Botley West Solar Farm

Environmental Statement

Volume 1

Chapter 14: Climate Change

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Jonathan Alsop	15 November 2024

Prepared by:

RPS
20 Western Avenue,
Milton Park, Abingdon,
Oxfordshire, OX14 4SH
United Kingdom

Prepared for:

Photovolt Development Partners GmbH, on behalf of SolarFive Ltd.

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Glossary

Term	Meaning
UK Electricity Grid Carbon Intensity	Carbon intensity is a measure of how clean UK Grid electricity is. It refers to how many grams of carbon dioxide (CO_2) are released to produce a kilowatt hour (kWh) of electricity.
Future Grid Average	Projection of how clean the future UK Grid electricity is likely to be based on current policies. It refers to how many grams of carbon dioxide (CO_2) are released to produce a kilowatt hour (kWh) of electricity.
Life Cycle Assessment	The systematic analysis of the potential environmental impacts of products or services during their entire life cycle.
Marginal Generation Source	Accounts for sustained changes in energy consumption and generation sources for the purposes of cost-benefit analysis, including policy appraisal.
Scope 1 Emissions	Direct greenhouse gas emissions from sources owned or controlled by the company (e.g. from combustion of fuel at an installation)
Scope 2 Emissions	Caused indirectly by consumption of purchased energy (e.g. from generating electricity supplied through the UK Electricity Grid to an installation);
Scope 3 Emissions	All other indirect emissions occurring as a consequence of the activities of the company (e.g. in the upstream extraction, processing and transport of materials consumed or the use of sold products or services).

Abbreviations

Abbreviation	Meaning
BEIS	The former Department for Business, Energy & Industrial Strategy
DESNZ	Department for Energy Security and Net Zero
DEFRA	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
EPD	Environmental Product Declaration
GHG	Greenhouse Gas
GWP	Global Warming Potential
LCA	Life Cycle Assessment
MOHC	Met Office Hadley Centre
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
RCP	Representative Concentration Pathway
UNFCCC	United Nations Framework Convention on Climate Change

Units

Unit	Description
%	Percentage
°C	Centigrade
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
$kgCO_2e$	Kilogrammes of Carbon Dioxide Equivalent
tCO_2e	Tonnes of Carbon Dioxide Equivalent
kWh	Kilowatt hour
MW	Megawatt
MWe	Megawatt electrical
MWp	Megawatt peak
MWh	Megawatt hour

14 Climate Change

14.1 Introduction

Overview

14.1.1 This chapter of the ES sets out the approach to the assessment of likely significant climate change effects, of the Project. The application for development consent is being made to the Planning Inspectorate (PINS) under the Planning Act 2008. The proposal is to install and operate approximately 840MWe of solar generation in parts of West Oxfordshire, Cherwell and Vale of White Horse Districts, within the county of Oxfordshire (the Project).

14.1.2 This chapter of the Environmental Statement (ES) has been prepared by RPS for Photovolt Development Partners GmbH (PVDP) on behalf of SolarFive Ltd (the Applicant).

14.1.3 This ES has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, as amended (the 'EIA Regulations'), and other required documents including a statement on pre-application consultation.

14.1.4 This ES Chapter has been prepared in accordance with the approach set out in the Scoping Report and the subsequent Preliminary Environmental Information Report (PEIR).

14.1.5 The assessment presented is informed by the following technical chapters:

- Volume 1, Chapter 9: Ecology and Nature Conservation **[EN010147/APP/6.3]**;
- Volume 1, Chapter 12: Traffic and Transport **[EN010147/APP/6.3]**;
- Volume 1, Chapter 17: Agricultural Land Use and Public Rights of Way **[EN010147/APP/6.3]**; and
- Volume 1, Chapter 18: Waste and Resources **[EN010147/APP/6.3]**.

14.1.6 This chapter also draws upon information contained within:

- Volume 3, Appendix 12.2: Traffic Survey Data **[EN010147/APP/6.5]**;
- Volume 3, Appendix 14.1: Climate Change Policy **[EN010147/APP/6.5]**;
- Volume 3, Appendix 14.2: Greenhouse Gas Calculations **[EN010147/APP/6.5]**;
- Volume 3, Appendix 14.3: Outline GHG Reduction Strategy **[EN010147/APP/6.5]**;
- Volume 3, Appendix 17.1: Soil Survey Data **[EN010147/APP/6.5]**; and
- Volume 3, Appendix 17.2: Published Agricultural Land Classification and Soils Data **[EN010147/APP/6.5]**.

14.2 Legislative and Policy Context

14.2.1 Further detail concerning relevant policy and legislation can be found in Appendix 14.1: Climate Change Policy **[EN010147/APP/6.5]**. A summary of key policy and legislation relevant to this chapter is detailed below.

Legislation

14.2.2 The Climate Change Act 2008, as amended (2019), created a framework for setting a series of interim national carbon budgets and plans for national adaptation to climate risks. The Act requires the UK government to set carbon budgets[1] for the whole of the UK. The Climate Change Act 2008 (2050 Target Amendment) Order 2019 set a target of achieving net zero by 2050.

At present, the Third, Fourth, Fifth and Sixth Carbon Budgets, set through The Carbon Budget Orders 2009, 2011, 2016, and 2021 are 2.54 giga tonnes carbon dioxide equivalent ($GtCO_2e$) for 2018-2022, 1.95 $GtCO_2e$ for 2023-2027, 1.73 $GtCO_2e$ for 2028-2032 and 0.97 $GtCO_2e$ for 2033-2037 respectively. The Sixth Carbon Budget is the first Carbon Budget that is consistent with the UK's net zero target, requiring a 78% reduction in GHG emissions by 2035 from 1990 levels.

The UK's nationally determined contribution (HM Government, 2020) under the Paris Agreement to the United Nations Framework Convention on Climate Change (UNFCCC), submitted in December 2020, commits the UK to reducing economy-wide GHG emissions by at least 68% by 2030, compared to 1990 levels.

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations), as amended, set out the requirements for EIA for NSIPs. Of particular relevance to climate change are the following points:

- "The EIA must identify, describe and assess in an appropriate manner, in light of each individual case, the direct and indirect significant effects of the proposed development on the following factors-… climate…" – EIA Regulations 2017, Section 5.
- "A description of the factors specified in regulation 5(2) likely to be significantly affected by the development … air climate (for example greenhouse gas emissions, impacts relevant to adaptation)" – EIA Regulations 2017, Schedule 4, paragraph 4.
- "A description of the likely significant effects of the development on the environment resulting from, inter alia—… (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change."– EIA Regulations 2017, Schedule 4, paragraph 5.

[1] A carbon budget places restrictions on the total amount of GHGs that can be emitted. The budget balances the input of CO_2 to the atmosphere by emissions from human activities, by the storage of carbon (i.e. in carbon reservoirs on land or in the ocean).

Guidance

14.2.3 The Climate Change Act 2008 also created the Committee on Climate Change, since renamed to the Climate Change Committee (CCC) to give advice on carbon budgets and report on progress. The CCC, through its Adaptation Sub-Committee, also gives advice on climate change risks and adaptation.

14.2.4 The CCC's Sixth Carbon Budget report makes the following policy recommendations, with regard to renewable energy deployment (Committee on Climate Change, 2020).

- Reducing demand and improving efficiency: require changes that will reduce carbon-intensive activities and the improvement of efficiency in the use of energy and resources.
- Take-up of low carbon solutions: phase out fossil fuel generation by 2035.
- Expansion of low carbon energy supplies: increasing renewables to 80% of generation by 2050.
- Electricity generation: will require a significant expansion of low carbon generation; this includes low cost renewables, with more flexible demand and storage.

14.2.5 Increasing the renewables penetration in the UK electricity mix to 80% by 2050 will largely be met with intermittent, non-dispatchable[2] generation types. In the Sixth Carbon Budget report, the CCC suggest that on average, 3 GW per year of solar generation will need to be installed to reach renewable supply targets.

14.2.6 The Net Zero Strategy: Build Back Greener (HM Government, 2021) sets out the UK's plans to achieve net zero emissions by 2050. Alongside this target is the ambition to fully decarbonise the UK's power system by 2035 through growth in renewable and nuclear power.

Planning policy context

National Policy Statements

14.2.7 There are currently six designated energy National Policy Statements (NPSs), EN-1, EN-2, EN-3, EN-4, EN-5 and EN-6. The 2023 revised NPSs (EN-1 to EN-5) came into force on 17 January 2024. The 2011 version of the NPS for Nuclear Power Generation (EN-6) remains in force. The Department for Energy Security and Net Zero (DESNZ) is in the process of preparing a new version.

14.2.8 **Table 14.1** sets out a summary of the policies within these NPSs, relevant to the Project, in relation to Climate change.

[2] Non-dispatchable sources of electricity generate electrical energy but cannot be turned on or off in order to meet fluctuating demand. The two main types of non-dispatchable sources are solar power and wind power.

Table 14.1: Summary of designated NPS document requirements relevant to this chapter

Summary of NPS Requirement	How and where considered in the ES
NPS EN-1	
This NPS sets out how the energy sector can help deliver the Government's climate change objectives by clearly setting out the need for new low carbon energy infrastructure to contribute to climate change mitigation (section 2 of NPS EN-1).	Volume 1, Chapter 5: Alternatives Considered **[EN010147/APP/6.3]**
Section 4.10 of NPS EN-1 advises that the ES should set out how the applicant has considered the projected impacts of climate change, on the Project. Section 4.10 also states that applicants should demonstrate that proposals have a high level of climate change resilience built in, by setting out appropriate climate adaptation measures. In developing measures to support climate adaptation, applicants should maximise the use of nature-based solutions and integrated approaches (for example, hydrology and biodiversity solutions), alongside other conventional techniques.	Consideration of this, and justification for the scoping out of in-depth consideration of climate risk can be found within Table 14.6. Within the table, typical manufacturing standards applicable to the Project are detailed that mitigate for the matters raised in the scoping opinion (ID – 3.8.1), laid out within Table 14.3. Consideration of risks such as extreme weather events and increased ambient temperatures has been laid out within Volume 1, Chapter 6: Project Description **[EN010147/APP/6.3]**, in relation to solar PV manufacturing standards. The development of the Project has taken an integrated approach, considering hydrology, flood risk, soils, landscape and biodiversity and this is reflected in the Outline Landscape and Ecology Management Plan **[EN010147/APP/7.6.3]**, Biodiversity Net Gain Plan **[EN010147/APP/6.5]**, Outline Soil Management Plan **[EN010147/APP/7.6.1]**, and Appendix 10.1: Flood Risk Assessment **[EN010147/APP/6.5]**.
GHG assessments should include 'A whole life GHG assessment showing construction, operational and decommissioning GHG impacts, including impacts from land use change…Where there are residual emissions, the level of emissions and the impact of those on national and international efforts to limit climate change, both alone and where relevant in combination with other developments at a regional or national level, or sector level, if sectoral targets are developed' (paragraph 5.3.4 of NPS EN-1).	This chapter provides an assessment of the whole life emissions of the Project, from construction, operation and maintenance, through to decommissioning emissions from each stage are set out within section 14.9, as well as the overall net whole life emissions in section 14.10. Emissions associated with the Project are contextualised within the UK carbon budgets at section 14.9. The assessment is supported by Volume 3, Appendix 14.2: Greenhouse Gas Calculations **[EN010147/APP/6.5]**.
The Secretary of State must be satisfied that the applicant has as far as possible assessed the GHG emissions of all stages of the development (paragraph 5.3.8 of NPS EN-1).	
With regards specifically to mitigation: *"a GHG assessment should be used to drive down GHG emissions at every stage of the Project and ensure that emissions are minimised as far as possible for the type of technology"*, (paragraph 5.3.5 of NPS EN-1)	Committed mitigation measures to reduce emissions associated with the Project, particularly by embodied carbon reductions, are detailed within this chapter at section 14.8.
Applicants should look for opportunities within the proposed development to embed	The development of the outline design of the Project has taken an integrated approach, considering hydrology, flood

Summary of NPS Requirement	How and where considered in the ES
nature-based or technological solutions to mitigate or offset the emissions of construction and decommissioning (paragraph 5.3.6 of NPS EN-1).	risk, soils, landscape and biodiversity. This is reflected in the Outline Landscape and Ecology Management Plan **[EN010147/APP/7.6.3]**, Biodiversity Net Gain Plan **[EN010147/APP/6.5]**, Outline Soil Management Plan **[EN010147/APP/7.6.1]**, and Appendix 10.1: Flood Risk Assessment **[EN010147/APP/6.5]**.
Steps taken to minimise and offset emissions should be set out in a GHG Reduction Strategy, secured under the Development Consent Order. The GHG Reduction Strategy should consider the creation and preservation of carbon stores and sinks including through woodland creation, hedgerow creation and restoration, peatland restoration and through other natural habitats (paragraph 5.3.7 of NPS EN-1).	An Outline GHG Reduction Strategy has been prepared and submitted alongside the ES (Volume 3, Appendix 14.3: Outline GHG Reduction Strategy **[EN010147/APP/6.5]**).
The Secretary of State should be content that the applicant has taken all reasonable steps to reduce the GHG emissions of the construction and decommissioning stage of the development (paragraph 5.3.9 of NPS EN-1).	Committed mitigation measures to reduce emissions associated with the Project, particularly by embodied carbon reductions, are detailed within this chapter at section 14.8.
The Secretary of State should give appropriate weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and decommissioning within the proposed development. However, in light of the vital role energy infrastructure plays in the process of economy wide decarbonisation, the Secretary of State must accept that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure (paragraph 5.3.10 of NPS EN-1).	The design of the Project has incorporated nature-based solutions, where practicable, such as in the development of biodiversity enhancement measures and in the outline design of the Project, which has taken into account hydrology, flood risk, landscape and biodiversity considerations. This is reflected in the Outline Landscape and Ecology Management Plan **[EN010147/APP/7.6.3]**, Biodiversity Net Gain Plan **[EN010147/APP/6.5]**, Outline Soil Management Plan **[EN010147/APP/7.6.1]**, and Appendix 10.1: Flood Risk Assessment **[EN010147/APP/6.5]**. The purpose of the Project is to generate and provide renewable energy that feeds into the UK Electricity Grid. Emissions arising from the operational phase of the project have been assessed within section 14.9,resulting in a significant beneficial effect.
Operational GHG emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments (paragraphs 5.3.11 and 5.3.12 of NPS EN-1).	
NPS EN-3	
Provides the primary policy for decisions by the Secretary of State on applications they receive for nationally significant renewable energy infrastructure defined at section 1.6 of NPS EN-3.	Volume 1, Chapter 5: Alternatives Considered **[EN010147/APP/6.3].**

