 to +26.01)

Table 6-12: Projected changes in cloud cover variables (%)

Climate Variable	Time Period	
	2020-2039	2050-2069
Annual total cloud anomaly (%)	-2.68 (-5.95 to +0.55)	-4.12 (-8.87 to +0.48)
Summer total cloud anomaly (%)	-5.87 (-13.54 to +1.19)	-10.15 (-22.54 to +1.62)
Winter total cloud anomaly (%)	+0.05 (-2.38 to +2.04)	+0.40 (-1.63 to +2.40)

Summary of Sensitive Receptors

6.6.14 Based on a review of the baseline conditions, the global climate is the receptor for the lifecycle GHG impact assessment. The sensitivity of this receptor is 'high', in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-30), which highlights the importance of mitigating GHG emissions to reduce the impacts of climate change.

6.6.15 The receptor for the review of climate change resilience is the Scheme itself, including all infrastructure, assets, and workers on site during construction, operation, and decommissioning.

6.7 Embedded Design Mitigation

6.7.1 As illustrated within the Outline Construction Environmental Management Plan (CEMP) [**EN010118/APP/7.10**] (various GHG mitigation measures are embedded within the Scheme. This embedded mitigation has been implemented to reduce the GHG impact of the Scheme and includes:

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

b. Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Scheme by employing best practice measures which go beyond statutory compliance;

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

d. 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 Scheme to all construction staff, and providing appropriate facilities for the safe storage of cycles;

e. Liaising with construction personnel for potential to implement staff minibuses and car sharing options;

f. Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Order limits;

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

h. Conducting regular planned maintenance of the Scheme to optimise efficiency.

6.7.2 The Outline CEMP of the ES also includes various climate change resilience measures embedded within the Scheme. These include:

a. Storing topsoil and other construction materials outside of the 1 in 100-year floodplain extent (Flood Zone 3), as far as reasonably practicable; and

b. Appointing at least one designated Flood Warden who is familiar with the risks and remains vigilant to news reports, Environment Agency flood warnings, and water levels of the local waterways.

6.7.3 An implementation mechanism analogous to the Outline CEMP but focussing on decommissioning will be developed prior to the decommissioning phase to encourage the use of lower-carbon and more climate change resilient methods. A Decommissioning Environmental Management Plan (DEMP) (including a GHG assessment) will be prepared prior to decommissioning. Refer to the ***Decommissioning Strategy*** **[EN010118/APP/7.12].**

6.7.4 Further climate change resilience measures embedded within the Scheme, particularly in relation to flood risk, are outlined below. The specific flood risk impacts and associated mitigation measures are discussed in more detail in ***Chapter 9: Water Environment*** of the ES. These measures include:

a. The design of drainage systems will ensure that there will be no significant increases in flood risk downstream during storms up to and including the 1 in 100 (1%) annual probability design flood, with an allowance of 40% for climate change;

b. Sustainable Drainage Systems (SuDS) features will be utilised to ensure the surface water drainage strategy adequately attenuates and treats runoff from the Scheme, whilst minimising flood risk to the Order limits and surrounding areas; and

c. Scheme infrastructure has been designed to ensure no floodplain storage is lost.

6.7.5 Health and safety plans developed for construction and decommissioning activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves. (Refer to the ***Outline CEMP*** and ***Decommissioning Strategy*** of the ES).

6.7.6 The effect of projected temperature increases on electrical equipment over the course of the Scheme's design life has been taken into account. Inverters (PV and BESS) will have a cooling system installed to control the temperature and allow the inverters to operate efficiently in warmer conditions. The PV modules and transformers have a wide range of acceptable operating temperatures, and it has been determined that increasing temperatures will not adversely affect their operation.

Assessment of Likely Impacts and Effects

6.7.7 The impacts and effects (both beneficial and adverse) associated with the construction, operation, and decommissioning of the Scheme are outlined in the sections below. The assessments have been carried out taking into consideration the embedded mitigation measures described in Section 6.7.

Lifecycle GHG Impact Assessment

6.7.8 Within this section, GHG emissions arising as a result of the Scheme are first identified and assessed for each lifecycle stage individually (construction, operation, and decommissioning).

6.7.9 While it is important to understand the GHG impacts at each individual lifecycle stage, it is also important to understand the net lifecycle GHG impact of the Scheme due to the long-term, cumulative nature of GHG emissions over the lifetime of the Scheme.

