SUNNICA ENERGY FARM

Preliminary Environmental Information Report

Chapter 6: Climate Change

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6.1 Introduction

6.1.1 This chapter identifies and proposes measures to address the potential impacts and effects of the Scheme on the climate during construction, operation and decommissioning.

6.1.2 It also considers the resilience of the Scheme to the physical impacts of climate change.

6.1.3 To align with the requirements of the EIA Regulations (Ref 6-1), consideration has been given within this chapter to the following aspects of climate change assessment:

- **Lifecycle greenhouse gas (GHG) impact assessment –** The impact of GHG emissions arising over the lifetime of the Scheme on the climate; and
- **Climate change resilience (CCR) review –** The resilience of the Scheme to projected future climate change impacts.

6.1.4 An in-combination climate change impact (ICCI) assessment identifies how the resilience of receptors in the surrounding environment are affected by the combined impact of future climate conditions and the Scheme. A separate ICCI assessment has been scoped out of this assessment (see Scoping Report at ***PEI Report Volume 2: Appendix 1A***) as the combined impacts have been assessed through other disciplines (e.g. the combined impact of the Scheme and an increase in heavy precipitation events on flood risk and Site drainage has been covered in the drainage strategy and flood risk assessment).

6.2 Legislation and Planning Policy

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

Legislation

- Climate Change Act 2008 (Ref 6-2);
- Climate Change Act 2008 (2050 Target Amendment) Order 2019 (Ref 6-3); and
- Carbon Budgets Order (2009) (Ref 6-4).

National Planning Policy

6.2.2 As outlined in **Section 1.3** of ***Chapter 1: Introduction***, the EIA for the Scheme must have regard to the relevant policies of the NPPF and relevant NPSs.. Key aspects of the NPPF and relevant NPSs, which have been considered during the development of this chapter, are outlined below.

- NPS EN-1 (Ref 6-5), with particular reference to paragraphs 2.2.9 and 4.8.2 in relation to climate impacts and adaptation; paragraphs 4.1.3 to

4.1.4 in relation to adverse effects and benefits; paragraphs 4.2.1, 4.2.3, 4.2.4, 4.2.8 to 4.2.10 and 5.1.2 in relation to EU Directive and ES requirements; paragraphs 4.5.3 and 4.8.1 to 4.8.12 in relation to adaptation measures in response to climate projections; and paragraphs 5.7.1 to 5.7.2 in relation to climate projections, flood risk and the importance of relevant mitigation.

- NPS EN-3 (Ref 6-6) – paragraph 2.3.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.3.5 in relation to ES requirements regarding climate change resilience.
- NPS EN-5 (Ref 6-7) – paragraph 2.4.1 regarding NPS EN-1 and the importance of climate change resilience, and paragraph 2.4.2 in relation to ES requirements regarding climate change resilience.
- NPPF (Ref 6-8) – paragraphs 8, 20 and 149 in relation to adaptation, mitigation and climate change resilience; paragraphs 148 and 157 in relation to flood risk and damage to property and people; paragraphs 150 and 153 in relation to reduction of CO_2 emissions through design and reduced energy consumption; and paragraphs 155 to 165 in relation to climate projections, associated flood risk and adaptation.

National Guidance

- Planning Practice Guidance for Climate Change (March 2019) (Ref 6-9).

Local Planning Policy

- East Cambridgeshire District Local Plan Adopted April 2015 (Ref 6-10), with particular reference to Policy ENV 4: Energy and water efficiency and renewable energy in construction, Policy ENV 6: Renewable energy development and ENV 8: Flood risk.
- Forest Heath District Council Core Strategy Adopted 2010 (Ref 6-11), with particular reference to Spatial Objective ENV 1, in relation to climate change, emissions reductions and water efficiency; Spatial Objective ENV 7 in relation to sustainable infrastructure; and Policy CS 4 in relation to emissions reductions and mitigation and adaptation to future climate change.
- Forest Heath and St Edmundsbury Councils: Joint Development Management Policies Document (last updated February 2015) (Ref 6-12), with particular reference to Policy DM7: Sustainable Design and Construction, and Policy DM8: Low and Zero Carbon Energy Generation.

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

6.2.4 Local planning policies for the Forest Heath and East Cambridgeshire districts identify the need to consider GHG emissions at all stages of a development’s lifecycle. New development should aim for reduced or zero carbon development by incorporating renewable or low carbon energy sources and maximising energy and water efficiency where practicable.

6.3 Assessment Assumptions and Limitations

6.3.1 This preliminary assessment is based on baseline and Scheme design information available at the time of writing this PEI Report. A final assessment is being undertaken as part of the EIA and will be reported in the ES that will be submitted with the DCO submission.

6.3.2 This section outlines the limitations of the data used, and any key assumptions made within the GHG calculations.

6.3.3 Vegetation will be retained as far as possible, while vegetation planting is also proposed, including planting of hedgerows, tree buds and grass beneath the solar PV modules. Therefore, it has been assumed that overall loss of vegetation will be minimal.

6.3.4 A detailed construction programme including estimates of plant operating hours is not yet available. For the purpose of this assessment it has been assumed that the plant types required for construction will be operating for 50% of the time during construction shifts, which are 12 hours per day, 5 days per week. Thumper attachments were also listed in the plant data provided, therefore, an extra 25% ‘on-time’ has been applied to the 360º dumpers to account for operation of the thumper attachments. The ‘on-time’ of each type of plant has been used in combination with the associated kW rating to estimate total energy use and therefore diesel requirements and associated GHG emissions.