Summary of NPS Requirement	How and where considered in the ES
Paragraph 2.4.11 of NPS EN-3 states that 'Solar photovoltaic (PV) sites may also be proposed in low lying exposed sites. For these proposals, applicants should consider, in particular, how plant will be resilient to: • increased risk of flooding; and • impact of higher temperatures.	Volume 1, Chapter 14: Climate Change **[EN010147/APP/6.3]** provides justification for not assessing the impact of higher temperatures in relation to its impact on the Project any further within Table 14.6. Consideration of flood risk is addressed within Volume 1, Chapter 10: Hydrology and Flood Risk of the ES **[EN010147/APP/6.3]**.
NPS EN-5	
With regards to climate change adaptation, applicants must consider how the development is vulnerable to, and how it has been designed to be resilient to the increased risks of flooding, wind and storm events, heightened temperatures, and subsidence resulting from climate change (paragraph 2.3.2 of NPS EN-5).	Consideration of this, and justification for its scoping out of further consideration within Volume 1, Chapter 14: Climate Change **[EN010147/APP/6.3]**, has been set out within Table 14.6
"The climate-warming potential of SF6 is such that applicants should, as a rule, avoid the use of SF6 in new developments. Where no proven SF6-free alternative is commercially available, and where the cost of procuring a bespoke alternative is grossly disproportionate, the continued use of SF6 is acceptable, provided that emissions monitoring and control measures compliant with the F-gas Regulation and/or its successors are in place" (paragraph 2.10.14 – 2.10.15 in NPS EN-5).	SF6 has been considered in Volume 1, Chapter 14: Climate Change **[EN010147/APP/6.3]** in paragraph 14.5.23.
"Applicants should at the design phase of the process consider carefully whether the proposed development could be reconceived to avoid the use of SF6-reliant assets" (paragraph 2.9.61 in NPS EN-5).	SF6 has been considered in Volume 1, Chapter 14: Climate Change **[EN010147/APP/6.3]** in paragraph 14.5.23. The proposed NGET substation, which may be constructed within the Project site boundary, is confirmed to be a non-SF6 gas insulated substation, in line with Ofgem requirement.
(Paragraph 2.3.2 – 2.3.3 of NPS EN-5) *Applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to:* • *Flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change* *[…]* • *Higher average temperatures leading to increased transmission losses*	Volume 1, Chapter 14: Climate Change provides justification for not assessing these impacts in relation to its impact on the Project any further within Table 14.6. Consideration of flood risk is addressed within Volume 1, Chapter 10: Hydrology and flood risk of the ES **[EN010147/APP/6.3]**. Consideration of higher average temperatures leading to transmission losses has been laid out within Volume 1, Chapter 6: Project Description **[EN010147/APP/6.5]**, in relation to solar PV manufacturing standards.

Summary of NPS Requirement	How and where considered in the ES
• *earth movement or subsidence caused by flooding or drought (for underground cables)* *[…]* *Section 4.9 of EN-1 advises that the resilience of the project to the effects of climate change must be assessed in the Environmental Statement (ES) accompanying an application. For example, future increased risk of flooding would be covered in any flood risk assessment.*	

The National Planning Policy Framework

14.2.9 The National Planning Policy Framework (NPPF) was most recently revised in 2023 (Department for Levelling Up, Housing and Communities, 2023). The NPPF sets out the Government's planning policies for England.

14.2.10 **Table 14.2** sets out a summary of the NPPF policies relevant to this chapter.

Table 14.2: Summary of NPPF requirements relevant to this chapter

Policy	Key Provisions	How and where considered in the ES
NPPF		
14. Meeting the challenge of climate change, flooding, and coastal change. Paragraph 157 and 159.	*'The planning system should support the transition to a low carbon future in a changing climate… New development should be planned for in ways that: avoid increased vulnerability to the range of impacts arising from climate change… and can help to reduce greenhouse gas emissions.*	Volume 1, Chapter 14: Climate Change, section 14.9 provides an assessment of the GHG emissions associated with the Project.

14.2.11 The Planning Practice Guidance (Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government, 2023) supports the NPPF and provides guidance across a range of topic areas, including climate change. It recommends the consideration of future climate risks and promotes the implementation of suitable adaptation and mitigation strategies to manage any climate risk.

Draft NPPF Updates

14.2.12 On 30 July 2024, the UK Government published proposed reforms to the NPPF (Ministry of Housing, Communities and Local Government, 2024), with a draft document that is out for consultation, closing 24 September 2024.

14.2.13 Particularly relevant to this chapter are alterations suggested to paragraph 164 which is set out below (deleted text presented with strikethrough, proposed new text underlined).

"~~In determining planning applications~~ Local planning authorities should support planning applications for all forms of renewable and low carbon development.

When determining planning applications for ~~renewable and low carbon~~ these developments, local planning authorities should:

a. *not require applicants to demonstrate the overall need for renewable or low carbon energy, and give significant weight to the proposal's contribution to renewable energy generation and a net zero future;*

b. *recognise that even small-scale and community-led projects provide a valuable contribution to ~~significant~~ cutting greenhouse gas emissions;*

~~c.~~ *in the case of applications for the repowering and life-extension of existing renewable sites, give significant weight to the benefits of utilising an established site.~~ ~~; and approve the application if its impacts are (or can be made) acceptable.~~"*

14.2.14 The proposed alterations to paragraph 164 of the NPPF shifts policy further in favour of renewable energy applications, clearly stating that local planning authorities should support planning applications for all forms of renewable and low carbon development.

Local planning policy

14.2.15 Detail of local policy relevant to Chapter 14: Climate Change can be found in Volume 3, Appendix 14.1: Climate Change Policy.

14.3 Consultation and Engagement

14.3.1 On 15 June 2023, the Applicants submitted a Scoping Report to the Planning Inspectorate, which described the scope and methodology for the technical studies being undertaken to provide an assessment of any likely significant effects for the construction, operation and maintenance and decommissioning phases of the Project. It also described those topics or sub-topics which are proposed to be scoped out of the EIA process and provided justification as to why the Project would not have the potential to give rise to significant environmental effects in these areas.

14.3.2 Following consultation with the appropriate statutory bodies, the Planning Inspectorate (on behalf of the Secretary of State) provided a Scoping Opinion on 24 July 2023. Key issues raised during the scoping process specific to climate change are listed in **Table 14.3**, together with details of how these issues have been addressed within the ES.

Table 14.3: Summary of scoping responses

Comment	How and where considered in the ES
Planning Inspectorate	
ID – 3.8.1: *"Risks from climate change are proposed to be scoped out on the basis that impacts are not likely to be considered significant during the Proposed Development's lifetime of 42 years. Mitigation will be embedded in the design and technology of the solar array to account for extreme weather events such as storms, high winds, and increased ambient temperatures.*	Justification for the scoping out of in-depth consideration of climate risk can be found within Table 14.6. Within the table, typical manufacturing standards applicable to the Project are detailed that mitigate for the matters raised in the scoping opinion (ID – 3.8.1). Consideration of risks such as extreme weather events and increased ambient temperatures has

On the premise that the ES explains how and to what degree the design and technology accounts for these events, the Inspectorate agrees to scope this matter out."	been detailed within Volume 1, Chapter 6: Project Description, in relation to solar PV manufacturing standards.
ID – 3.8.2: Impacts from GHG emissions from land use change - All phases. *"The Inspectorate agrees that this can be scoped out as the Proposed Development is unlikely to cause significant release of GHG emissions from land use change during all phases. This is due to the minimal disturbance proposed to the land (piling and cable route excavation only) and considering the nature of the land use change from agricultural to either mowing or sheep grazing and wildflower planting."*	As a result of the Planning Inspectorate's comments in the scoping opinion, no further action has been taken.
ID – 3.8.3: Impacts from flood risk as a result of climate change – All phases. *"Scoping Report paragraph 7.8.32 proposes that impacts from flooding as a result of climate change will be assessed in the Flood Risk Assessment which will incorporate the latest climate change projections. The Inspectorate agrees that on this basis, An additional assessment of impacts from flooding as a result of climate change is not required."*	As a result of the Planning Inspectorate's comments in the scoping opinion, no further action has been taken.
ID – 3.8.4: GHG emissions – Decommissioning. *"Scoping Report paragraph 7.8.37 states that GHG emissions during decommissioning will be minimised through the recycling of PV modules and components where possible.* *The Inspectorate would expect to see a Decommissioning Plan, agreed with the Local Authority, secured through the inclusion of an Outline Decommissioning Plan or similar with the Application. The ES should clearly set out if and how impacts from GHG emissions will be assessed for the decommissioning "phase."*	Decommissioning effects in relation to GHG emissions have been assessed in Volume 3, Appendix 14.2: Greenhouse Gas Calculations, and are summarised below in within section 14.9. It should be noted that an Outline Decommissioning Plan **[EN010147/APP/7.6.4]**, has been submitted alongside the environmental statement, in line with scoping opinion (ID – 3.8.4)

14.3.3 Following scoping, consultation and engagement with interested parties specific to Climate Change has continued.

14.3.4 The PEIR was issued to inform the statutory consultation carried out on the Project between 30 November 2023 and 8 February 2024. It presented the preliminary findings of the EIA process for the Project at that time.

14.3.5 This Statutory Consultation included a series of nine in-person public information events, held in Bladon, Woodstock (twice), Begbroke, Long Hanborough, Cassington, Cumnor, Botley and Eynsham, and a community webinar.

14.3.6 Further details regarding the consultation process and responses can be found in Volume 1, Chapter 3: Consenting and Consultation Process, of this ES.

14.3.7 Responses and representations to this consultation are presented, alongside the Applicant's responses having regard to feedback received, in the Consultation Report **[EN010147/APP/5.1]**.

14.3.8 A summary of the key issues raised during consultation activities undertaken to date is presented in **Table 14.4**, together with how these issues have been considered in the production of this ES chapter.

Table 14.4: Summary of consultation relevant to this chapter

Date	Consultee	Issues Raised	How and where considered in the ES
Section 42 Response			
February 2024	CPRE Oxford	*'If the project were to go ahead we would expect to see a robust lifetime maintenance plan to ensure maximum long-term efficiency of the panels'.*	An outline Operational Management Plan (oOMP) has been prepared and submitted alongside the ES **[EN010147/APP/7.6.2]**, covering anticipated replacement of PV panels during the operational lifespan of the Project.
Section 43 Response			
February 2024	Oxfordshire County Council	*'The Climate Action Service notes that GHG emissions at decommissioning are considered out of scope as they have been deemed to be insignificant. Given the scale of the development, we feel that decommissioning could still have a considerable impact, e.g., in disposal / recycling and potentially in transport movement and should still be scoped in.'*	GHG emissions arising from the decommissioning phase of the Project has been assessed in section 14.9. Further supporting this, an Outline Decommissioning Plan has been prepared and submitted alongside the ES **[EN010147/APP/7.6.4]**.

14.4 Assessment Methodology

Relevant Guidance

14.4.1 The main guidance used for the assessment of GHG emissions in this ES chapter is the Institute of Environmental Management and Assessment (IEMA) guide 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' (IEMA, 2022), in line with standard practice in EIA.

14.4.2 Additional guidance used for the quantification of GHG emissions includes:

- the Greenhouse Gas Protocol suite of documents (World Resources Institute (WRI); and World Business Council for Sustainable Development (WBCSD), 2004).

Scope of the Assessment

14.4.3 The scope of this ES has been developed in consultation with relevant statutory and non-statutory consultees as detailed in **Table 14.3** and **Table 14.4**. The scope of the assessment focuses on three key stages; construction, operation and maintenance, and decommissioning of the Project.

14.4.4 Taking into account the scoping and consultation process, **Table 14.5** summarises the issues considered as part of this assessment.