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

Construction (2024 to 2026)

6.7.11 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 BESS is estimated to account for 142,400 tonnes, with the manufacture of PV Panels leading to a further 119,207 tonnes. **Table 6-13** summarises the emissions resulting from the manufacture of materials required for the construction of the Scheme.

Table 6-13: Embodied emissions from the manufacture of materials and components

Emissions source	*Embodied emissions (t CO_2e)*	*Proportion of total embodied emissions*
Battery storage (BESS)	142,400	40.7%
PV Panels	119,207	34.0%
PV Inverters	29,390	8.4%
PV framework	28,253	8.1%
BESS Inverters	23,512	6.7%
Transformers	4,123	1.2%
Cables	2,503	<1%
Concrete	618	<1%
Aggregate	114	<1%
Total Products	**350,119**	**100%**

6.7.12 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 Order limits, transportation of construction workers to and from the Order limits and the transportation and disposal of waste from the Order limits. **Table 6-14** below summarises overall construction emissions from various emissions sources. For details of methodology, activity data and emissions factors, refer to ***Appendix 6A: Climate Change – Technical Appendix*** of the ES.

Table 6-14: Emissions resulting from the construction phase

Emissions source	*Emissions (tonnes CO_2e)*	*Proportion of overall construction emissions*
Products and materials	350,119	94.8%
Transportation of products and materials to Order limits	13,938	3.8%
Worker commuting	1,906	<1%
Fuel use	1,605	<1%
Waste (including transport)	1,234	<1%

Emissions source	Emissions (tonnes CO_2e)	Proportion of overall construction emissions
Water use	328	<1%
Construction total	**369,130**	**100%**

Operation (no earlier than 2026 and assumed to 2066)

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

6.7.14 Information provided by the Applicant states that the on-site warehouse building will have 10 kW of continuous power demand, and that this will be supplied from the National Grid for a total annual grid electricity consumption of 87,600 kWh/yr. The UK Government publishes projections of grid carbon intensity for each year to 2100, with emissions per kWh of electricity generated set to decline over the period to 2050. Emissions therefore will be highest in year one of operation and fall thereafter. Applying these projected grid factors, emissions in the first year of operations are estimated to be just over eight tonnes CO_2e/yr, falling to less than one tonne CO_2e/yr by the final year of the design life when the national grid is assumed to be largely renewables fed. Lifetime emissions from grid power consumption total 71.2 tonnes CO_2e. This is likely to be an overestimate given that the power will sometimes be generated onsite from the Solar PV or from the BESS.

6.7.15 The Applicant has provided estimated lifetime replacement rates for PV Panels, PV Inverters, Battery Energy Storage System cells, BESS Inverters, and transformers. It has been assumed that over the design life of the Scheme, 5% of PV and BESS transformers, 10% of PV Panels, and 150% of PV and BESS inverters and of the cells of the BESS itself are likely to required replacement. Based on these estimated replacement rates and applying the same embodied and transportation emissions factors used to quantify the impact of construction, the replacement of these components is estimated to result in embodied emissions of 305,079 tonnes CO_2e, and additional emissions of 4,391 tonnes CO_2e from their transportation from country of origin to the DCO Site.

6.7.16 With the exception of the emissions data for PV Panels, which have been derived from an Environmental Product Declaration, the embodied carbon factors on which these figures are based are subject to considerable uncertainty, with there being no industry-standard factors for most of these items. Furthermore, if the replacement of inverters and BESS cells takes place mid-way through the Scheme's 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 assessment, and that much more reliable data will be available.

6.7.17 Emissions from the transportation of workers assume eight workers on site each day, with each worker driving to site in their own vehicle a maximum of 30km each way. This is assumed to be a conservative assumption that is likely to overestimate the distance travelled. The emissions factor applied is for an average car of unknown fuel, from the most recent conversion factors for company reporting. Based on these assumptions, emissions are estimated at 38 tonnes CO_2e per year, for a total of 1,511 tonnes over the 40-year design life of the Scheme. This figure is a highly conservative worst-case scenario, with the actual operational transport emissions likely to be much lower with the inevitable transition to EVs combined with the ongoing decarbonisation of UK grid electricity.

6.7.18 Emissions from the supply of water and treatment of wastewater can be estimated by applying the same emissions factors as for construction emissions. Based on 8 workers each consuming 90 litres per day, annual emissions from water and wastewater are estimated at 110 kg CO_2e per year or 4.45 tonnes over the design life of the Scheme.