6.3.5 A 1-way distance of 30km per journey has been assumed for the worker transportation calculations, which is a conservative estimate as, where possible, staff will be located within 30km of the DCO Site according to data provided by the Applicant’s design team. The Defra 2020 emissions factors for ‘Average car’ and ‘Average van’, including well-to-tank (WTT) emissions[1], have been applied to this distance and total worker numbers to calculate GHG emissions associated with worker transport.

6.3.6 HGV and sea freight distances assumed for transportation of materials and waste are outlined below. The country of origin has been provided by the Applicant’s design team for each of the key assets of the Scheme, and assumptions have been made around the specific ports used based on proximity to relevant manufacturing facilities within each country.

- HGV transport of materials within China prior to sea freight transportation – 150km (based on the average distance of a number of major manufacturing centres in and around Shanghai to the nearest port);
- HGV transport of materials within South Korea prior to sea freight transportation – 50km (based on the proximity of various BESS manufacturers to the nearest port);

[1] Well-to-tank emissions, also known as upstream or indirect emissions, are the GHG emissions released into the atmosphere from the production, processing and delivery of a fuel to the point of use.

- HGV transport of materials within Europe, including distance prior to, and following, sea freight transportation – 1,600km (based on half of the reasonable maximum distance equipment might be transported within Europe, plus the distance between Dover and the DCO Site);
- HGV transport of materials following sea freight transportation from China or South Korea – 200km (based on the road distance between Dover and the Site);
- Sea freight distance from China to England – 21,880km (based on the sea freight distance between Shanghai and Dover);
- Sea freight distance from South Korea to England – 22,920km (based on the Sea freight distance between Port of Jinhai and Dover); and
- Sea freight distance from Europe to England – 50km (based on the sea freight distance between Calais and Dover).

6.3.7 For HGV transportation of materials, the Defra 2020 emissions factor for 'Rigid HGV – 7.5-17t' has been applied, including WTT emissions. It has been assumed that HGVs are 100% laden[2].

6.3.8 For sea freight transportation, the Defra 2020 emissions factor for 'Products tanker – Average' has been applied, including WTT emissions.

6.3.9 For HGV transportation of waste, the Defra 2020 emissions factor for 'Rigid HGV – 7.5-17t' has been applied, including WTT emissions. It has been assumed that HGVs are on average 50% laden as they will be empty travelling to the DCO Site, and 100% laden for the return journey.

6.3.10 To calculate GHG emissions associated with waste treatment during construction, a conservative assumption that 50% of waste will be recycled, while 50% will be sent to landfill, has been applied, and the appropriate Defra 2020 emissions factors have been used.

6.3.11 To calculate the embodied carbon within transformers, the material breakdown of transformers reported in a lifecycle assessment produced by Harrison *et al* (2010) (Ref 6-13) was used as a benchmark to estimate material quantities associated with the transformers required for the Scheme. This breakdown assumes 52.7% of each transformer, by weight, is steel, 13.8% is copper, 21.7% is oil, and 11.9% is 'other'. It has been assumed for the purposes of this assessment that 'other' comprises equal quantities of plastic, aluminium, glass, iron, paint and rubber.

6.3.12 For the embodied carbon within the panels, PV inverters and battery energy storage systems (BESS) inverters, embodied energy benchmarks reported by Rajput and Singh (2017) (Ref 6-14) have been applied to the current Scheme specifications. The embodied energy was then converted from kilowatt hours (kWh) to kilograms of CO_2 equivalent (kgCO_2e) using the energy intensity of the countries in which they are produced (Ref 6-15; Ref 6-16), assuming that the energy used in the factories is predominantly

[2] HGVs are assumed to be 100% laden here, but an average of 50% laden for the waste transportation calculations. The apparent difference in assumptions is a result of the units used within the calculations. For example, for waste transportation, the total distance (km) travelled by HGVs for both legs of journey is used to estimate GHG emissions (kgCO_2e/ km). However, for transportation of materials, the 'tonne km' (i.e. total tonnes multiplied by the total km travelled to the DCO Site) is used. Therefore, if HGVs were assumed to be 50% laden using the tonne km unit, this would lead to a significant overestimation as double the HGVs would be required for the same quantity of materials.

electricity. The benchmarks and relevant energy intensities used are outlined in Table 6-1 below.

6.3.13 The embodied carbon of switchgear was estimated using a benchmark reported by FutureFirma (Ref 6-17), while the embodied carbon of lithium ion batteries was estimated using a benchmark reported by Philippot et al (2019) (Ref 6-18). These embodied carbon benchmarks are outlined in Table 6-1 below.

Table 6-1: Embodied energy benchmarks and emissions intensities assumed[3]

Asset	Embodied energy/ GHG benchmark	Country	Emissions intensity
Modules	980 kWh/ m^2	China	0.57 $kgCO_2e$/ kWh
PV inverters	210 kWh/ kw	Europe	0.295 $kgCO_2e$/ kWh
BESS inverters	210 kWh/ kw	China	0.57 $kgCO_2e$/ kWh
Switchgears	175 $kgCO_2e$/ kV	N/a	N/a
Li-ion batteries	155 $kgCO_2e$/ kWh	N/a	N/a

6.3.14 To estimate the embodied carbon within cabling, it has been assumed that 60% of the total cable weight is aluminium, while 40% is plastic.