Table 14.5: Issues considered within this assessment

Activity	Potential effects scoped into the assessment
Construction Phase	
Manufacturing and installation of the solar panels and associated infrastructure.	GHG emissions arising from such activity would contribute to global GHG emissions concentrations and climate change.
Operation and Maintenance	
Electricity export to the UK Electricity Grid	The Project would export energy to the grid that is zero-carbon at the point of generation (aside from the emissions associated with the construction phase), thereby displacing the marginal generating source that would be providing energy in the absence of the Project, in effect resulting in 'avoided' GHG emissions, which have been quantified within this chapter. Further context is provided in paragraph 14.5.22.
Anticipated maintenance of the solar panels and associated infrastructure during operation.	GHG emissions arising from such activity would contribute to global GHG emissions concentrations and climate change. An example of this would be GHG emissions associated with anticipated necessary replacement of PV panels during the operational lifetime of the Project.
Decommissioning Phase	
Decommissioning of the solar panels and associated infrastructure.	GHG emissions arising from such activity would contribute to global GHG emissions concentrations and climate change. GHG Emissions associated with the decommissioning phase include activity associated with deconstructing of the PV array, as well as any committed recycling / reuse of materials.

14.4.5 Effects which are not considered likely to be significant have been scoped out of the assessment. A summary of the effects scoped out is presented in **Table 14.6**.

Table 14.6: Issues scoped out of the assessment

Issue	Justification
Climate Risk	
Climate Risk: General	Risks to the Project from climate change are scoped out of the assessment, as these are not considered likely to be significant during the Project's operating lifetime.
Increased Ambient Temperatures	Increased ambient temperatures as a result of climate change are scoped out, as the manufacturing standards for PV modules IEC TS 63126:2020, IEC 62548 and IEC 61215-1:2021 require modules to be functional over a wide range of temperatures, humidity and UV radiation. As such, the potential for small system efficiency losses due to hotter temperatures during the Project's lifetime are not considered to have any potential to significantly affect the lifecycle GHG emissions and thus significantly reduce the environmental effect of the renewable electricity generation.
Extreme Weather Events	Extreme weather events such as storms with high winds are also possible in the existing and future baseline and the Project's design will account for this. Manufacturing standards for PV modules (IEC TS 63126:2020, IEC 62548 and IEC 61215-1:2021) require consideration for extensive weathering (such as from hailstorms) and extreme thermal fluctuations. As such, extreme weather events are not considered to cause significant environmental effects to the Project.
Flood Risk	Flood risk is assessed, with appropriate climate change allowance, in the Flood Risk Assessment (Volume 3: Appendix 10.1) for the Project and no separate assessment has been undertaken within the climate change chapter.
Land-Use Change	
Land-use change: Construction	GHG emissions resulting from land-use change during construction are likely to be insignificant. This is due to the current agricultural land use which has limited carbon storage value and minimal disturbance during installation of solar PV modules and Balance of System (BoS[3]) components.
Land-use change: Operation	Carbon sequestration through biogenic growth (the process by which plants remove carbon dioxide from the atmosphere and store it in their tissues during growth) captured during the operational period of the Project would also likely be insignificant compared to the magnitudes of GHGs emitted and avoided during the construction and operational phase of the Project (Bai and Cotrufo, 2022). As such the impact of land-use changes on the carbon sequestration potential of the land is scoped out.
Land-use change: Decommissioning	GHG emissions resulting from land-use change during decommissioning are likely to be insignificant. This is due to the

[3] BoS components are predominantly comprised of inverters, electrical cabling and frames/mounting structures.

Study area

14.4.6 The red line boundary for the Project represents the relevant geographical study area for climate change for the purpose of this assessment. The current land use, direct and indirect emissions resultant from project elements (solar array, balance of systems etc.) within the redline boundary have formed the basis of this assessment.

14.4.7 Although, it should be noted that indirect emissions from transportation, embedded material emissions etc. have no specific geographical study area as this is dependent upon supply chain procurement activities. Where relevant, worst-case supply chain distance or location assumptions have been detailed in the methodology and applied. Additional context can be found in Volume 3, Appendix 14.2: Greenhouse Gas Calculations. GHG emissions have a global (international) effect rather than directly affecting any specific local receptor. The impact of GHG emissions occurring due to the Project on the global atmospheric concentration of the relevant GHGs, expressed in CO_2-equivalents (CO_2e), is therefore considered within this assessment.

14.4.8 The climate change study area for cloud cover change is the UKCP18 climate projections 25 km grid cell in which the Project site is located (MOHC, 2023). Explanation of UKCP18 climate projections is provided below in the Future Cloud Cover Change section (paragraphs 14.9.35-14.9.38.

Methodology for Baseline Studies

Desk studies

14.4.9 Desk studies were undertaken to determine the GHG emissions and associated avoided GHG emissions through abatement of UK Electricity Grid carbon intensity resultant from the Project. A summary of desk study sources used can be found below in Table 14.7.

Site-specific surveys

14.4.10 No site-specific surveys have been undertaken to inform the EIA for climate change.

14.5 Assessment Criteria and Assignment of Significance

Overview

14.5.1 The methodology used for the climate change impact assessment has followed the general principles set out in Volume 1, Chapter 4: Approach to Environmental Assessment of the ES. Topic specific guidance for GHG assessments for EIA (IEMA 2022) has informed the assessment of effect for GHG emissions as detailed below.

14.5.2 GHG emissions have been estimated by applying published factors to activities in the baseline and to those required for the Project. The emissions factors relate to a given level of activity, or amount of fuel, energy or materials used, to the mass of GHGs released as a consequence.

14.5.3 Information gathered in Volume 3, Appendix 14.2: Greenhouse Gas Calculations of the ES has been sourced from primary calculations and secondary sources to calculate the impact and subsequent effect of the Project on climate change. Within Volume 3, Appendix 14.2: Greenhouse Gas Calculations, methodology and corresponding calculations are broken down to the Project component level.

14.5.4 The GHGs considered in this assessment are those in the 'Kyoto basket'[4] of global warming gases expressed as their CO_2-equivalent global warming potential (GWP). This is denoted by CO_2e units in emissions factors and calculation results. GWPs used are typically the 100-year factors in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (IPCC, 2013) or as otherwise defined for national reporting under the United Nations Framework Convention on Climate Change (UNFCCC).

Additional guidance used for the quantification of GHG emissions includes:

- The Greenhouse Gas Protocol suite of documents (World Resources Institute (WRI); and World Business Council for Sustainable Development (WBCSD), 2004).

14.5.5 GHG emissions caused by an activity are often categorised into 'scope 1', 'scope 2' or 'scope 3' emissions, following the guidance of the WRI and the WBCSD Greenhouse Gas Protocol suite of guidance documents (WRI and WBCSD, 2004).

- Scope 1 emissions: direct GHG emissions from sources owned or controlled by the company (e.g. from combustion of fuel at an installation);
- Scope 2 emissions: caused indirectly by consumption of purchased energy (e.g. from generating electricity supplied through the UK Electricity Grid to an installation); and
- Scope 3 emissions: all other indirect emissions occurring as a consequence of the activities of the company (e.g. in the upstream extraction, processing and transport of materials consumed or the use of sold products or services).

14.5.6 This assessment has included emissions from all three scopes, where this is material and reasonably possible from the information and emissions factors available, to capture the impacts attributable most completely to the Project. These emissions have not been separated out by defined scopes (scopes 1, 2 or 3) within this assessment.

14.5.7 The assessment has considered (a) the GHG emissions arising from the Project, (b) any GHG emissions that it displaces or avoids, compared to the

[4] The 'Kyoto Basket' encompasses the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (SF_6).

current or future baseline, and hence (c) the net impact on climate change due to these changes in GHG emissions overall.

14.5.8 The majority of the construction-stage GHG emissions associated with the manufacturing of components is likely to occur outside the territorial boundary of the UK and hence outside the scope of the UK's national carbon budget. However, in recognition of the climate change effect of GHG emissions (wherever occurring) and the need, as identified in national policy, to avoid 'carbon leakage' overseas when reducing UK emissions, the full life-cycle GHG emissions of the Project have been evaluated when determining the significance of effects.

Receptor Value and Sensitivity

14.5.9 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high sensitivity** (given the importance of the global climate as a receptor), as defined within IEMA's 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' guidance (IEMA, 2022).

Magnitude of impact

14.5.10 In accordance with the IEMA GHG in EIA Guidance (2022) GHG emissions have been quantified directly and expressed based on their GWP as tonnes of CO_2e emitted, the magnitude of impact is reported numerically. Where a quantifiable figure is not possible this is expressed qualitatively.

Significance of effect

14.5.11 The significance of the effect upon the climate has been determined by taking into account the sensitivity of the receptor and the magnitude of the impact.

14.5.12 In all cases, the evaluation of receptor sensitivity, impact magnitude and significance of effect has been informed by professional judgement and is underpinned by narrative to explain the conclusions reached.

14.5.13 Assessment guidance for GHG emissions (IEMA, 2022) describes five levels of significance for emissions resulting from a development, each based on whether the GHG emission impact of the development will support or undermine a science-based 1.5 °C compatible trajectory towards net zero. To aid in considering whether effects are significant, the guidance recommends that GHG emissions should be contextualised against pre-determined carbon budgets, or applicable existing and emerging policy and performance standards where a budget is not available. It is a matter of professional judgement to integrate these sources of evidence and evaluate them in the context of significance.

14.5.14 Taking the guidance into account, the following have been considered in contextualising the Project's emissions:

- The magnitude of net GHG emissions as a percentage of national and local carbon budgets (where feasible).
- The GHG emissions intensity of the Project against current baseline emissions intensity for such energy generation and projections or policy goals for future changes in that baseline; and
- Whether the Project contributes to, and is in line with, the UK's policy for GHG emissions reductions, where these are consistent with science-based commitments to limit global climate change to an internationally-agreed level (as determined by the UK's nationally determined contribution to the Paris Agreement (HM Government, 2020))

14.5.15 Effects from GHG emissions are described in this chapter as adverse, negligible or beneficial based on the following definitions, which follows the examples in Box 3 of the IEMA guidance (IEMA, 2022) as follows:

- **Major adverse:** the Project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type.
- **Moderate adverse:** the Projects GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type.
- **Minor adverse:** the Projects GHG impacts would be reduced through measures that go well beyond existing and emerging policy requirements and good practice design standards for projects of this type.
- **Negligible:** the Projects GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050.
- **Beneficial:** the Projects net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline.

14.5.16 Major and moderate adverse effects and beneficial effects are considered to be significant in EIA terms. Minor adverse and negligible effects are not considered to be significant in EIA terms.

14.5.17 GHG emissions associated with a proposed project are often reported as a whole life figure (net emissions) that takes account of all stages of the Project. The net whole life figure is the key element for determining the Project's whole life impact on climate change. However, it is noted in the IEMA guidance (2022) that due to the nature of GHG emissions, it is good practice to include a section that reports on the whole life GHG emissions associated with the Project, alongside the sections that assess construction, operation, and decommissioning effects in isolation. This approach has been taken for the purpose of this assessment.

Assumptions and limitations of the assessment

14.5.18 There is uncertainty about future climate and energy policy and market responses, which affect the likely future carbon intensity of energy supplies, and thereby the future carbon intensity of the electricity generation[5] being displaced by the Project. UK Government projections consistent with national carbon budget commitments have been used in the assessment.

14.5.19 As discussed in Volume 1, Chapter 6: Project Description, there are a variety of potential cable corridor options associated with the Project. The quantities assessed for cables, set out in Table 14.9 is considered to provide the worst-case assumption across all options. As such, cable corridor options have not been assessed in further detail.

14.5.20 Regarding quantification of the associated construction GHG emissions from the Project. It should be noted that a single environmental product declaration (EPD) has been utilised to assess the PV modules, which is a preferred panel choice from a preferred supplier (EPD-Norway, 2024). It should be noted that, to provide flexibility, there is a chance that a different module could finally be selected, as part of a Rochdale envelope approach to design. However, in utilising the provided EPD for the purposes of this assessment, it is not anticipated that other potential optioneering choices would result in emissions of a significantly different order of magnitude.

14.5.21 In assessing inverters, a comparable EPD from an alternative supplier has been utilised (Fraunhofer IBP, 2024), as one was not available for the preferred inverter choice. In utilising a comparable EPD for the purposes of this assessment, it is not anticipated that other potential optioneering choices would result in emissions of a significantly different order of magnitude.

14.5.22 Regarding quantification of the associated operational GHG emissions from the Project, there are a number of uncertainties. These include, the unknown future development of climate policy and targets for renewables deployment being met and subsequent reductions in future UK electricity Grid carbon intensity as forecast within the DESNZ (2023) long run marginal figures. The long run marginal figures are dynamic and show year-on-year decarbonisation towards the UK's committed net zero 2050 pledge accounting for increases in renewable generation sources (such as the Project) supplying the UK electricity Grid. As such comparison with the future long run marginal factors have the potential to understate the benefit of the Project's avoided emissions. As such, the current carbon intensity of UK electricity Grid can be used as a static point to represent the displacement of current generation sources making up the UK electricity Grid. Due to this, these two scenarios detail the potential range of avoided emissions displaced by the Project through its life time as described further in 14.6.9 and 14.6.10.

14.5.23 Sulphur hexafluoride (SF6) is a powerful greenhouse gas with a global warming potential of 23,900 kgCO_2e/kg. Fugitive emissions of SF6 from certain

[5] When we talk about the carbon intensity of electricity, we are referring to the number of grams of carbon dioxide equivalent (CO_2e) that it takes to produce a kWh of electricity. Future carbon intensity then refers to how this figure is projected to change in future, accounting for developments and implementation of climate and energy policies, as well as market responses to said policies.

electrical items such as gas insulated switchgear, as proposed as part of this Project, have historically been a significant source of emissions. Manufacturers of such equipment are now increasingly able to offer SF6-free components, and it is the Applicant's intention to avoid the use of SF6-free assets in the Project. Manufacturers of equipment that does continue to use SF6 are sealed-for-life with extremely low leakage rates (Widger & Haddad, 2018). For this reason, it is assumed that emissions of SF6 from the Project will be negligible and not material to the GHG assessment, as such, they have not been considered further.