6.7.19 While sulphur hexafluoride (SF_6) is a potential source of GHG emissions over the lifetime of the Scheme (from its use in certain electric components such as gas-insulated switchgears and transformers during production, operation through leakage, and dismantling), it is not likely to be possible to accurately quantify the small level of fugitive emissions from the leakage of SF_6 due to insufficient data. Manufacturers of electrical switchgear and transformers are increasingly able to provide equipment that either does not contain any SF_6, or is sealed for life with extremely low leakage rates. This will therefore not be considered further in the assessment and is not expected to have a material impact on the predicted effects on GHG emissions associated with the Scheme (Ref 6-36).

6.7.20 An increase in carbon sink from land use change has been estimated 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 using data provided by the Applicant's biodiversity consultants. 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. It is estimated that over the lifetime of the Scheme, this land use change will sequester 87,228 tonnes CO_2e. Upon decommissioning, it is estimated that 44,939 tonnes CO_2e will be rereleased to the atmosphere as grassland and scrubland are returned to arable farming, while 42,288 tonnes CO_2e will be retained in permanently converted hedgerows and woodland.

6.7.21 Not including the impacts of an increased carbon sink from land use change (see below), total operational emissions over the design life of the Scheme are estimated at 309,584 tonnes CO_2e. 98.6% of this figure results from the supply of replacement components, with only 0.03% the result of ongoing operational emissions. With the temporary increase in carbon sink of -87,228 tonnes CO_2e over the Scheme's design life, the net operational emissions total is 222,356 tonnes CO_2e.

6.7.22 **Table 6-15** summarises operational emissions sources.

Table 6-15: Emissions resulting from the operational phase

Emissions source	*Emissions (tonnes CO_2e)*	*Proportion of overall operational emissions*
Materials (replacement components)	305,079	98.2%
Transportation of materials	4,134	1.33%
Worker transport	1,511	0.49%
Grid electricity	71	<0.1%
Water/wastewater	4.4	<0.1%
Operations total	**310,799**	**100%**
Increased carbon sink	*-87,228*	
Net Operations total	**223,572**	

6.7.23 Operation of the Scheme will be undertaken in accordance with the measures included in the ***Outline Operational Environmental Management*** Plan (OOEMP) [**EN010118/APP/7.11**].

Decommissioning (2066 to 2067)

6.7.24 GHG emissions from the Scheme during decommissioning are subject to a very high degree of uncertainty, as the conditions that will apply over four decades into the future cannot be described with any confidence. Therefore, for the purpose of this assessment, and following discussions with the Applicant's design team, it is assumed that decommissioning emissions from the use of plant, worker travel, water and wastewater consumption would be set at 50% of the corresponding emissions during the construction phase. This is very likely to be a conservative estimate which is likely to overestimate decommissioning emissions.

6.7.25 Emissions from the disposal and recycling of materials and components at the end of the Scheme'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 810 tonnes CO_2e. Refer to ***Appendix 6A: Climate Change – Technical Appendix*** of this ES.

6.7.26 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 2,725 tonnes CO_2e. This is very likely to be a highly conservative estimate as HGV transport decarbonises in the future.

6.7.27 As discussed above, at the end of life of the Scheme, land use change from arable to grassland or scrubland is assumed to return to arable land on decommissioning, with carbon sequestered in soil and vegetation being rereleased to the atmosphere. 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. Therefore, the GHG impact of the decommissioning phase takes account of net land use change emissions. **Table 6-16** summarises the emissions resulting from the decommissioning phase. Refer to ***Appendix 6A: Climate Change – Technical Appendix*** of this ES.

Table 6-16: Emissions resulting from the decommissioning phase

Emissions source	*Emissions (tonnes CO_2e)*	*Proportion of overall decommissioning emissions*
Transportation of materials	2,804	51%
Worker commuting	953	17%
Waste recycling/disposal	810	15%
Fuel use	802	15%
Water use	164	3%
Decommissioning sub-total	**5,534**	**100%**
Release of carbon sequestered from land converted to grassland or scrubland during construction, and returned to arable on decommissioning	*44,939*	
Decommissioning total	**50,473**	

6.7.28 A Decommissioning Environmental Management Plan (DEMP) (including a GHG assessment) will be prepared prior to decommissioning. Refer to the ***Decommissioning Strategy***.