6.3.15 For GHG emissions associated with replacing broken components during the operation stage, the following part replacement rates were applied to the product and transportation emissions calculated for the construction phase:

- Modules – 0.2%
- PV inverters – 4.4%
- BESS inverters – 3.1%
- Transformers – 1.8%
- Medium voltage (MV) switchgear – 0.8%
- Module structures – 0.1%

6.3.16 As the emissions associated with the other construction activities (e.g. plant fuel use, water and energy use, worker transportation and waste management) are not available broken down by asset, it was not possible to apply the part replacement rates to these figures. Instead, the total embodied and transportation emissions estimated for the maintenance phase have been prorated up based on the proportion of embodied and

[3] For modules, PV inverters and BESS inverters, the methodology used provided the embodied energy (kWh required to produce each unit of the asset). The emissions intensity of the country in which they were produced was used to estimate kgCO2e as a result of using this energy. However, for switchgears and li-ion batteries, the methodology used provided a kgCO2e figure, so no conversion using the emissions intensity was necessary.

transportation emissions during construction (86% share). Therefore, the maintenance estimate incorporates emissions from all associated activities.

6.3.17 Operational energy generation data was provided by the Applicant's design team. This data accounts for efficiency losses of the panels over time based on an initial degradation factor of 2.5% for the first year, and 0.55% degradation for each subsequent year to the end of the warranty of the panels (30 years). In order to model efficiency losses over the entire assessed lifetime of 40 years, this 0.55% degradation rate has also been applied to the final 10 years of the operational lifetime.

6.4 Assessment Methodology

6.4.1 The methodologies described in the following section have been developed in line with the relevant planning policy (see **Section 6.2**) and appropriate industry guidance for assessing GHGs (Ref 6-19) and considering climate change resilience and adaptation (Ref 6-20) in EIA.

6.4.2 While the lifecycle GHG impact assessment assesses the significance of the GHG impact of the Scheme, the CCR review does not assess the significance as only a review of the impacts is required in line with the IEMA guidance (Ref 6-20).

Study Area

Lifecycle GHG Impact Assessment

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

Climate Change Resilience Review

6.4.4 The study area for the CCR review is the DCO Site i.e. it covers all assets and infrastructure which constitute the Scheme, during construction, operation (including maintenance) and decommissioning.

Sources of Information

Lifecycle GHG Impact Assessment

6.4.5 Where available, data required to undertake the lifecycle GHG impact assessment was provided by the project design team and analysed using the methodology outlined below in this section. Where data was unavailable, reasonable assumptions have been made based on professional judgement, details of which are outlined in **Section 6.3**.

Climate Change Resilience Review

6.4.6 Historic climate data obtained from the Met Office website (Ref 6-21) and UK Climate Projections 2018 (UKCP18) (Ref 6-22) data were also obtained to determine the historic and future baseline conditions.

6.4.7 CCR measures that have been built into the Scheme design were determined through liaison with the project design team and relevant environmental discipline leads.

Impact Assessment Methodology

Lifecycle GHG Impact Assessment

6.4.8 The potential effects of the Scheme on the climate during construction are calculated in line with the GHG Protocol (Ref 6-23) and the GHG 'hot spots' (i.e. materials and activities likely to generate the largest amount of GHG emissions) have been identified. This has enabled priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA's Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (Ref 6-19).

6.4.9 This lifecycle approach considers emissions from the following lifecycle stages of the Scheme: construction stage, operation stage (including maintenance) and decommissioning stage.

6.4.10 Where activity data has allowed, expected GHG emissions arising from the construction, operational and decommissioning activities, and embodied carbon in materials of the Scheme, have been quantified using a calculation-based methodology as per the following equation as stated in the Defra 2020 emissions factors guidance (Ref 6-24):

Activity data x GHG emissions factor = GHG emissions value

6.4.11 In line with 'The GHG Protocol' (Ref 6-23), when defining potential impacts (or 'hot spots'), the seven Kyoto Protocol GHGs have been considered, specifically:

1. Carbon dioxide (CO_2);
2. Methane (CH_4);
3. Nitrous oxide (N_2O);
4. Sulphur hexafluoride (SF_6);
5. Hydrofluorocarbons (HFCs);
6. Perfluorocarbons (PFCs); and
7. Nitrogen trifluoride (NF_3).

6.4.12 These GHGs are broadly referred to in this chapter under an encompassing definition of 'GHG emissions', with the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (Megatonnes of CO_2 equivalent).

6.4.13 Where data is not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-19).

6.4.14 Table 6-2 summarises the key anticipated GHG emissions sources associated with the Scheme.

Table 6-2: Potential sources of GHG emissions

Lifecycle stage	Activity	Primary emission sources
Product stage	Raw material extraction and manufacturing of products required to build the equipment for the Scheme. Due to the complexity of the manufacturing processes and design of the equipment, and the use of materials with high embodied carbon, this stage is expected to make a significant contribution to overall GHG emissions. Transportation of materials for manufacturing.	Embodied GHG emissions from energy use in extraction and production. Emission of potent GHGs during manufacture, such as sulphur hexafluoride (SF_6). GHG emissions from vehicle use.
Construction process stage	On-site construction activity including emissions from construction compounds. Transportation of construction materials (where these are not included in embodied GHG emissions). Due to the nature of the equipment required, this could require shipment of certain aspects over significant distances. Transportation of construction workers.	Energy (electricity, fuel, etc.) consumption from plant and vehicles, generators on-site, and construction worker commuting. Fuel consumption from transportation of materials to the DCO Site (where these are not included in embodied GHG emissions). GHG emissions from transportation of workers to the DCO Site.
Construction process stage (cont.)	Disposal of any waste generated by the construction processes. Land use change. Water use.	GHG emissions from disposal and transportation of waste. GHG emissions from net loss of carbon sink. Provision of potable water, and treatment of wastewater.
Operation stage	Operation of the Scheme. Maintenance of the Scheme.	GHG emissions from energy consumption, provision of potable water, and treatment of wastewater. These operational aspects are expected to be negligible in the context of overall GHG emissions. Leakage of potent GHGs during operation, such as SF_6 (derived from certain electric items such as gas-insulated switchgears and gas-insulated transformers during production, operation through leakage, and dismantling). GHG emissions from energy consumption, material use and waste generation as a result of site

Lifecycle stage	Activity	Primary emission sources
		maintenance. Maintenance is generally expected to be insignificant, however if part replacement is required this has the potential to be significant given the complexity of the equipment required.
Decommissioning stage	On-site decommissioning activity. Transportation and disposal of waste materials. Transportation of workers.	Energy (electricity, fuel, etc.) consumption from plant, vehicles and generators on site. GHG emissions from disposal and transportation of waste. This has the potential to be significant given the complexity of the design of the equipment, and the use of materials with high associated waste treatment emissions. GHG emissions from transportation of workers to the DCO Site.