14.5.24 The above uncertainties are integral to the assessment of climate change effects but a precautionary approach has been taken as far as practicable to provide a reasonable worst case assessment. On the basis of the above, it is considered that limitations to the assessment have been minimised and that the results provide a sufficiently robust estimate of the impacts of the Project to identify likely significant effects.

14.6 Baseline Environment Conditions

Desk study

14.6.1 Information on climate change within the study area and wider supply chain was collected through a detailed review of existing studies and datasets. These are summarised at **Table 14.7**,noting that this list is not exhaustive.

14.6.2 With regard to current GHG emissions from the site, the current baseline is agricultural land, comprised of a series of agricultural fields of varying sizes. They are primarily used for pasture grazing and arable farming. Results from Volume 3, Appendix 17.1: Soil Survey Data, and Volume 3, Appendix 17.2: Published Agricultural Land Classification and Soils Data, do not indicate any high soil or vegetation carbon stocks (e.g. peat) on the land that would be subject to disturbance by construction.

14.6.3 With regard to emissions associated with the electricity export of the Project, the baseline is the current average grid electricity carbon intensity[6]. This value has been taken from published benchmarks (DESNZ, 2024) and is 0.25692 $kgCO_2e/kWh$, which is inclusive of Well-to-tank (WTT) and WTT Transmission and Distribution (T&D) Losses.

Table 14.7: Summary of desk study sources used

Title	Source	Year	Author
UK Government GHG Conversion Factors for Company Reporting.	Department for Energy Security and Net Zero (DESNZ) and Department for Environment, Food and Rural Affairs (Defra)	2024	DESNZ
Valuation of Energy Use and Greenhouse Gas: Supplementary	Gov.UK	2023	DESNZ

[6]a static representation of the current (2024) average carbon intensity of electricity generated for the UK national grid, presented in $kgCO_2e/kWh$ (DESNZ, 2024)

Title	Source	Year	Author
guidance to the HM Treasury Green Book.			
Renewable sources of energy: 'Load factors for renewable electricity generation (DUKES 6.3)	Digest of UK Energy Statistics (DUKES)	2024	DESNZ & BEIS
Special Report on Solar PV Global Supply Chains.	International Energy Agency	2022	IEA
Future Energy Scenarios	ESO National Grid	2024	ESO National Grid
Longi LR5 72HGD 590w PV module EPD	EPD-Norway	2024	EPD-Norway
Hot dip galvanized steel with Magnelis® coating EPD	IBU-EPD	2019	IBU-EPD
SMA Solar Technology - Sunny Central Power Inverter (SC 4600 UP)	Fraunhofer IBP	2024	Fraunhofer IBP
Inventory of Carbon and Energy (ICE) Database V3.0	ICE	2019	ICE
Power transformer - TrafoStar 500 MVA EPD	ABB	2003	ABB
OneClick LCA Software	OneClick	2024	OneClick

Site-specific surveys

14.6.4 No site-specific surveys have been undertaken to inform the ES for climate change.

Future baseline conditions

14.6.5 The future baseline GHG emissions for existing land-use without the Project are expected to remain similar, with a decrease in agriculture-related emissions over time in line with the UK's national climate change policies.

14.6.6 The future baseline for electricity generation that would be displaced by the Project depends broadly on future energy and climate policy in the UK, and more specifically (with regard to day-to-day emissions) on the demand for renewable energy generation source`s such as the operation of the Project compared to other generation sources available, influenced by commercial factors and National Grid's needs.

14.6.7 Under the UK's climate targets and ambitions, the power system is intended to be fully decarbonised by 2035, as set out in the Net Zero Strategy: Build back greener (HM Government, 2021). Projections of this decarbonisation are provided by DESNZ (long run marginal projections, further detail within Volume 3, Appendix 14.2) and are subject to the successful implementation of renewable energy generation projects such as this Project. These provide a

valuable indicator of the rate of necessary – and expected – progress in reducing the carbon intensity of electricity generation as context for the Project's performance over its lifetime.

14.6.8 However, to solely assess the Project's impact against a decarbonisation scenario which effectively relies upon its own, or similar projects', development occurring would understate the potential avoided emissions. Further, the long run marginal figures are only a future baseline projection and cannot be taken with certainty. Finally, the DESNZ projections are for the operational carbon intensity of generation sources, not accounting for embodied carbon (i.e. construction stage emissions for the generation asset) and the full life-cycle effects.

14.6.9 As such, the current grid average intensity figure of 0.25692 $kgCO_2e/kWh$ (DESNZ, 2024) will also be considered. It is a static figure that does not represent the likely scenario of an increasingly decarbonised grid over the Project's 37.5 year estimated operational lifespan.

14.6.10 It is likely that the true value of avoided emissions as a result of the Project will fall somewhere within the range of the two above scenarios. The current grid average represents a scenario that lacks future renewable energy deployment to the UK national grid, whereas the long run marginal accounts for future renewable energy installation, in line with current policy and a worst case for the purpose of avoided emissions. Therefore, both the current grid average and long run marginal projections have been used to provide a range of values for the current baseline and future business-as-usual baseline against which the benefits of the Project have been calculated.

Key receptors

14.6.11 **Table 14.8** identifies the receptors taken forward into the assessment.

Table 14.8: Key receptors taken forward to assessment

Receptor	Description	Sensitivity/value
Global atmospheric mass of the GHGs	GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e has therefore been treated as a single receptor.	High sensitivity

14.7 Key Parameters for Assessment

Maximum design scenario

14.7.1 The maximum design scenarios identified in **Table 14.9** have been selected as those having the potential to result in the greatest effect on a single receptor in this assessment – global atmospheric mass of GHG. These scenarios have been selected from the Project Design Envelope provided in Volume 1,

Chapter 6: Project Description of this ES. Effects of greater adverse significance are not predicted to arise under any other development scenario, based on details within the Project Design Envelope (e.g., different infrastructure layout). As the “worst case” scenario has been assessed in terms of GHG emissions (which as set out below is already predicted to provide significant benefits in terms of GHG emissions reductions), there may be opportunities to further reduce emissions through detailed design.

Table 14.9: Maximum design scenario considered for the assessment of potential impacts

Potential Impact Phase	Phase C	Phase O	Phase D	Maximum Design Scenario	Justification
The impact of GHG emissions arising from the manufacturing, transportation of materials, and installation of the Project.	✓	×	×	**Construction phase** • The maximum capacity of solar generation that consent is being sought for – approximately 840 MWe • Indicative Maximum Number of Solar PV Modules – 2,200,000 PV modules • Maximum Watts peak (Wp) for solar modules – approximately 1375 MWp • Indicative PV mounting structure material - Galvanized steel fixed tilt. • Indicative total number of piles – 1,600,000 • Indicative number of Power Converter Stations (PCS) - 156 (PCS containing two inverters plus MV transformers) • NGET Substation: – Site area: 3.8 ha – HV Transformers (3 x 460 MVA) • Secondary Substations – HV transformers (3 x 220 MVA, 1 x 180 MVA,1 x 60 MVA, 1 x 45 MVA) – Footprint (per substation): 18 x 10m (i.e. 180 m^2) • Main Project Substation: – Building Area: 8,680 m^2) – HV transformers (2 x 500 MVA) • Power Control Stations (PCS) – 156 MV transformers (6 MVA), one per PCS – Footprint (per substation) 14 x 2.9 m (i.e. 40.6 m^2) • Total HGV journeys required during construction - 25,709 • Total project component weights alongside construction movements associated (Volume 3, Appendix 12.6, Annex A).	The maximum capacity of solar generation that consent is being sought for will equally result in the maximum consumption of fuel and materials arising from manufacturing and installation of the Project, representing the greatest potential for GHG emissions.

Potential Impact Phase	Phase C	Phase O	Phase D	Maximum Design Scenario	Justification
The impact of GHG emissions arising from the operation of the Project.	×	✓	×	**Operation and maintenance phase** • The maximum capacity of solar generation that consent is being sought for approximately 840 MWe • Replacement of PV modules and Inverters once during operational lifespan of the Project.	The greatest generating capacity represents the greatest abatement of fossil fuels from the Grid. A capacity factor based on historic averages achieved across the UK and reasonable degradation factor ensures a conservative operational output for the lifetime Project. It is anticipated that in the future developments would achieve higher capacity factors and as such a higher operational output and subsequent abatement of fossil fuels from the Grid. EPDs utilised for PV modules and inverters state reference service life of 25 years, as such, they are assumed to be replaced once during the operational lifetime of the Project. This is discussed below in section 14.9, and further in Volume 3, appendix 14.2: Greenhouse Gas calculations. It is anticipated that emissions related to manufacturing and transport will be significantly decarbonised by the time replacement is required, as such this provides a conservative assumption.
The impact of GHG emissions arising from the decommissioning of the Project.	×	×	✓	**Decommissioning phase** • The maximum capacity of solar generation that consent is being sought for – approximately 840 MWe • Indicative Maximum Number of Solar PV Modules – 2,200,000 PV modules • Maximum Watts peak (Wp) for solar modules – approximately 1,375 MWp • Indicative PV mounting structure material - Galvanized steel fixed tilt. • Indicative total number of piles – 1,600,000 • Indicative number of Power Converter Stations (PCS) - 156 (PCS containing two inverters plus MV transformers)	Maximum consumption of fuel and materials arising from manufacturing and installation of the Project if it is capable of this capacity of generation, representing the greatest potential for GHG emissions.

Potential Impact Phase	Phase C O D	Maximum Design Scenario	Justification
		• NGET Substation: – Site area: 3.8 ha – HV Transformers (3 x 460 MVA) • Secondary Substations – HV transformers (3 x 220 MVA, 1 x 180 MVA,1 x 60 MVA, 1 x 45 MVA) – Footprint (per substation): 18 x 10m (i.e. 180 m^2) • Main Project Substation: – Building Area: 8,680 m^2) – HV transformers (2 x 500 MVA) • Power Control Stations (PCS) – 156 MV transformers (6 MVA), one per PCS – Footprint (per substation) 14 x 2.9 m (i.e. 40.6 m^2) • Total HGV journeys required during construction - 25,709 Total project component weights alongside construction movements associated (Volume 3, Appendix 12.6, Annex A).	

[a] C=construction, O=operational and maintenance, D=decommissioning

14.8 Mitigation and Enhancement Measures Adopted as Part of the Project

14.8.1 The design process for the Project has been heavily influenced by the findings of early environmental appraisals and the EIA process. The Project has had several measures incorporated into the design to avoid or minimise environmental impacts.

14.8.2 The key aspects where the design has evolved are described in ES Volume 1, Chapter 5: Alternatives Considered **[EN010147/APP/6.3]**. These include measures required for legal compliance, as well as measures that implement the requirements of good practice guidance documents. The assessment has been undertaken on the basis that these measures are incorporated in the design and construction practices (i.e. they are 'embedded mitigation').

14.8.3 Embedded mitigation measures for the construction phase are set out in the ES Volume 1, Chapter 6: Project Description **[EN010147/APP/6.3]**, Appendix 6.1: Project Mitigation Measures and Commitments Schedule **[EN010147/APP/6.5]** and the various management plans outlined in this chapter **[EN010147/APP/7.6]**.

14.8.4 Implementation of embedded mitigation relied upon in the assessment will be secured in the DCO, including by ensuring the works described in Schedule 1 of the DCO are restricted to their corresponding works areas shown on the Works Plans **[EN010147/APP/2.3]**, a DCO requirement requiring compliance of detailed design of the Project to accord with the Outline Design Principles **[EN010147/APP/7.7]**, or through specific DCO requirements requiring compliance with a management strategy, plan, or other requirement document.

14.8.5 Consideration has been given to any ‘additional mitigation’ over and above the embedded mitigation that may be required and has the potential to mitigate any significant adverse effects identified following the assessment of the Project inclusive of its embedded mitigation. Where significant effects remain following the implementation of embedded mitigation and achievable further measures could lower the identified effect, the topic chapter identifies additional mitigation and explains how the additional mitigation is secured, for example via a specific DCO requirement, via a management plan, or document secured by a DCO requirement like the Project Mitigation Measures and Commitments Schedule **[EN010147/APP/6.5]**.

14.8.6 To the extent any likely significant effects are anticipated following the assessment of the Project after the implementation of embedded and additional mitigation, each topic chapter will report these as residual effects. Residual effects for all topics are summarised in Chapter 21: Summary of Significant Environmental Effects of the ES **[EN010147/APP/6.3]**.

14.8.7 Where relevant, measures have also been identified that may result in enhancement of environmental conditions. Enhancement measures are not required to mitigate significant effects of the Project and are not factored into the determination of residual effects. They are further measures which would have additional beneficial outcomes should they be implemented.