Overall lifetime emissions

6.7.29 Lifetime emissions from the construction, operation and decommissioning of the Scheme are summarised in **Table** 6-17**.** The sum is 642,040 tCO_2e being emitted over the Scheme lifetime. This is prior to consideration of the CO_2e avoidance that can be attributed directly to the Scheme.

Table 6-17: Emissions resulting over the lifetime of the Proposed Development

Phase	*Emissions (tonnes CO_2e)*	*Proportion of overall lifetime emissions*

Construction	369,130	7.4%
Operations	223,572	34.8%
Decommissioning	50,473	7.8%
Lifetime total	**643,175**	**100%**

Carbon intensity of the Proposed Development

6.7.30 Renewable energy generation from the Scheme during the first year of operation is estimated to be 356,475 MWh, 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, resulting in an estimated energy generation figure of 298,977 MWh in the final year of operation, and a total energy generation figure of around 13,076,218 MWh over the 40-year Scheme lifetime. It is possible this is a slightly conservative estimate, however, as future climate projections indicate a reduction in annual cloud cover over time (see **Section 6.6**) which may have a beneficial impact on the energy generation potential of the Scheme and has not been taken into account in the calculations.

6.7.31 Dividing this lifetime generation figure into the lifetime emissions total shown in **Table 6-15** gives a total carbon intensity value of 49.2 gCO_2e/kWh.

6.7.32 The current UK grid carbon intensity of 212 gCO_2e/kWh, however these figures cannot be directly compared as the published UK grid carbon intensity figure only takes into account operational emissions from the generation of electricity, overwhelmingly from the fossil fuels used to power gas-fired and occasionally coal-fired power stations (Ref 6-31). For a meaningful comparison to be made between the Scheme and the UK grid, the operational carbon intensity of the Scheme must only include emissions from the ongoing operations of the Scheme and exclude emissions from construction and decommissioning.

6.7.33 Combining lifetime generation figures and operational emissions figures gives an operational carbon intensity value of 17.1g CO_2e/kWh.

6.7.34 Comparing the Scheme against a gas fired Combined Cycle Gas Turbine (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 (Ref 6-37). The operational carbon intensity of the Scheme is therefore 95.2% lower than that of the counterfactual CCGT. Each kilowatt hour of electricity generated by the Scheme will emit 337g CO_2e less than if it was generated by a gas fired CCGT generating facility.

6.7.35 Combining this figure with the estimated lifetime output from the Scheme indicates an overall lifetime carbon reduction, relative to the counterfactual CCGT, of over 4.4 million tonnes CO_2e.

Significance of Effect (Construction)

6.7.36 GHG emissions from construction will be assessed against the relevant carbon budget periods during which they arise in order to identify the significance of their impact. Construction emissions will fall under the 4th UK carbon budget.

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

6.7.38 Based on the nature of the Scheme and experience with similar projects, it is not expected that annual emissions from the construction of the Scheme will contribute to equal to or more than 1% of the annualised 3rd or 4th carbon budgets. The magnitude of effect is therefore expected to be low. GHG emissions from the construction of the Scheme are therefore anticipated to have a **minor adverse** effect on the climate.

Significance of Effect (Operation)

6.7.39 The Scheme 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 Scheme 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.

6.7.40 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 Scheme over its lifetime.

6.7.41 GHG emissions from the operation of the Scheme are therefore anticipated to have a **major beneficial** effect on the climate, both for the years up to and including 2037 and from 2038 onwards.

Significance of Effect (Decommissioning)

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

6.7.43 GHG emissions from the decommissioning phase are therefore anticipated to have a **minor adverse** effect on the climate.

Overall GHG Impact

6.7.44 The GHG impact of construction and decommissioning are anticipated to result in minor adverse effects on the climate, while the impact of operations is considered to have a major beneficial effect. Overall, the whole-life GHG impact can be expressed in terms of the average GHG intensity of the electricity generated by the Scheme over its lifetime.

6.7.45 As the GHG intensity figure for the Scheme is anticipated to sit continually below the forecast grid average, GHG emissions savings are expected to be achieved throughout the lifetime of the Scheme. Therefore, the GHG emissions during construction, operation, and decommissioning of the Scheme can be considered to be ‘offset’ by the net positive impact of the Scheme on GHG emissions and the UK’s ability to meet its carbon targets.