Climate Change Resilience Review

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

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

6.4.17 The review of potential impacts and the Scheme's vulnerability considers the mitigation measures that have been designed into the Scheme, discussed in **Section 6.7**.

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

Significance Criteria

6.4.19 Due to the absence of any defined industry guidance for assessing the magnitude of GHG impacts for EIA, standard GHG accounting and reporting principles have been followed to assess impact magnitude. According to the IEMA guidance on assessing GHG emissions in EIA (Ref 6-19), "*GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant*".

6.4.20 The IEMA guidance (Ref 6-19) also states it is down to the professional judgment of the practitioner to determine how best to contextualise a project's GHG impact and assign the level of significance. It is suggested that sectoral, local or national carbon budgets can be used, as available and appropriate, to contextualise a project's GHG impact and determine the level of significance. The approach adopted for the purposes of this assessment is outlined below.

6.4.21 In GHG accounting it is common practice to consider exclusion of emission sources that are <1% of a given emissions inventory on the basis of a *'de minimis'* contribution. Both Department of Energy and Climate Change (DECC) (Ref 6-25) and the PAS 2050 (2011) Specification (Ref 6-26) allow emissions sources of <1% contribution to be excluded from emission inventories, and these inventories to still be considered complete for verification purposes.

6.4.22 Where available, UK national carbon budgets have been used for the purposes of this assessment to represent future emissions inventory scenarios for the UK. These legally binding targets outline the total amount of GHGs that the UK can emit over a 5-year period.

6.4.23 However, UK National carbon budgets are not currently available beyond 2032 (Ref 6-27). Therefore, a qualitative approach has been taken for assessing the significance of GHG emissions arising as a result of the Scheme for the years beyond 2032. A quantitative approach is not possible beyond 2032 as although the carbon budgets are set to decrease over time, there will still be permitted GHG emissions beyond 2050, but with offsetting measures in place to ensure net emissions are zero. Therefore, the rate at which they will decrease is not known, so it is not possible to predict the quantity of emissions permitted within the carbon budgets beyond 2032.

6.4.24 It should be noted that the available carbon budgets are based on the previous UK Government target of an 80% reduction in GHG emissions by 2050, rather than the current net zero target for 2050 (Ref 6-3). Therefore, when the 6th carbon budget is published (anticipated December 2020), the 4th and 5th carbon budgets may be revised to reflect this new target (Ref 6-28). If available, these revised and additional carbon budgets will be considered within the ES.

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

6.4.26 This approach has been used to assess the magnitude of the GHG impact associated with the Scheme and the associated criteria are outlined in Table 6-3. This differs from the standard criteria used in the EIA process by omitting the 'Very Low' and 'Medium' categories for magnitude. This is because the magnitude of the impact is determined by a boundary of less than, or equal to or more than, 1% of the carbon budgets.

Table 6-3: Magnitude Criteria for GHG Impact Assessment

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

6.4.27 The UK carbon budgets are in place to restrict the amount of greenhouse emissions the UK can legally emit in a five-year period (Ref 6-27). The UK is currently in the 3rd carbon budget period, which runs from 2018 to 2022.

6.4.28 The appropriate UK national carbon budgets that span the construction programme of the Scheme, taking account of the ongoing construction works (2022 to 2025) are the 3rd and 4th carbon budgets (2018 to 2022 and 2023 to 2027, respectively). For the purposes of attributing construction GHG emissions proportionately between the 3rd and 4th carbon budgets, the 24-month construction programme is assumed to run for 3 months during 2022, 12 months during 2023 and 9 months during 2024. However, this is not certain at this stage in the design. These assumptions will therefore be reviewed and updated as appropriate at the ES stage.

6.4.29 Where possible, the operational phase of the Scheme (fully operational by 2025) has been compared to all the appropriate and available carbon budgets within the design life of the Scheme: the 4th and 5th carbon budgets (2023 to 2027 and 2028 to 2032, respectively). While the Scheme will be operational beyond this time, the budgets are only available to 2032. Therefore, beyond 2032, a qualitative approach has been adopted, using professional judgement to determine the significance of the impact of GHG emissions arising as a result of the Scheme.

6.4.30 Table 6-4 shows the current and future UK carbon budgets up to 2032, which highlights a reduction in the amount of greenhouse gas the UK can legally emit in the future. This means that any source of emissions contributing to the UK's carbon inventory will have a greater impact on the UK carbon budgets in the future.

Table 6-4: Relevant Carbon Budgets for this Assessment

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

6.4.31 The significance of effects has been determined using the matrix in Table 6-5. The sensitivity of the receptor (global climate) to increases in GHG emissions is always considered 'High', and the magnitude of the impact is determined by a boundary of less than, or equal to or more than, 1% of the carbon budgets (i.e. minor or major).