14.8.8 Both embedded and additional mitigation measures relevant to this chapter are summarised in **Table 14.10**.

Table 14.10: Mitigation measures intended to be adopted as part of the Project

Commitment number	Measure adopted	How the measure will be secured
Embedded Mitigation		
14.1	As a renewable energy development, climate change mitigation is an inherent aim of the Project. In order to ensure maximum energy yield, and therefore maximum GHG emissions displacement, the solar array would be south facing, and tables of panels would be distanced between 1.5 and 3 m apart from one another so as to avoid inter-panel shading.	Committed within the Project design set out in Outline Design Principles document **[EN010147/APP/7.7]**
14.2	Outline decommissioning plan has been produced and submitted alongside Application	Outline Decommissioning Plan **[EN010147/APP/7.6.4]**
14.3	Outline GHG reduction strategy has been produced and submitted alongside Application	Volume 3, Appendix 14.3: Outline GHG Reduction Strategy **[EN010147/APP/6.5]**
14.4	"Where practicable, pre-fabricated elements would be delivered to the site ready for assembly, which will reduce on-site construction waste and reduce vehicle movements as part of the construction process."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.5	"Construction materials would be sourced locally where practicable, to minimise the impact of transportation."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.6	"Vehicles used in road deliveries of materials, equipment and waste arisings on- and off-site would be loaded to full capacity, wherever practicable, to minimise the number of journeys associated with the transport of these items ."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.7	"All machinery and plant would be procured to adhere with emissions standards prevailing at the time of procurement, where feasible and should be maintained in good repair to remain fuel efficient."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.8	"When not in use, vehicles and plant machinery involved in site operations would be switched off to further reduce fuel consumption."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.9	"The volume of waste generated would be minimised, and resource efficiency maximised, by applying the principles of the waste hierarchy throughout the construction period. Segregated waste storage should be employed to maximise recycling potential for materials. "	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.10	"GHG emissions arising from the construction stage can be minimised via engagement with the supply chain and procurement decisions that consider GHG emissions performance as documented through Environmental Product Declarations. Where feasible, construction elements such as solar panel modules and associated components will be selected with consideration of minimising GHG impacts."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**

Commitment number	Measure adopted	How the measure will be secured
14.11	"Equipment and machinery requiring electricity would only be switched on when required for use. Procedures would be implemented to ensure that staff adhere to good energy management practices, e.g. through turning off lights, computers and heating/air conditioning units when leaving buildings."	Outline Code of Construction Practice **[EN010147/APP/7.6.1]**
14.12	Regular planned maintenance of the Scheme will be conducted to optimise efficiency of the Scheme infrastructure, such as replacement of PV modules and PCS, when required.	Outline Operational Management Plan **[EN010147/APP/7.6.2]**
14.13	Increasing recyclability by segregating waste to be re-used and recycled were reasonably practicable.	Outline Operational Management Plan **[EN010147/APP/7.6.2]**
14.14	Operating 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.	Outline Operational Management Plan **[EN010147/APP/7.6.2]**
14.15	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 staff.	Outline Operational Management Plan **[EN010147/APP/7.6.2]**
14.16	Switching off vehicles and plant when not in use and ensuring vehicles conform to current EU emissions standards.	Outline Operational Management Plan **[EN010147/APP/7.6.2]**
14.17	Measures proposed for the construction phase (see Outline CoCP) will also be adopted for the decommissioning phase in respect of Climate Change.	Outline Decommissioning Plan **[EN010147/APP/7.6.4]**
14.18	Ensure that best practice in relation to reuse, recovery, or repurposing of materials is considered, where practicable during the decommissioning stage. This would include measures such as recycling of PV modules, metalwork, and other pieces of infrastructure associate with the Project.	Outline Decommissioning Plan **[EN010147/APP/7.6.4]**

14.9 Assessment of effects

14.9.1 The impacts of the construction, operation and maintenance, and decommissioning phases of the Project have been assessed. The potential impacts arising from the construction, operation and maintenance and decommissioning phases of the Project are listed in Table 14.9, along with the maximum design scenario against which each impact has been assessed.

14.9.2 In assessing the aforementioned impacts of the construction, operation and maintenance, and decommissioning phases of the Project, a life cycle assessment (LCA) has been conducted. A LCA comprises an evaluation of the inputs, outputs and potential environmental impacts that occur throughout the lifecycle of a particular project, in this case a solar farm, encompassing either a cradle-to-gate (Project site) or a cradle-to-grave (accounting for in use and

decommissioning) approach. This can be further broken down into the following LCA phases of development:

- materials and construction (A1-A5);
- operation and maintenance (B1-B5); and
- decommissioning (C1-C4).

14.9.3 Additional to GHG emissions associated with life cycle stages A1 – C4 are D stage GHG emissions. D stage falls beyond the product life cycle and encompasses benefits and loads beyond the system boundary. This includes reuse, recovery, or any recycling potential of materials which may reduce the overall embodied carbon footprint of a material once this stage is accounted for. Emissions associated with D stage emissions have been accounted for within the Decommissioning section, as the relevant commitment to end of life treatment of the products and materials is within the Outline Decommissioning Plan **[EN010147/APP/7.6.4]**.

14.9.4 For reference, a diagram setting out the various life-cycle stages of a whole life carbon assessment is set out below in Figure 14.1.

Figure 14.1: GHG Emissions life-cycle stages

Whole Life Carbon Assessment: Life-cycle modules (BS EN 15978)													
Development Life-cycle Information													Supplementary Information Beyond the Development Life-cycle
A1 - A3			A4 - A5		B1 - B7					C1 - C4			D
Product stage			Construction process stage		Use stage					End-of-Life stage			Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	
Raw material extraction and supply	Transport to manufacturing plant	Manufacturing & fabrication	Transport to project site	Construction & installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Deconstruction & demolition	Transport to disposal facility	Waste processing for reuse, recovery or recycling	Disposal	Reuse Recovery Recycling potential
					B6: Operational energy use									
					B7: Operational water use									

14.9.5 A description of the potential effect on receptors caused by each identified impact is given below.

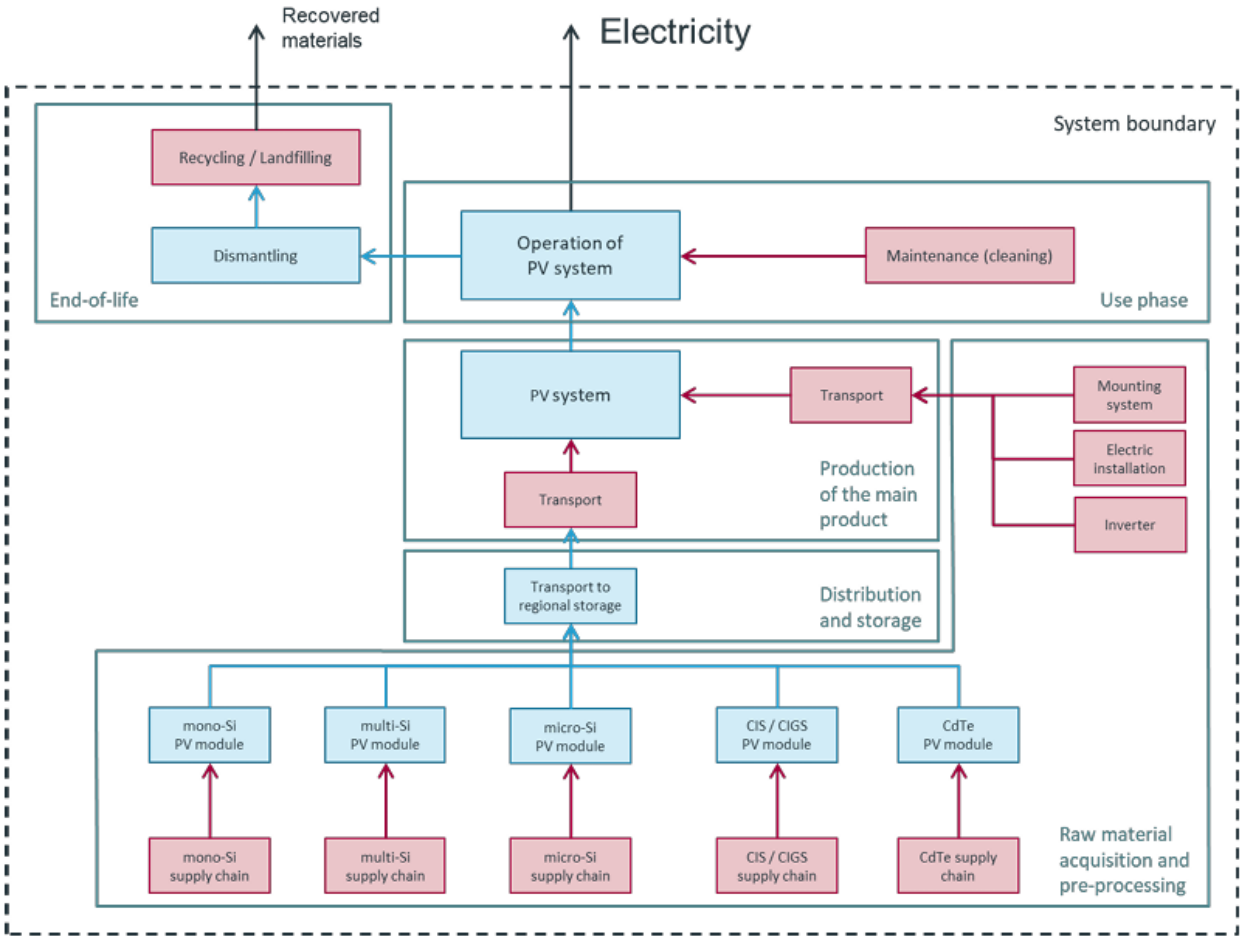
Impact 1 – GHG Emissions arising from the manufacturing, transportation of materials and installation of the Project.

14.9.6 This section considers the embodied carbon emissions associated with the consumption of materials and fuel required to construct the Project. This has included consideration of the maximum quantum of PV panels, length of

cables, and maximum size of the substations and associated infrastructure representing the greatest potential for GHG emissions from the construction and installation of the Project as a conservative estimate of impact.

14.9.7 Solar PV Life Cycle Assessment's (LCAs) are a complex process, given the large number of materials and processes involved in the production of PV modules and BoS components. The quantification of the emissions resulting from these activities requires a GHG LCA. Figure 14.2 below displays the system boundaries considered in a typical GHG LCA for a PV development of this nature.

Figure 14.2: System Boundaries for a Solar PV Development (IEA, 2020)



14.9.8 Furthermore, the associated GHG emissions are dependent on the location (and associated energy mix) of where these processes are occurring. For the purposes of quantifying the GHG emissions associated with the Project during construction, the following elements of the Project have been assessed as part of this LCA:

- PV Modules
- PV Module Frames (piles and mounting structure)
- Inverters
- Cabling - DC 6mm

- Cabling - DC 150mm
- Cabling - AC 33kv
- Cabling - AC 275kv
- Cabling - Fibre Optic
- Project Substations
- NGET Substation
- Power Converter Stations (PCS)
- Deer Proof Fencing
- Security Fencing
- Gates (regular + security)

14.9.9 The manufacturing, transportation and installation of materials for the Project would result in both direct and indirect GHG emissions. GHG emissions arising from the manufacturing of material components (A1 – A3) of the Project listed above in addition to the construction transport movements (A4) and site emissions (A5) have been presented in Table 14.11 below.

Table 14.11: Construction emissions overview

Component	Amount	Unit	GHG emissions associated (tCO_2e)
PV Modules	1375	MWp	506,000
PV Module Frames (Piles and Mounting Structure)	38,183	tonnes	98,131
Inverters	312	No.	4,629
Substations and Power Converter Stations - Transformers	2,936	MVA	15,447
Substations and Power Converter Stations - Buildings	16,094	m^2	
Substations and Power Converter Stations - Concrete	1,782	tonnes	
NGET Substation - Transformers	1,380	MVA	23,732
NGET Substation - Buildings	38,000	m^2	
DC Cabling (6mm^2) – Copper	847	tonnes	16,896*
DC Cabling (6mm^2) – Insulation	415	tonnes	
DC Cabling (150mm^2) – Copper	2,000	tonnes	
DC Cabling (150mm^2) – Insulation	304	tonnes	
AC Cabling (33kv) – Copper	433	tonnes	
AC Cabling (33kv) – Insulation	359	tonnes	
AC Cabling (275kv) – Copper	1,010	tonnes	

Component	Amount	Unit	GHG emissions associated (tCO_2e)
AC Cabling (275kv) – Insulation	997	tonnes	
Cabling – Fibre Optic	9	tonnes	36
Deer proof fencing	105,578	metres	454
Security fencing and gates (regular and security)	41.9	tonnes	116
Construction transport emissions – HGV movements	n/a	n/a	40,261
Construction transport emissions – Construction staff movements	n/a	n/a	
Construction transport emissions – On site supervisor / controller activity	n/a	n/a	
Construction transport emissions – International Shipping	n/a	n/a	
Site Emissions – Construction site activity	n/a	n/a	2,523
Total	**n/a**	**n/a**	**717,006**

*This captures the worst-case assessment of cable corridor options, as discussed above in 14.5.19.

14.9.10 Further detail on the calculations behind the results stated within Table 14.11 can be found within Volume 3, Appendix 14.2: Greenhouse Gas Calculations **[EN010147/APP/6.5]**.

Construction phase

Sensitivity of the receptor

14.9.11 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high sensitivity** (given the severe consequence of global climate change and the cumulative contributions of all GHG emissions sources).

Magnitude of impact

14.9.12 The majority of the construction-stage impacts are 'Scope 3' (supply chain) emissions resulting from the extraction of raw materials and manufacturing of the PV cells, inverters, transformers and other BoS components.