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

6.7.47 It would be possible for a low-carbon energy generation project to have a GHG intensity below the projected grid for most of its lifetime, but above it towards the end of its lifetime and still have an overall positive impact on the UK’s ability to meet its carbon targets. As the GHG intensity of the Scheme remains below the projected grid average throughout its lifetime, however, it is considered that the beneficial impact of the Scheme is of high magnitude. Therefore, the Scheme overall is considered to have a **major beneficial** effect on the climate.

Climate Change Resilience Review

6.7.48 This section describes the potential climate change impacts during construction, operation, and decommissioning, before commenting on the adequacy of the climate change resilience measures built into the Scheme.

6.7.49 Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in **Table 6-18**.

6.7.50 Potential climate risks to the operational phase, the likelihood, consequence and significance are detailed in **Table 6-19**.

6.7.51 Potential climate risks to the construction phase, the likelihood, consequence and significance are detailed in **Table 6-20**.

Table 6-18: Construction- Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase in annual temperature	Very Likely	All receptors	Overheating of electrical equipment Damage to materials Risk of overheating to workers	Detailed in the Outline CEMP. The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Very Unlikely	Very Low	Negligible	No	None
Increase in summer temperature	Very Likely	Plant and vehicles, physical structures, materials, and access routes to sites	Overheating of electrical equipment Damage to materials Risk of overheating to workers	Detailed in the Outline CEMP. The Contractor will monitor weather forecasts and plan works accordingly, protecting workers and resources from any extreme weather conditions.	Very Unlikely	Very Low	Negligible	No	None
Increase in winter temperature	Very Likely	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Decrease in annual rainfall	Possible	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Decrease in summer rainfall	Likely	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Increase to winter rainfall	Likely	Plant and vehicles, physical structures, materials, 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	Possible	Low	Minor	No	None
Increase in heat waves	Possible	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	Very Unlikely	Low	Negligible	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
		and access routes to sites		and resources from any extreme weather. Equipment has cooling systems where necessary.					
		Staff, visitors on-site	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.	Unlikely	Medium	Minor	No	None
Increase droughts	Possible	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Increase in storm intensity	Unlikely	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,	Unlikely	Low	Minor	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
				protecting workers and resources from any extreme weather conditions.					

Table 6-19: Operation - Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase in annual temperature	Very Likely	All receptors	Thermal comfort of building users. Increase in air conditioning requirements. Overheating of electrical equipment.	All buildings will be designed to UK standards and specifications, including use of cooling systems.	Very Unlikely	Very Low	Negligible	No	None
Increase in summer temperature	Very Likely	All receptors (infrastructure, buildings, staff and workers)	Thermal comfort of building users. Increase in air conditioning requirements. Overheating of electrical equipment.	All buildings will be designed to UK standards and specifications, including use of cooling systems.	Unlikely	Low	Minor	No	None
Increase in winter temperature	Very Likely	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Increase in annual rainfall	Possible	All receptors	Surface water flooding and standing waters. Deterioration of structures or foundations due to increase in soil moisture levels. Damage to building	See- Decrease in summer rainfall	Very Unlikely	Very Low	Negligible	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
			surfaces/ exposed utilities from increased drying/wetting and increase frost penetration						
Decrease in summer rainfall	Likely	All receptors (infrastructure, buildings, staff and workers)	Water shortages. Deterioration of structures or foundations due to decrease in soil moisture levels.	Detailed building design to consider water efficiency fixtures.	Unlikely	Medium	Minor	No	None
Increase to winter rainfall	Likely	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. Damage to building surfaces/ exposed utilities from increased drying/wetting and increase frost penetration.	The Flood Risk Assessment (FRA) includes a number of adaptation measures that would be considered in the detailed design and operations management.	Possible	Low	Minor	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase to heat waves	Possible	All receptors (infrastructure, buildings, staff and workers)	See- Increase in summer temperature	See- Increase in summer temperature	Unlikely	Low	Minor	No	None
Increase droughts	Possible	All receptors	See- Decrease in summer rainfall	See- Decrease in summer rainfall	Unlikely	Medium	Minor	No	None
Increase in storm intensity	Unlikely	Built terrestrial assets, staff facilities and access	See- Increase in winter rainfall	See- Increase in winter rainfall	Unlikely	Very High	Minor	No	None

Table 6-20: Decommissioning - Potential Climate Change Impacts and Relevant Embedded Adaptation/Resilience Measures