6.4.32 This is in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-19) which states that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments. It is therefore considered that any emissions, or emissions reductions, as a result of the Scheme might be considered significant. For the purposes of this assessment, the magnitude of significance will be determined using the criteria outlined in Table 6-5.

Table 6-5: Significance of Effects Matrix for GHG Impact Assessment

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

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

6.5 Stakeholder Engagement

6.5.1 Stakeholders for the Scheme include statutory consultees, land managers, landowners, academics and local communities. In addition to the statutory consultation process, there will be ongoing engagement with statutory and formal consultees to steer the development of the Scheme.

6.5.2 Consultation undertaken to date in relation to climate change is outlined in Table 6-6.

Table 6-6: Main matters raised during consultation

Consultee	*Main matter raised*	*How has the concern been addressed*	*Location of response in chapter*
Planning Inspectorate	The ES should include a description and assessment (where relevant) of the likely significant effects the Scheme has on climate and the vulnerability of the project to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Scheme.	This has been addressed within this PEI Report, and will be addressed within the ES	See Section 6.1, Section 6.8 and Section 6.9 of this Chapter
Planning Inspectorate	The Scoping Report refers to an 'in-combination' climate change assessment but it does not relate to impacts with other developments and	An ICCI assessment is separate to a cumulative assessment. An ICCI assessment considers the combined impact of the	See Section 6.1 of this Chapter

Consultee	*Main matter raised*	*How has the concern been addressed*	*Location of response in chapter*
	instead refers to the impact the Scheme will have on future climate change predictions. This should be clarified within the ES.	Scheme and future climate change on receptors, as identified by other environmental assessments in the ES. The purpose of an ICCI is not to assess the cumulative impact of the Scheme with other developments. The ICCI assessment has been scoped out of this assessment.	
Planning Inspectorate	It is unclear how the GHG impact assessment will determine which other forms of electricity production activities "may be avoided or displaced" as a result of the Scheme. The GHG impact assessment within the ES should describe any assumptions made to determine other electricity production activities and explain what is meant by being "avoided or displaced" as result of the Scheme.	The GHG intensity of the Scheme is compared to the GHG intensity of natural gas, nuclear and onshore and offshore wind energy generation. To put the Scheme into the context of current and future UK grid electricity generation a comparison has also been made between the Scheme and the projected GHG intensity of UK Grid electricity to 2050.	See Section 6.8 of this Chapter
Planning Inspectorate	The Scoping Report states the GHG impact assessment will use a "business as usual" approach where the Scheme is not built but also states the baseline will include "emissions that may be avoided as a result of the Scheme". The ES should clarify this matter and explain how these two approaches are used in tandem to inform a "business as usual" baseline.	It is anticipated that baseline GHG emissions will not be material in the context of the overall Scheme. The wording of the description of baseline conditions has been amended within this PEI Report to ensure clarity.	See Section 6.6 of this Chapter
Planning Inspectorate	The Scoping Report states that the Scheme will be 'designed to be as resilient as reasonably practicable to future climate change'. The Scoping Report does not elaborate on this point making it unclear and ambiguous. The ES should clearly describe and assess measures incorporated to adapt to	Climate change adaptation measures built into the Scheme have been described within this PEI Report.	See Section 6.8 and Section 6.9 of this Chapter

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
	climate change.		
Planning Inspectorate	The Applicant should ensure that assumptions used to assess climate change are based on the worst-case scenario and are clearly stated within the ES.	A conservative, worst-case approach has been followed within the GHG calculations. Assumptions made are described in Section 6.3.	See Section 6.3 of the Chapter
East Cambridge-shire District Council	To gain a true reflective understanding of the benefits/harm to the Environment, the GHG emissions associated with the Scheme should be compared to at least one fossil fuel, nuclear and at least one alternative renewable energy.	The energy intensity (gCO_2e/kWh) of the Scheme is compared to energy intensity ranges for natural gas, nuclear and onshore and offshore wind. The Scheme has also been compared with the projected average GHG intensity through to 2050.	See Section6.8 of this Chapter
East Cambridge-shire District Council	The location of the upgraded Burwell substation is in area of Flood Defences, it will be important that any climate change resilience considers what would happen if these flood defences were to fail; this might need to reflect on potential sea level changes due to the nature of the fen landscape (much of it below sea level).	Flood risk is assessed in the Flood Risk Assessment (FRA) to be submitted alongside the PEI Report. The FRA considers the impacts of sea level rise on the Burwell substation site. Sea level rises are not anticipated to affect the remainder of the DCO Site.	N/a
Natural England	The ES should identify how the Scheme's effects on the natural environment will be influenced by climate change, and how ecological networks will be maintained.	This is included within **Chapter 8 Ecology** of the PEI Report.	N/a
Cambridge-shire County Council (Mobilising Local Energy Investment)	Within the scoping report, temperature change has been identified as out of scope. This may be the case globally, but it may be worth considering local/microclimate temperature changes associated with significant levels of solar PV panels.	Local/microclimate temperature changes are considered within **Chapter 8 Ecology**.	N/a

6.6 Baseline Conditions

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

Lifecycle GHG Impact Assessment

6.6.2 The land within the DCO Site consists mainly of arable land, managed hedgerows and trees. Trees are present individually in some areas as well as rows of trees and small woodland areas. The abundance of vegetation within the Scheme suggests a relatively high carbon sink potential. Also, the current use of the Scheme has minor levels of associated GHG emissions as the land use is largely agricultural. Baseline agricultural GHG emissions are dependent on soil and vegetation types present, and fuel use for the operation of agricultural vehicles and machinery.