14.9.13 The impact is predicted to be of international spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude of the construction phase of the Project is considered to be 717,006 tCO_2e.

Significance of the effect

14.9.14 As stated in paragraph 14.5.8, the majority of construction-stage emissions are likely to occur from the PV cell supply chain outside the territorial scope of the UK's national carbon budget, so, it is not meaningful to contextualise emissions within this budget in order to assess their significance. However, carbon leakage (offshoring of emissions) has been identified as a risk in the UK's Net Zero Strategy (HM Government, 2021, page 122) and in advice published by the Committee on Climate Change (2020) with regard to industrial decarbonisation.

14.9.15 As GHG impacts are global, regardless of where the release point is geographically located, for the purpose of EIA all GHG emissions and associated impacts of the Project are assessed against the significance criteria in UK guidance and goals for emission reduction, despite likely occurring outside the UK's territory.

14.9.16 The majority of emissions occur at LCA stages A1-A3. The Project has committed to considering ways that they can reduce their impact across the A1-A3 LCA stages, as set out within the outline CoCP **[EN010147/APP/7.6.1]**.

14.9.17 Considering the potential magnitude of GHG emissions set out in paragraph 14.9.13, and embedded mitigation measures associated with the Project, based on the definitions in paragraphs 14.5.14 and 14.5.15 the magnitude of impact on the **high sensitivity** receptor would result in **minor adverse** construction-stage effect, which is not significant in EIA terms.

14.9.18 However, as the purpose of the Project is to provide a source of renewable energy, the construction-stage effects must be considered together with the long-term operational effect in order to determine the overall lifetime effect of the Project. This is set out in the following sections, of which the operational GHG effects of the Project are stated in the following section.

Impact 2 – GHG emissions associated with the operation and maintenance stage of the Project

Operation and maintenance

14.9.19 Emissions during the operation and maintenance phase of the Project refer to activities contributing to maintenance of the asset in addition to the associated avoided emissions through the export of renewable energy to the UK Electricity Grid.

14.9.20 The maintenance activities for the Project largely involves operational stage vehicle movements, and material replacement such as PV module and inverter replacement, whenever necessary. Further detail is provided within the outline Operational Management Plan **[EN010147/APP/7.6.2]** .

14.9.21 Emissions associated with the operational vehicle movements have been captured, alongside emissions associated with the embodied carbon of panels, and BoS material replacements (inverters), over the Projects assumed 37.5-year lifetime. Conservative assumptions for material replacement rates have been used to provide a maximum design scenario. Further detail can be found

within Volume 3, Appendix 14.2: Greenhouse Gas Calculations **[EN010147/APP/6.5]**.

14.9.22 The proposed solar array would export energy, approximately 840 MWe, to the UK Electricity Grid that is zero-carbon at the point of generation[7], thereby displacing the marginal generating source that would be providing energy in the absence of the Project.

14.9.23 The marginal source displaced may in practice vary from moment to moment depending on the operation of the capacity market, i.e., led by commercial considerations and National Grid's needs at any given time. For the purpose of this assessment, the current grid average figure of 0.25692 kgCO_2e/kWh (DESNZ, 2024) has been used as the baseline for this assessment, alongside the long run marginal figures (DESNZ, 2023), to present a potential range of carbon emissions saved in association with marginal generating source displacement, as a result of the Project.

14.9.24 A range is provided as, while the current grid average figure is a useful available metric, it is a static figure that does not represent the likely scenario of an increasingly decarbonised grid over the Project's 37.5 year estimated operational lifespan. This represents no new renewable electricity abating fossil fuel generation in the grid. Whilst the long run marginal figures are dynamic and show year on year decarbonisation towards the UK's committed net zero 2050 pledge, it is only a future baseline projection and cannot be taken with certainty, hence, neither are perfect estimates. It is likely that the true value of emissions displaced from the national grid as a result of the Project will fall somewhere within this range, however, due to uncertainties such as future development of climate policy and targets for renewables deployment actually being met, a more precise estimation could not be considered robust.

14.9.25 The annual energy output of the Project has been calculated assuming a conservative load factor[8] of 11.06 % and taking into account the annual degradation of the PV modules. Further detail has been included within Volume 3, Appendix 14.2 **[EN010147/APP/6.5]**.

14.9.26 The total output (MWh) and total projected avoided emissions (tCO_2e) over the Project's 37.5 year operating lifetime are displayed within Table 14.12, below.

Table 14.12: Operational GHG effects

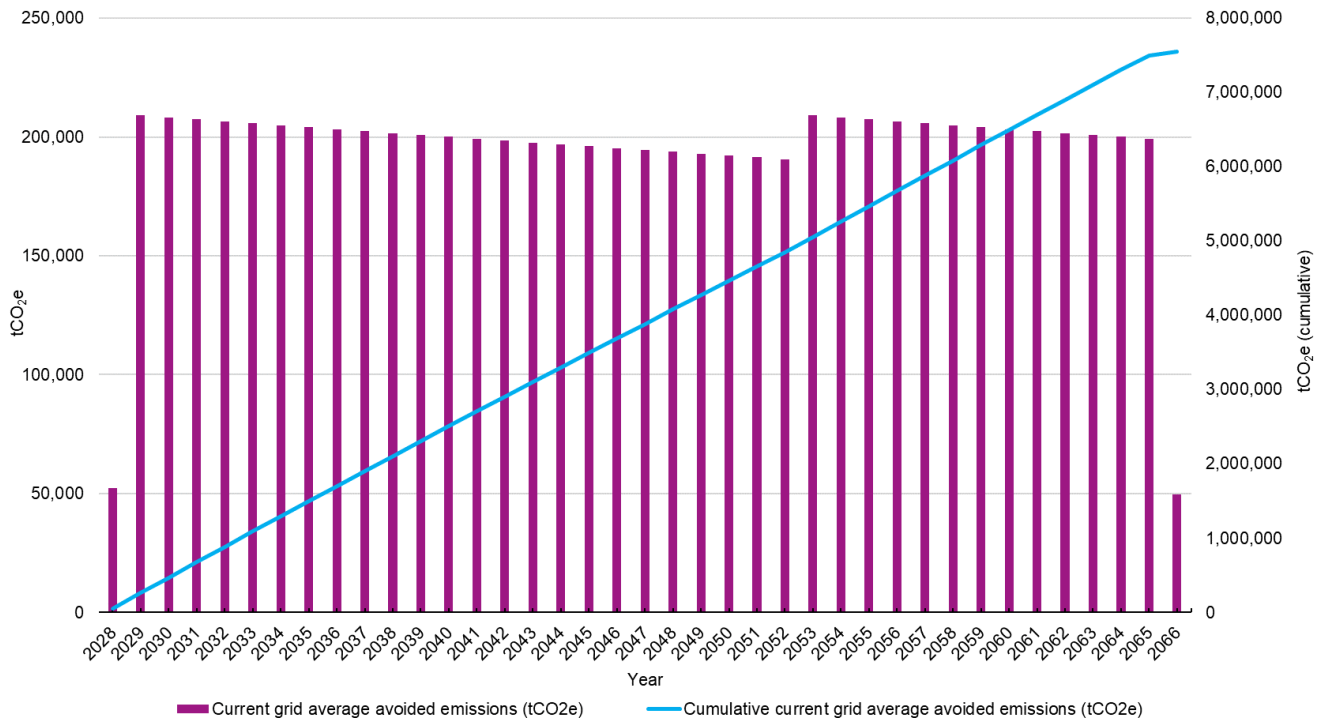
Operating Years	Output (MWh)	Avoided emissions (tCO_2e)	
		Current grid average	Long run marginal
37.5	29,376,880	-7,547,508	-432,490

[7] i.e. not including the embodied carbon emissions associated with the construction of the array discussed in the construction effects section.

[8] The load factor refers to the total number of hours at which the facility is generating electricity at its rated capacity (i.e. approximately 840 MW) over the year. It is determined by irradiance conditions, performance ratio, and orientation and tilt of the panels.

14.9.27 Graph 1 shows both the annual and cumulative avoided emissions that the Project provides, also accounting for the degradation of PV modules[9], under the current grid average scenario.

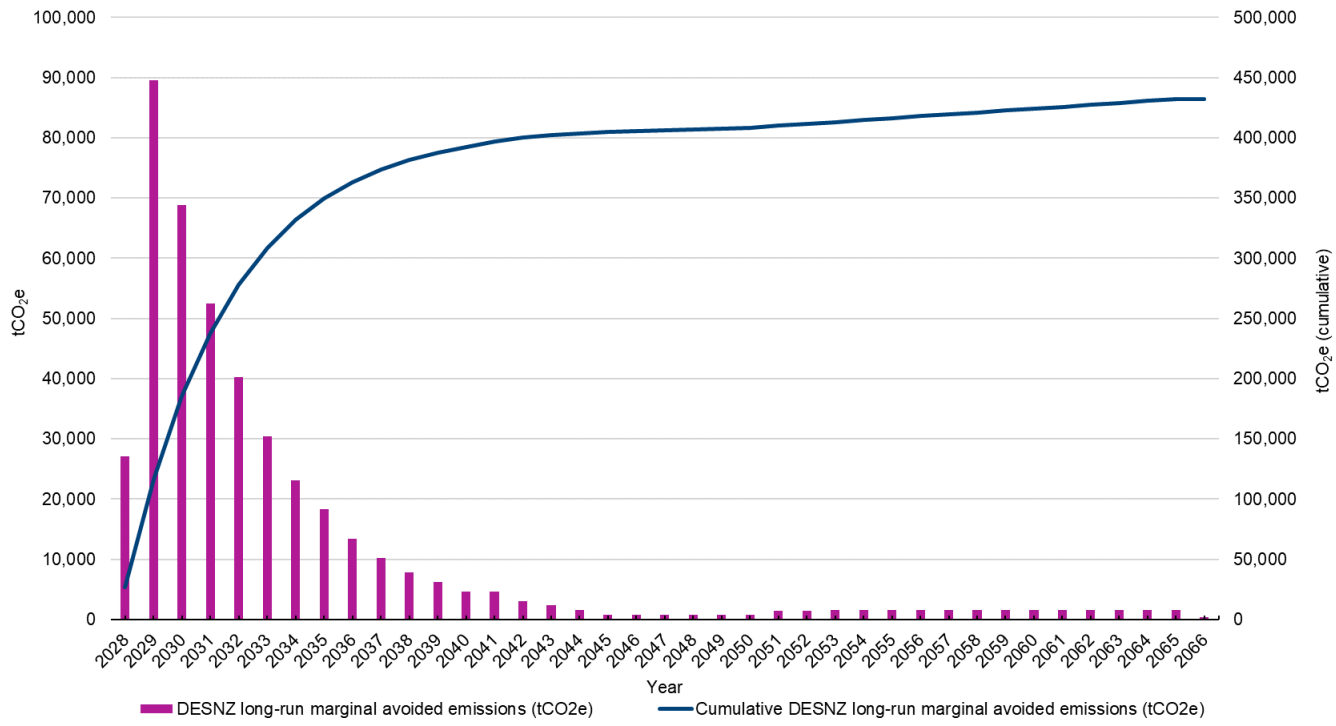
Graph 1: Annual and Cumulative GHG Impacts (current grid average)



14.9.28 Graph 2 shows both the annual and cumulative avoided emissions for the Project, also accounting for the degradation of PV modules, under the long run marginal scenario.

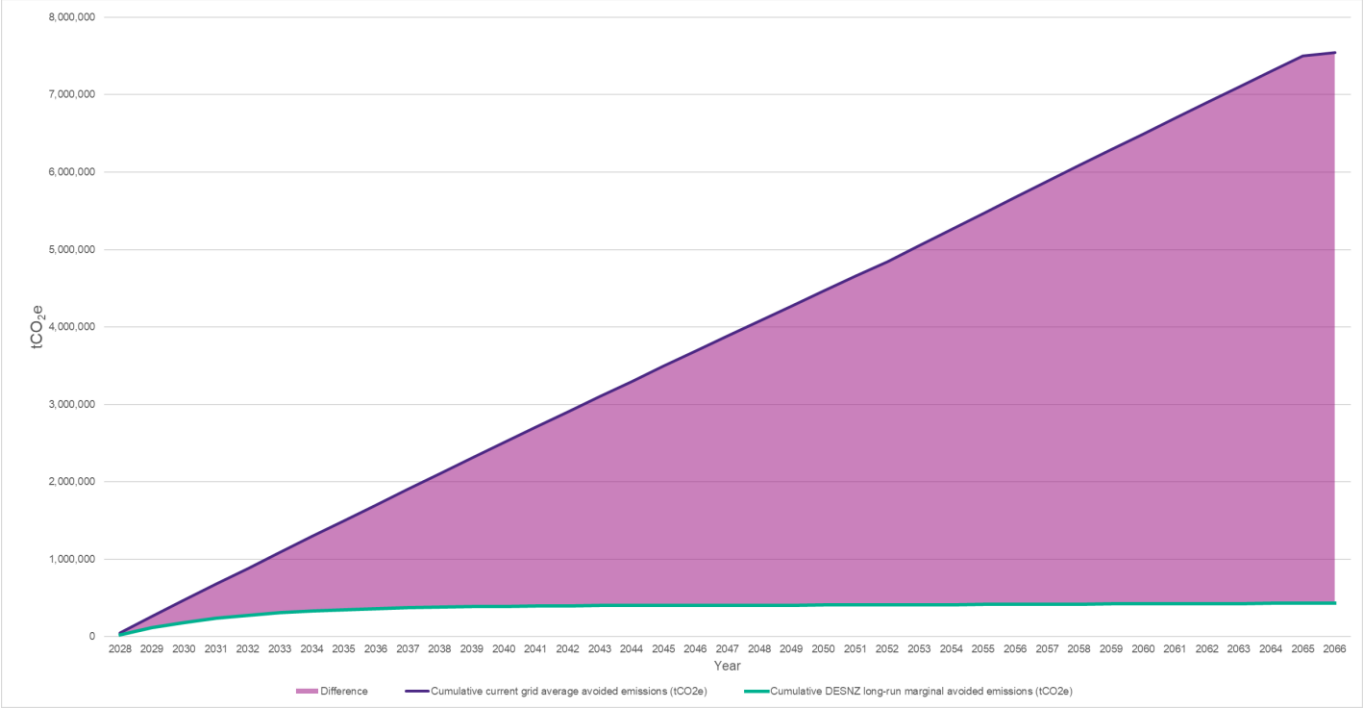
[9] It should be noted that the degradation factor applied to PV modules resets in the Projects 26 year of operation, as it is anticipated that all panels will be replaced once by this time.