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase in annual temperature	Very Likely	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 DEMP, and health and safety plans and likely to be similar to CEMP	Very Unlikely	Very Low	Negligible	No	None
Increase in summer temperature	Very Likely	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	Unlikely	Medium	Minor	No	None
		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.		Unlikely	Low	Minor	No	None
Increase in winter temperature	Very Likely	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase in annual rainfall	Possible	All receptors	None considered	See- Decrease in summer rainfall	Very Unlikely	Very Low	Negligible	No	None
Decrease in summer rainfall	Likely	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Increase to winter rainfall	Likely	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.	Possible	Low	Minor	No	None
Increase to heat waves	Possible	Staff, visitors on-site	Increased heat stress/ heat exhaustion for workers.	See increase in summer temperature	Unlikely	Medium	Minor	No	None
		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.		Unlikely	Low	Minor	No	None

Climate Hazard Type	Climate Hazard Projection	Sensitive Receptor	Description of Potential Impact	Embedded Design Measures	Likelihood of Impact Occurring (see section 6.6)	Consequence of Impact Occurring	Resilience Risk Level	Significance	Additional Mitigation or Monitoring Measures
Increase droughts	Possible	All receptors	None considered	None considered	Very Unlikely	Very Low	Negligible	No	None
Increase in storm intensity	Unlikely	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.	Unlikely	Low	Minor	No	None

6.8 Additional Mitigation and Enhancement Measures

6.8.1 No additional mitigation or monitoring beyond the measures already described in Section 6.7 are required during construction, operation, or decommissioning of the Scheme.

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

6.9 Summary of Likely Significant Residual Effects

6.9.1 The residual effect for GHG emissions is that the Scheme will have a major positive benefit.

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

6.10 Cumulative Effects

6.10.1 Most developments result in GHG emissions and consequently all developments therefore have the potential to result in a cumulative effect on GHG emissions. As such it is not possible to define a study area for the assessment of cumulative effects on GHG emissions nor to undertake a cumulative effects assessment, as the identified receptor is the global climate and effects are therefore not geographically constrained.

6.10.2 Also, as the assessment methodology uses the relevant UK National Carbon Budgets as a proxy for the global climate, this wider perspective is already covered by default. Undertaking a cumulative effects assessment would therefore result in double counting as the GHG emissions from the cumulative schemes also fall within the UK carbon budgets. Consequently, consideration of the effects of the Scheme together with other developments on GHG emissions has been scoped out of this assessment.

6.10.3 Furthermore, the overall significance of the Scheme is major beneficial, and therefore it is not considered necessary to consider the effect of the Scheme along with other developments. The Scheme would not be contributing to any significant adverse cumulative effects if any were identified on a UK or global scale, and indeed the Scheme would be contributing towards reducing the magnitude of any national or global adverse cumulative effects.

6.10.4 As the CCR Review is only concerned with the assets of the Scheme and a broader consideration of existing interdependent infrastructure, a cumulative assessment is not required.

6.11 References

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Ref 6-9 Department of Energy & Climate Change (2011). National Policy Statement for Renewable Energy Infrastructure (EN-3).
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Ref 6-15 Chelmsford Local Plan (2020).
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Ref 6-20 Datasheet for Jinkosolar TR-Bifacial 72M 510-530 Watts.
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Ref 6-30 Institute of Environmental Management and Assessment (IEMA) (2017). Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.

Ref 6-31 Department for Environment, Food and Rural Affairs and the Department of Business, Energy and Industrial Strategy (2019). Conversion Factors 2021: Methodology.
Ref 6-32 Department of Energy and Climate Change (DECC) (2013). Guidance on Annual Verification for emissions from Stationary Installations.
Ref 6-33 British Standards Institution (2011). PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.
Ref 6-34 Committee on Climate Change (2021). UK Carbon Budgets.
Ref 6-35 HM Government (2021). The Carbon Budget Order 2021.
Ref 6-36 Widger, P. and Haddad, A. (2018). Evaluation of SF6 Leakage from Gas Insulated Equipment on Electricity Networks in Great Britain.
Ref 6-37 UK Parliament (2015). Fossil fuelled power stations: carbon emissions and nitrogen oxides – answer to written question 17799 tabled by Dr Alan Whitehead MP.
Ref 6-38 Essex County Council – Net Zero: Making Essex Carbon Neutral, the report of the Essex Climate Action Commission (2021)