6.6.3 For the lifecycle GHG impact assessment, the baseline is a ‘business as usual’ scenario whereby the Scheme is not implemented, for those lifecycle stages that have been scoped into the assessment, presented in Table 6-2. The baseline comprises existing carbon stock and sources of GHG emissions within the DCO Site from the existing activities on-site.

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

Climate Change Resilience Review

Current Baseline

6.6.5 The current baseline for the CCR is the current climate in the location of the Scheme. Historic climate data obtained from the Met Office website (Ref 6-21) recorded by the closest meteorological station to the Scheme (Brooms Barn climate station) for the 30-year climate period of 1981-2010 is summarised in Table 6-7 below.

Table 6-7: Historic climate data

Climatic Factor	Month	Figure
Average annual maximum daily temperature (°C)	-	14.0
Warmest month on average (°C)	July	22.2
Coldest month on average (°C)	February	1.2
Mean annual rainfall levels (mm)	-	631.8
Wettest month on average (mm)	August	62.9
Driest month on average (mm)	February	39.2

6.6.6 The Met Office historic 10-year averages for the East Anglia region identify gradual warming (although not uniformly so) between 1969 and 2018, with increased rainfall. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in Table 6-8.

Table 6-8: Historic 10-year averages for temperature and rainfall for the East Anglia region

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

Future Baseline

6.6.7 The future baseline is expected to differ from the present-day baseline described above. UKCP18 provides probabilistic climate change projections for pre-defined 20-year periods for annual, seasonal and monthly changes to mean climatic conditions over land areas. For the purpose of the assessment, UKCP18 probabilistic projections for pre-defined 20-year periods for the following average climate variables have been obtained and will be further analysed and reported in the Environmental Statement for the Scheme:

- mean annual temperature;
- mean summer temperature;
- mean winter temperature;
- maximum summer temperature;
- minimum winter temperature;
- mean annual precipitation;
- mean summer precipitation;
- mean winter precipitation;
- mean annual cloud cover;
- mean summer cloud cover; and
- mean winter cloud cover.

6.6.8 Projected temperature, precipitation and cloud cover variables are presented in Table 6-9, Table 6-10 and

6.6.9 Table 6-11, respectively. UKCP18 probabilistic projections have been analysed for the 25km^2 grid square within which the Scheme is located. These figures are expressed as temperature/ precipitation anomalies in relation to the 1981-2000 baseline.

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

6.6.11 As the design life of the Scheme is at least 40 years, the CCR assessment has considered a scenario that reflects a high level of GHG emissions at the 10%, 50% and 90% probability levels up to 2069[4] to assess the impact of climate change over the assessed lifetime of the Scheme.

Table 6-9: Projected changes in temperature variables (°C)

Climate Variable	Time Period	
	2020-2039	2050-2069
Mean annual air temperature anomaly at 1.5 m (°C)	+1.0 (+0.3 to +1.7)	+2.3 (+1.1 to +3.6)
Mean summer air temperature anomaly at 1.5 m (°C)	+1.3 (+0.4 to +2.2)	+2.9 (+1.0 to +4.8)
Mean winter air temperature anomaly at 1.5 m (°C)	+0.9 (-0.1 to +1.9)	+2.1 (+0.6 to +3.6)
Maximum summer air temperature anomaly at 1.5 m (°C)	+1.4 (+0.2 to +2.7)	+3.3 (+0.9 to 5.8)
Minimum winter air temperature anomaly at 1.5 m (°C)	+0.9 (-0.1 to +1.9)	+2.1 (+0.5 to +3.8)

[4] Climate projections are available for various 20-year time periods. 2050-2069 is the closest period to the final year of decommissioning (2066).

Table 6-10: Projected changes in precipitation variables (%)

Climate Variable	Time Period	
	2020-2039	2050-2069
Annual precipitation rate anomaly (%)	+0 (-5 to +6)	-3 (-11 to +5)
Summer precipitation rate anomaly (%)	-7 (-31 to +18)	-23 (-51 to +6)
Winter precipitation rate anomaly (%)	+5 (-4 to +16)	+12 (-4 to +30)

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

Climate Variable	Time Period	
	2020-2039	2050-2069
Annual total cloud anomaly (%)	-2.3 (-5.8 to +0.9)	-4.5 (-10.1 to +1.2)
Summer total cloud anomaly (%)	-4.8 (-12.8 to +2.4)	-10.8 (-24.7 to +2.9)
Winter total cloud anomaly (%)	+0 (-1.5 to +1.5)	+0.5 (-1.6 to +2.5)

Summary of Sensitive Receptors

6.6.12 Based on a review of the baseline conditions, the global climate is the receptor for the lifecycle GHG impact assessment. The sensitivity of this receptor is high, in line with the IEMA guidance on assessing GHG emissions in EIA (Ref 6-19), which highlights the importance of mitigating GHG emissions to reduce the impacts of climate change.

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

6.7 Embedded Design Mitigation

6.7.1 Various GHG mitigation measures are embedded within the Scheme and are included within the Framework Construction Environmental Management Plan (CEMP; see Appendix 16C). This embedded mitigation has been implemented to reduce the GHG impact of the Scheme. Specific embedded mitigation measures include:

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

- Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHGs, from the Scheme by employing best practice measures which go beyond statutory compliance;
- Designing, constructing and implementing the Scheme in such a way as to minimise the creation of waste and maximise the use of alternative materials with lower embodied carbon such as locally sourced products and materials with a higher recycled content;
- Reusing suitable infrastructure already available on site where possible to minimise the use of natural resources and unnecessary materials (e.g. reusing excavated soil for fill requirements) ;
- Encouraging the use of lower carbon modes of transport by identifying and communicating local bus connections and pedestrian and cycle access routes to/ from the Scheme to all construction staff, and providing appropriate facilities for the safe storage of cycles;
- Liaising with construction personnel for potential to implement staff minibuses and car sharing options;
- Implementing a Travel Plan to reduce the volume of construction staff and employee trips to the Scheme;
- Switching vehicles and plant off when not in use and ensuring construction vehicles conform to current EU emissions standards; and

6.7.2 Regular planned maintenance of the Scheme will also be conducted during operation to optimise efficiency.

6.7.3 The Framework CEMP (see Appendix 16C) also includes various climate change resilience measures embedded within the Scheme. These include:

- Storing topsoil and other construction materials outside of the 1 in 100-year floodplain extent (Flood Zone 3), as far as reasonably practicable; and
- Appointing at least one designated Flood Warden who is familiar with the risks and remains vigilant to news reports, Environment Agency flood warnings and water levels of the local waterways.