Graph 2: Annual and Cumulative GHG Impacts (DESNZ long-run marginal)



14.9.29 Graph 3 below displays the cumulative impact of both scenarios, with shading to highlight the difference, representing the potential range of avoided emissions that the Project's operational phase will enable.

Graph 3: Current Grid Average and Long-run Marginal GHG emissions



14.9.30 As discussed above in 14.9.21, emissions associated with transport movements and material replacements during the operational lifetime of the project have been quantified.

14.9.31 Due to uncertainty with vehicle movements and site emissions during operation and maintenance phase as stated above in 14.6.2, the EPD's provided for PV modules (EPD-Norway, 2024) and Inverters (Fraunhofer IBP, 2024), have been utilised to quantify A1 - A5 stage emissions during the operational phase of the Project. Emissions factors for both EPD's have been provided below within Table 14.13.

Table 14.13: EPD Emissions factors A1 – A5.

EPD	Emissions factor	Total (A1 – A5)
PV Module	kgCO_2e / Wp	0.38533
Inverters	kgCO_2e per inverter unit	15,611

14.9.32 The above total factors stated within Table 14.13 was then applied to the maximum generation capacity of the Project that is assumed to be replaced by the PV modules (1,375 MWp) and total number of inverters required during construction (312), resulting in the following GHG emissions:

- PV Modules – 529,829 tCO_2e
- Inverters – 4,871 tCO_2e

14.9.33 As GHG emissions arising from maintenance activities to the Project during operation amounts to 534,699 tCO_2e.

14.9.34 Additional detail can be found in Volume 3, Appendix 14.2 **[EN010147/APP/6.5]**.

Future Cloud Cover Change

14.9.35 The Met Office Hadley Centre (MOHC) published both probabilistic climate change projections and downscaled global circulation model outputs for the UK at various spatial scales. This is called the UK Climate Projections 2018 (UKCP18) dataset, first published in November 2018 and at v2.8.0 (MOHC, 2023) at the time of writing. The projections are based on representative concentration pathway (RCP) scenarios used by the IPCC. The RCP scenarios (four scenarios presented in the IPCC fifth Assessment report which are included within the UKCP18 database) describe different climatic futures, all of which are considered possible depending on the volume of GHGs emitted. These provide the basis for future assessments of climate change and possible response strategies, thereby giving a low-high range in potential global GHG reduction initiatives and resulting rate of climatic effects over a given period.

14.9.36 The probabilistic projections published at a 25 km grid cell scale are considered the most useful for this assessment, being designed to show a range of projection values that reflect uncertainty in modelled outcomes. Projections for the global emissions RCP 8.5 (worst-case RCP scenario) have

been utilised, this is a high-emissions scenario assuming 'business as usual' growth globally with little additional mitigation to combat climate change.

14.9.37 Whilst an assessment of the effect of a changing climate on the Project has not been assessed, as justified within Table 14.6, future changes to cloud cover as a result of climate change have been considered. The total cloud anomaly from the UKCP18 probabilistic dataset averaged over the 2040-2069 time period relative to a 1981-2010 baseline for the 25 km grid square within which the Project site is located is included within Table 14.14 below. This period provides good coverage of the operational period of the Project, when changes in cloud cover may impact annual yields.

Table 14.14: Future cloud cover change

Cloud cover change (%) for RCP8.5			
	10th Percentile	**Median**	**90th Percentile**
2040-2069	-8.22	-3.60	0.77

14.9.38 The total annual cloud cover has a direct relationship with the total annual solar insolation being received by the solar array, thereby effecting the total annual energy yield. As shown within Table 14.14, cloud cover is anticipated to decrease during the Project's operating lifetime. This has positive implications for increased energy generation potential and demonstrates that the Project's technology would be resilient to, and benefit from, potential climate change in this respect. An increase in annual yield from the Project would increase avoided emissions and reduce the payback period, increasing the benefits seen from the Project.

Sensitivity of receptor

14.9.39 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high sensitivity** (given the severe consequence of global climate change and the cumulative contributions of all GHG emissions sources).

Magnitude of impact

14.9.40 The impact is predicted to be of international spatial extent, long term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be -7,012,809 to 182,307 tCO_2e for the operation and maintenance phase.

Significance of effect

14.9.41 The nature and significance of effect has been characterised as set out in paragraphs 14.5.14 and 14.5.15, by contextualising the Project's operational GHG impacts within the UK carbon budget, in comparison with the carbon intensity of electricity supply in the baseline, and with regard to its compliance with the UK's net zero trajectory, local and national climate-related policy, legislation and guidance

Carbon Budget Context

14.9.42 The Project's operational-stage emissions have been contextualised in the context of the UK's fourth, fifth and sixth carbon budgets. The Project's GHG impacts given within Table 14.15 represents national carbon budget expenditures respectively that would have occurred in the absence of the Project and have therefore been avoided. As the Project is a nationally significant infrastructure project (NSIP), subject to the Development Consent Order (DCO) process, it has been contextualised at the national scale only, and not regional, as it would not be appropriate to do so.

14.9.43 Table 14.15 displays the UK national carbon budgets and how the Project's operational GHG impacts relate to them.

Table 14.15: GHG Impact in the Context of the UK's Carbon Budgets

Time period	2028-2032	2033-2037	Total[10]
UK carbon budget (tCO_2e)	1,730,000,000	960,000,000	2,690,000,000
Current grid average			
Project GHG impacts (tCO_2e)	-883,368	-1,020,325	**-1,903,693**
Project avoided emissions as percentage of UK carbon budget	- 0.0511%	- 0.1063%	**- 0.0708%**
Long run marginal			
Project GHG impacts (tCO_2e)	-278,081	-95,510	**-373,591**
Project avoided emissions as percentage of UK carbon budget	- 0.0161%	- 0.0099%	**- 0.0139%**

14.9.44 As can be seen from Table 14.15, when both the current grid average and long run marginal scenarios are considered, in terms of contextualising avoided emissions within the UK's carbon budgets, a saving somewhere within the range of 0.0139% - 0.0708%, through avoided emissions, would occur as a result of the Project across the two budget periods. This would provide a measurable contribution from a single project towards avoiding potential carbon budget expenditure on the national level.

Climate Policy, Legislation and Guidance

14.9.45 The Project is in line with the NPS EN-3's principle of supporting new renewable and low carbon energy developments, in addition to their

[10] This is the total during the budget periods, not the total for the Project's assumed lifetime.

associated infrastructure, in order to contribute to reductions in GHG emissions.

14.9.46 Further, the Project is supported by national energy and climate change policy (including the National Infrastructure Strategy, Sixth Carbon Budget, Net Zero Strategy, and British Energy Security Strategy, detailed within Volume 3, Appendix 14.1) which collectively highlights the need for an end to the use of unabated fossil fuel generation, whilst also significantly ramping up electricity generation capacity in order to meet the demands of increased electrification of transport, heat and industry. As such, government policy recognises that large-scale deployment of renewable energy generators such as the Project are necessary in order to meet GHG reduction targets.

14.9.47 By facilitating the expansion of renewable energy supply, the Project would assist the UK Government target of achieving a fully decarbonised power system by 2035, as well as the UK Government's target to become net zero by 2050.

14.9.48 By aiding the delivery of the expansion of renewable energy generation, the Project is in line with UK-wide planning policy and legislation.

Effect

14.9.49 Using the definitions in paragraph 14.5.15, which sets out how effects from GHG emissions are described in line with IEMA (2022) guidance, the impact of GHG emissions from the operational phase of the Project on the **high sensitivity** receptor would result in a **beneficial** effect, which is significant in EIA terms.

14.9.50 This is on the basis that, during its operational period, the Project will not result in any GHG emissions (aside from negligible energy use during maintenance activities). The Project will provide renewable energy, thereby enabling the continued decarbonisation of grid electricity and the displacement of higher-emitting energy sources, which is identified in both policy and expert guidance as essential to facilitate the UK's 1.5°C-aligned trajectory towards net zero.

14.9.51 By reducing the need for electricity generation from existing sources with higher carbon intensity in the current and future business-as-usual baseline, the Project indirectly causes GHG emissions that would otherwise have occurred to be avoided.

14.9.52 As such it is considered to cause a net reduction in GHG emissions that would be released to the atmosphere compared to the baseline over its operating lifetime (under the current grid average scenario), which meets the definition of a significant beneficial effect.

Impact 3 – GHG emissions associated with the decommissioning of the Project

Decommissioning

14.9.53 GHG emissions arising from the decommissioning has been assessed in further detail within Volume 3, Appendix 14.2: Greenhouse Gas Calculations **[EN010147/APP/6.5]**.

14.9.54 Emissions arising from the end-of-life stage (C1-C4 stage) of the following elements of the Projects emissions have been quantified:

- PV Modules
- PV Module Frames (Mounting structures and piles)
- Inverters

14.9.55 As is laid out within Table 14.11, GHG emissions associated with PV modules, module frames, and inverters account for circa 85% of GHG emissions at construction stage. As such, this accounts for the majority of the Project and gives a likely indication as to the associated end-of-life stage emissions associated with the Project.

14.9.56 The vast majority of emissions associated with solar PV developments arises in the construction stage, from the embodied carbon of the PV modules and BoS components, and as such GHG emissions from decommissioning will be minimal in comparison (International Energy Agency, 2021). This sentiment is supported in the results from end-of-life stage emissions, amounting to 24,281 tCO_2e, a fraction of construction stage emissions.

14.9.57 As a result of the above, it is assumed decommissioning of remaining Project components would provide an immaterial contribution to GHG emissions, and has not been assessed further.

14.9.58 Benefits from D stage emissions (Benefits and loads beyond the system boundary) have been claimed wherever a clear commitment to reuse, recycle / recover potential has been committed to within the Outline Decommissioning Plan **[EN010147/APP/7.6.4]**.

14.9.59 Project components that have been able to claim avoided emissions through D stage benefits include:

- PV Modules;
- module frames;
- steel gates (regular and security gates); and
- steel security fence.

14.9.60 By committing these Project components to reuse, recycling, or recovery at end-of-life, secured via the Outline Decommissioning Plan **[EN010147/APP/7.6.4]**, this helps displace GHG emissions by negating the need to produce new components from virgin materials. GHG emissions arising from D stage benefits of Project components amounts to -274,074 tCO_2e. Further detail can be found within Volume 3, Appendix 14.2 **[EN010147/APP/6.5]**.

Sensitivity of receptor

14.9.61 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high**

sensitivity (given the severe consequence of global climate change and the cumulative contributions of all GHG emissions sources).

Magnitude of impact

14.9.62 The impact is predicted to be of international spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. Accounting for both C1-C4 stage emissions, and D stage emissions arising from the Project results in net emissions of -249,793 tCO_2e during the decommissioning phase of the Project.

Significance of effect

14.9.63 Considering the potential magnitude of GHG emissions set out in paragraph 14.9.62 and absence of mitigation or reduction of emissions, based on the definitions in paragraphs 14.5.14 and 14.5.15 the magnitude of impact on the **high sensitivity** receptor would result in **beneficial** decommissioning-stage effect, which is significant in EIA terms.

14.10 Net Whole Life GHG Emissions

14.10.1 As set out in paragraph 14.5.17, consideration of the Projects' whole life impact is an important consideration when assessing the Projects' impacts and subsequent effects on climate change.

14.10.2 Consistent with the assessment of operational effects, the lifetime effects assessment is made on the basis that the Project will displace higher-emitting energy sources that would have continued in the business-as-usual baseline, whilst also considering projected future energy scenarios. This has been calculated using both the current grid average carbon intensity of generation (DESNZ, 2024), and the long run marginal projection from DESNZ (2023), treating the former as remaining consistent in the future baseline without the Project[11], and the latter as a robustly calculated estimation of the pathway the UK national grids carbon intensity will move towards, if projects such as the Project continue to be consented and implemented in line with UK policy aims for renewable deployment.

14.10.3 The whole-life GHG emissions (total construction-stage, operational-stage, and decommissioning-stage emissions) resulting from the Project is shown in Table 14.16. This is shown alongside the anticipated carbon payback period for the Project.