6.7.4 A Decommissioning Plan including similar measures to the framework CEMP will be developed prior to the decommissioning phase to encourage the use of lower-carbon and more climate change resilient methods. It would not be appropriate to develop such requirements now as the decommissioning environment beyond 2065 is likely to be considerably different to today.

6.7.5 Further climate change resilience measures embedded within the Scheme, particularly in relation to flood risk, are outlined below. The specific flood risk impacts and associated mitigation measures are discussed in more detail in ***Chapter 9: Flood Risk, Drainage and Water Resources***.

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

- SuDS features will be utilised to ensure the surface water drainage strategy adequately attenuates and treats runoff from the Scheme, whilst minimising flood risk to the DCO Site and surrounding areas; and
- PV sites and grid connection routes are being designed to ensure no floodplain storage is lost. There are some PV cells within areas of Flood Zone 3a, but these are raised up and will not reduce floodplain storage.

6.7.6 Health and safety plans developed for construction and decommissioning activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves.

6.8 Assessment of Likely Impacts and Effects

6.8.1 The impacts and effects (both beneficial and adverse) associated with the construction, operation (including maintenance) and decommissioning of the Scheme are outlined in the sections below. The assessments have been assessed following consideration of the embedded mitigation measures as described in **Section 6.7**.

Lifecycle GHG Impact Assessment

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

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

6.8.4 Therefore, the net impact of the Scheme is also identified and assessed, taking into account the renewable energy generation and the benefit of this in the context of the wider energy generation sector and the National Grid average GHG intensity. This overall assessment, which accounts for all GHG emissions over the assessed lifetime of the Scheme, compares the Scheme’s GHG intensity to the National Grid average GHG intensity to quantify the net GHG impact of the Scheme compared with other predicted grid energy generation sources.

Construction (2022 to 2025)

6.8.5 The greatest GHG impact during the construction phase is as a result of embodied carbon in construction materials which accounts for 74% of total construction emissions.

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

6.8.7 As discussed in **Section 6.3**, vegetation loss is anticipated to be minimal, and grass, hedgerow and tree planting is proposed. Therefore, based on professional judgement, the loss of carbon sink from land use change is not anticipated to have an impact on the overall outcome of the lifecycle GHG impact assessment and is therefore not included in the GHG calculation.

6.8.8 Total GHG emissions from the construction phase are estimated to equate to around 127,264 tCO_2e. A breakdown of estimated GHG emissions from the construction of the Scheme is presented in Table 6-12.

6.8.9 GHG emissions from construction activities will be limited to the duration of the construction programme (2 years). When annualised, the total annual construction emissions equate to around 63,632 tCO_2e.

Table 6-12: Construction GHG emissions

Emissions Source	Emissions (tCO_2e)	% of Construction Emissions
Products	94,061	74%
Water use	<1	<1%
Fuel use	2,896	2%
Transportation of materials & waste	19,847	16%
Worker transportation	5,643	4%
Waste treatment	4,816	4%
Total	**127,264**	**100%**

Operation (2025 to 2065)

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

6.8.11 Energy requirements for Scheme operation during the day, i.e. auxiliary services and standby power, will be directly met by energy generated by the Scheme. Therefore, the energy exported to the National Grid (net energy generation) has been calculated by subtracting these energy requirements from the gross energy generation from the Scheme.

6.8.12 Energy requirements for Scheme operation during the night, however, will be met by energy imported from the National Grid. Therefore, the night-time energy use will result in GHG emissions as a result of the production of grid electricity[5]. These emissions constitute the 'operation' emissions reported in Table 6-13.

[5] For the purposes of this assessment, operational GHG emissions have been estimated based on the UK grid GHG intensity projections (in line with the BEIS projections (Ref 6-32) and National Grid's Future Energy Scenarios for 2050 (Ref 6-33)).

6.8.13 Operational GHG emissions equate to approximately 878 tCO_2e in the first year of operation, as presented in Table 6-13. Annual operational emissions then decrease over time as the grid decarbonises, equating to approximately 26,897 tCO_2e over the 40-year design life.

Table 6-13: Operational GHG emissions (based on the first year of operation)

Emissions Source	Emissions (tCO_2e)	% of Operation Emissions
Worker transportation	24	2%
Maintenance	349	28%
Operation	878	70%
Total	**1,250**	**100%**

6.8.14 While sulphur hexafluoride (SF_6) is a potential source of GHG emissions over the lifetime of the Scheme (i.e. derived from certain electric items such as gas-insulated switchgears and gas-insulated transformers during production, operation through leakage, and dismantling), it has not been possible to quantify fugitive emissions from the leakage of SF_6 due to insufficient data. SF_6 is one of the seven GHGs identified by the Kyoto Protocol (Ref 6-29) due to its high Global Warming Potential (GWP) of 23,900.