[11]This is considered to be a balanced assumption: on the one hand it does not assume displacement by the Project of future grid average or marginal generators with a projected decreasing carbon intensity (which would be a circular argument, as the projected decrease in grid-average and marginal carbon intensity can only be achieved with renewable projects such as the Project); but on the other it does not assume displacement of higher carbon intensity sources such as gas-fired generation, due to differences in the position with respect to baseload and dispatchability of renewable generation.

Table 14.16: Project Net GHG Impacts

	Value	Unit
Construction stage emissions	717,006	tCO_2e
Operational stage emissions*	-7,012,809	tCO_2e
Decommissioning stage emissions	-249,793	tCO_2e
Net (whole life) emissions*	-6,545,595	tCO_2e
Earliest carbon payback period*	6	Years

*Based on current grid average scenario

14.10.4 Notwithstanding the GHG emissions resulting from the construction stage of the Project, the magnitude of avoided emissions resulting from the operational stage achieves a carbon payback from its 6th year of operation under the current grid average scenario, which should be considered the earliest year in which this could take place. It is likely that the payback period will increase as the grid decarbonises, reducing the intensity of energy generation that the Project will displace. The extent of this cannot be robustly estimated at present as it is dependent on the future reality of grid emission reductions.

14.10.5 Using the definitions in paragraphs 14.5.14 and 14.5.15, the impact of whole-life GHG emissions from the Project on the **high sensitivity** receptor is considered to meet the definition of a **beneficial** effect that is **significant** in EIA terms. Although a significant initial carbon cost of manufacturing and installation is incurred, alongside some emissions associated with maintenance during operation, and decommissioning of the Project, by achieving a carbon payback period of 6 years (at the earliest) and providing net negative emissions compared to the business-as-usual baseline over its remaining operating period, this will be in line with the decarbonisation of electricity generation by 2035 as targeted in UK climate policy under the Sixth Carbon Budget. It will provide an immediate contribution to the UK's ambitions to increase renewable energy capacity, and its net emission savings would be material at the scale of recommended 1.5°C compatible UK carbon budgets. It would therefore be consistent with the definition of a 'beneficial' effect that achieves decarbonisation in line with or sooner than required by policy and would have minimal residual emissions trending to net negative emissions over its operating life.

14.10.6 To provide further context, the following electricity generation carbon intensity has been calculated for the Project, informed by the relevant operation and maintenance stage emissions (excluding procurement of materials) and energy generated over the respective whole Project's lifetime:

- Project operational emissions intensity – 0.82 gCO_2e/kWh

14.10.7 This intensity is lower than the current grid average (207 gCO_2e/kWh), fossil fuel generation (437 gCO_2e/kWh) and the Climate Change Committee's electricity emissions intensity targets for 2030 (50 gCO_2e/kWh) and 2035 (10 gCO_2e/kWh), thereby demonstrating that the electricity generated by the Generation Assets enables and aids UK Grid decarbonisation. Given the

operation and maintenance emissions reported for each project do not account for the decarbonisation of associated activities (i.e. vehicle movements and material replacement) in line with the UK's planned decarbonisation of the manufacturing and transport sectors, it can be expected that the true carbon intensities will be reduced compared to those reported above. As such, it is likely that the carbon intensity for the Project would align with the Climate Change Committee's electricity emissions target of 2 gCO_2e/kWh by 2050.

14.10.8 In the long term, following its carbon payback period, the ongoing avoided emissions from the operation of the Project meet the definition of a significant beneficial effect (as was set out in the operational effects section when this lifecycle stage was considered in isolation).

Future monitoring

14.10.9 No monitoring to test the predictions made within the impact assessment is proposed as there is no monitoring that would be relevant to the climate change topic.

14.11 Cumulative Effects

14.11.1 As is detailed within the IEMA (2022) GHG in EIA Guidance all developments that emit greenhouse gas (GHG) have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a cumulative impact on climate change irrespective of geographic location. Consequently, cumulative effects due to other specific local development projects cannot be individually identified and assessed. When evaluating the impact of the Project the atmospheric mass of GHGs has been defined as a high sensitivity receptor. This approach is consistent with the IEMA (2022) GHG in EIA Guidance.

14.11.2 As detailed in Volume 1, Chapter 6: Project Description **[EN010147/APP/6.3]** there is an option for the NGET substation to be delivered on an adjacent portion of land, outside of the Project boundary, within the context of climate change it has been assumed and assessed that the NGET falls within the project boundary (option 1 as described in paragraph 6.4.25 of Volume 1 Chapter 6: Project Description). Option 2 would assume that the NGET falls out of the Project Boundary and would be delivered independent of the scheme. This is discussed below in section 14.12.

14.12 Cumulative effects assessment

14.12.1 As is justified in paragraph 14.11.1, no relevant cumulative effects assessment has been completed for this climate change chapter in relation to additional schemes not required for Project delivery, except for commentary on the NGET substation under option 2, as discussed above in 14.11.2.

NGET Substation (Option 2)

14.12.2 Relating to option 2 (NGET substation delivered separately to the Project), quantified construction emissions amount to 23,732 tCO_2e. This forms the potential emissions for the purpose of assessing this element cumulatively, should it be delivered outside the boundary of the Project.

14.12.3 Under this option the emissions for the Project during construction would be reduced by 23,732 tCO_2e, to amount to 693,274 tCO_2e.

14.12.4 Given the stage of design of the NGET substation, it is not possible to quantify emissions arising from the operation and maintenance, or decommissioning phases and as such have not been considered. Assumptions for quantification of emissions associated with the construction of the NGET substation made in our assessment are provided in Table 14.11. Additional information can be found in Volume 3, Appendix 14.2: Greenhouse Gas Calculations. The same assumptions and approach has been taken for construction stage emissions associated with the NGET cumulative effects assessment.

Sensitivity of receptor

14.12.5 GHG emissions have a global effect rather than directly affecting any specific local receptor to which a level of sensitivity can be assigned. The global atmospheric mass of the relevant GHGs and consequent warming potential, expressed in CO_2e, has therefore been treated as a single receptor of **high sensitivity** (given the severe consequence of global climate change and the cumulative contributions of all GHG emissions sources).

Magnitude of impact

14.12.6 The impact is predicted to be of international spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor indirectly. Emissions arising from the NGET substation amounts to 23,732 tCO_2e during the construction phase. In combination with the estimated 693,274 tCO_2e associated with construction of the Project, the cumulative impact of construction is deemed to be 717,006 tCO_2e.

Significance of effect

14.12.7 Considering the potential magnitude of GHG emissions set out in paragraph 14.12.6, and embedded mitigation measures associated with the Project, alongside mitigation measures committed to by NGET in relation to the NGET substation, such as commitment to provide a substation which is SF6 free, based on the definitions in paragraphs 14.5.14 and 14.5.15 the magnitude of impact on the **high sensitivity** receptor would result in **minor adverse** construction-stage effect, which is not significant in EIA terms.

14.12.8 In addition to the above. The NGET substation is a piece of infrastructure for the national grid, and as such should be contextualised within the UK's carbon budget. Considering the emissions arising from the construction of the NGET substation (23,732 tCO_2e), with the UK carbon budget for 2023-2027(1,950,000,000 tCO_2e), the NGET substation accounts for 0.001%, a negligible contribution.

14.13 Transboundary effects

14.13.1 As per the scoping report, it was concluded that the Project is unlikely to have a significant effect either alone or cumulatively on the environment in a

European Economic Area State (EEA states) and therefore a transboundary assessment is not proposed in the ES.

14.13.2 Also, as confirmed within the IEMA GHG EIA Guidance (IEMA, 2022), all developments which emit GHGs have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a transboundary impact on climate change. Consequently, transboundary effects due to other specific international development projects are not individually identified but would be taken into account when considering the impact of the Project by defining the atmospheric mass of GHGs as a **high sensitivity** receptor. Each country has its own policy and targets concerning carbon and climate change which are intended to limit GHG emissions to acceptable levels within that country's defined budget and international commitments.

14.14 Inter-related effects

14.14.1 Inter-relationships are the impacts and associated effects of different aspects of the Project on the same receptor. These are as follows.

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Project (construction, operation and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g., construction noise effects from piling, operational substation noise, and decommissioning disturbance).
- Receptor led effects: Assessment of the scope for all effects (including inter-relationships between environmental topics) to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on climate change, such as direct habitat loss or disturbance, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

14.14.2 In relation to climate change, consideration of inter-related effects has been provided within the future baseline section of individual environmental statement chapters.

14.14.3 A summary of the likely inter-related effects arising from the Project on climate change is provided in Volume 1, Chapter 19: Cumulative Effects and Inter-relationships of the ES.

14.15 Summary of impacts, mitigation measures and monitoring

14.15.1 Information on climate change within the study area was collected through desktop review.

14.15.2 The potential impact of GHG emissions arising from to the Project on the global atmospheric GHG concentration that contributes to climate change, has been assessed and reported in this chapter.

14.15.3 Table 14.17 presents a summary of the potential impacts and residual effects on climate change. The impacts assessed include:

- The impact of GHG emissions arising from the manufacturing and installation of the Project during construction.
- The impact of GHG emissions arising from the operation of the Project.
- The impact of GHG emissions arising from the decommissioning of the Project.

14.15.4 It is concluded that overall there will be likely significant positive effects arising from the Project during the operation and maintenance, and decommissioning phases periods of the Project, with emissions over the construction phase that would be typical of any construction activity of this scale, as summarised below:

- Construction phase: Considered embedded mitigation committed to as part of the Project, emissions from the manufacturing and installation of the Project would result in emissions of up to 717,006 tCO_2e. This would be a **minor adverse** effect which is not significant in EIA terms with a residual effect of minor adverse. The construction phase must also be evaluated in terms of whole life time emissions from the Project.
- Operations and maintenance stage: The operational phase of the Project would enable the generation renewable electricity and thereby assist in the displacement of fossil fuels as a generation source. This would result in a positive GHG impact. When considering the avoided emissions, and accounting for GHG emissions arising due to maintenance of the Project during this phase, the operational impact results in the order of approximately -7,012,809 tCO_2e savings over the Projects 37.5 year operational lifetime (under the current grid average scenario). This would result in a **beneficial** effect which is significant in EIA terms.
- Decommissioning phase: Emissions from the decommissioning of the Project would result in emissions of up to -249,793 tCO_2e. This would result in a **beneficial** effect which is significant in EIA terms.

14.15.5 Despite the GHG emissions resulting from the construction-stage of the Project, the magnitude of avoided emissions resulting from the operational and decommissioning stages of the development allows the Project to enable avoided emissions from year 6 of operation (carbon payback period).

14.15.6 Over the lifetime of the Project, it would result in -6,545,595 tCO_2e of avoided emissions (under the current grid average scenario).

14.15.7 Consideration of the Project's net emissions performance can be considered with the following contextualisation:

- It would contribute to reducing carbon budget expenditure at a national level; and
- It would contribute towards meeting UK energy and climate policy goals.

14.15.8 The Project is in line with the NPS EN-3's principle of supporting new renewable and low carbon energy developments, in addition to their associated infrastructure, in order to contribute to reductions in GHG emissions.

14.15.9 Further, the Project is supported by national energy and climate change policy (including the National Infrastructure Strategy, Sixth Carbon Budget, and Net Zero Strategy) which highlight the need for an end to the use of unabated fossil fuel generation, whilst also significantly ramping up electricity generation capacity in order to meet the demands of increased electrification of transport, heat and industry. As such, government policy recognises that large-scale deployment of renewable energy generators such as the Project is necessary in order to meet GHG reduction targets.

14.15.10 By enabling the expansion of renewable energy supply by providing additional renewable energy generation capacity, the Project would assist the UK Government's target of achieving a fully decarbonised power system by 2035 as well as the aim to become net zero by 2050.

14.15.11 As is detailed within the IEMA (2022) GHG in EIA Guidance all developments that emit greenhouse gas (GHG) have the potential to impact the atmospheric mass of GHGs as a receptor, and so may have a cumulative impact on climate change irrespective of geographic location. Consequently, cumulative effects due to other specific local development projects cannot be individually identified and assessed in accordance with the IEMA GHG in EIA Guidance (IEMA, 2022). When evaluating the impact of the Project the atmospheric mass of GHGs has been defined as a high sensitivity receptor.

14.15.12 When considering the potential magnitude of GHG emissions associated with Option 2 and embedded mitigation measures associated with the Project, alongside mitigation measures committed to by NGET in relation to the NGET substation, such as commitment to provide a substation which is SF6 free, the magnitude of impact on the high sensitivity receptor would result in minor adverse construction-stage effect, which is not significant in EIA terms.

14.15.13 No potential transboundary impacts have been identified in regard to effects of the Project.

Table 14.17: Summary of potential environmental effects, mitigation and monitoring.

Description of impact	Phase C	Phase O	Phase D	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Additional mitigation	Residual effect	Proposed monitoring
The impact of GHG emissions arising from the manufacturing and installation of the Project during construction.	✓	×	×	717,006 tCO_2e	High	Minor Adverse (Not Significant)	n/a	Minor adverse (not significant)	None
The impact of GHG emissions arising from the operation of the Project.	×	✓	×	-7,012,809 tCO_2e	High	Beneficial (Significant)	n/a	Beneficial (Significant)	None
The impact of GHG emissions arising from the decommissioning of the Project.	×	×	✓	-249,793 tCO_2e	High	Beneficial (Significant)	n/a	Beneficial (Significant)	None

[a] C=construction, O=operational and maintenance, D=decommissioning

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