6.8.15 However, it is not anticipated that SF_6 emissions will significantly affect the overall outcome of this assessment. For example, total annual SF_6 emissions from the National Grid Transmission Network in 2015-2016 equated to 216,645 tCO_2e (Widger and Haddad, 2018; Ref 6-30), and are assumed to be similar each year. As the Scheme will provide less than 0.5% of total generation capacity to the National Grid Transmission Network, and as switchgears and transformers are not limited to power generation facilities but can be found all across the network, it is anticipated that the Scheme's contribution to this total will be minimal.

6.8.16 The operational GHG footprint is considered to reflect a robust worst-case as the calculations for worker transportation and maintenance have been carried out using current emissions factors. However, embodied carbon and emissions associated with energy and fuel use throughout the supply chain are anticipated to be lower in the future as a result of grid decarbonisation and machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050.

Decommissioning (2065 to 2067)

6.8.17 The greatest GHG impacts during the decommissioning phase are as a result of transportation of waste and fuel use on site, which account for 42% and 38% of total decommissioning emissions, respectively.

6.8.18 Other sources of emissions during decommissioning within the scope of the GHG emissions assessment include water use for decommissioning activities, transportation of construction workers to and from the Scheme and waste disposal.

6.8.19 Total GHG emissions from the decommissioning phase are estimated to equate to 7,608 tCO_2e. A breakdown of estimated GHG emissions from the decommissioning of the Scheme is presented in Table 6-14.

6.8.20 GHG emissions from decommissioning activities will be limited to the duration of the decommissioning programme (2 years). When annualised, the total annual decommissioning emissions equate to 3,804 tCO_2e.

Table 6-14: Decommissioning GHG emissions

Emissions Source	Emissions (tCO_2e)	% of Decommissioning Emissions
Water use	<1	<1%
Fuel use	2,896	38%
Transportation of materials & waste	3,161	42%
Worker transportation	327	4%
Waste treatment	1,223	16%
Total	**7,608**	**100%**

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

Overall

6.8.22 Total GHG emissions from the construction, operation, and decommissioning phases are estimated to be approximately 127,264 tCO_2e, 26,897 tCO_2e and 7,608 tCO_2e, respectively. Overall, this equates to GHG emissions of approximately 161,768 tCO_2e over the assessed lifetime of the Scheme.

Table 6-15: Lifetime GHG emissions

Lifecycle Stage	Emissions (tCO_2e)
Construction	127,264
Operation	26,897
Decommissioning	7,608
Total	**161,768**

6.8.23 Energy generation from the Scheme during the first year of operation is estimated to be 653,973 MWh. A 0.55% degradation factor has been applied for each subsequent year, resulting in an estimated energy generation figure of 527,408 MWh in the final year of operation, and a total energy generation figure of around 23,539,267 MWh over the 40-year assessed lifetime. It is possible this is a slightly conservative estimate, however, as future climate projections indicate a reduction in annual cloud cover over time (see **Section 6.6**), which may have a beneficial impact on the energy generation potential of the Scheme.

6.8.24 Based on the total energy generation and the lifecycle GHG emissions of 161,768 (see Table 6-15), the GHG intensity of the energy generated by the Scheme over its assessed lifetime is 6.87 grams of CO_2 equivalent per kWh (gCO_2e/kWh). This compares favourably with fossil fuel electricity generation and is comparable with other low carbon fuel. Table 6-16 outlines energy intensity ranges of alternative forms of energy generation (Ref 6-31).

Table 6-16: Comparison of energy intensities of various forms of energy generation

Energy Generation Type	GHG Intensity (gCO_2e/kWh)
Combined Cycle Gas Turbine (CCGT)	380-500
Nuclear	5-55
Offshore Wind	5-24
Onshore Wind	7-20

6.8.25 While this comparison is useful to contextualise the impact of the Scheme in relation to alternative forms of energy generation, it is not considered appropriate to only compare the GHG intensity of Scheme against individual energy generation types. In reality, the energy generated by this Scheme will contribute to electricity generated for the National Grid. Grid electricity generation comprises a mixture of energy generation types. The GHG intensity of the Scheme has therefore also been compared to the GHG intensity of the National Grid.

6.8.26 Plate 6-1 presents the GHG intensity of energy generation from the Scheme alongside forecast average Grid GHG intensity. Average GHG intensity presented in this figure is based on a combination of forecast data from BEIS (Ref 6-32) and National Grid (Ref 6-33). BEIS 2018 forecasts show a steady decrease in average grid intensity from 160gCO_2e/kWh in 2018 down to 41gCO_2e/kWh in 2035.

6.8.27 National Grid has produced GHG Grid intensity projections for four Future Energy Scenarios (FES) beyond 2030 to 2050, two of which are in line with the UK’s net zero carbon target for 2050. The first of these two scenarios, ‘Community Renewables’, is based on the large-scale uptake of small, community led renewable energy while the second scenario, ‘Two Degrees’, focuses on large centralised initiatives. As the most ambitious scenario, and therefore the ‘worst case’ in the context of determining GHG savings as a result of the Scheme, the Two Degrees scenario has been used for the purposes of this assessment.

6.8.28 The grid average GHG intensity forecast used in Plate 6-1 for 2050 is based on the ‘Two Degrees’ scenario which presents a forecast intensity of 13.9gCO_2e/kWh. Due to no other available interim data, a flat rate of reduction in intensity has been estimated from 2035 to 2050. This forecast decrease is predominantly due to an increased uptake of renewable energy and nuclear generation, while the use of fossil fuels to generate energy declines.

6.8.29 As no projections exist beyond 2050, the projected 2050 GHG intensity is assumed for the remainder of the assessed lifetime.

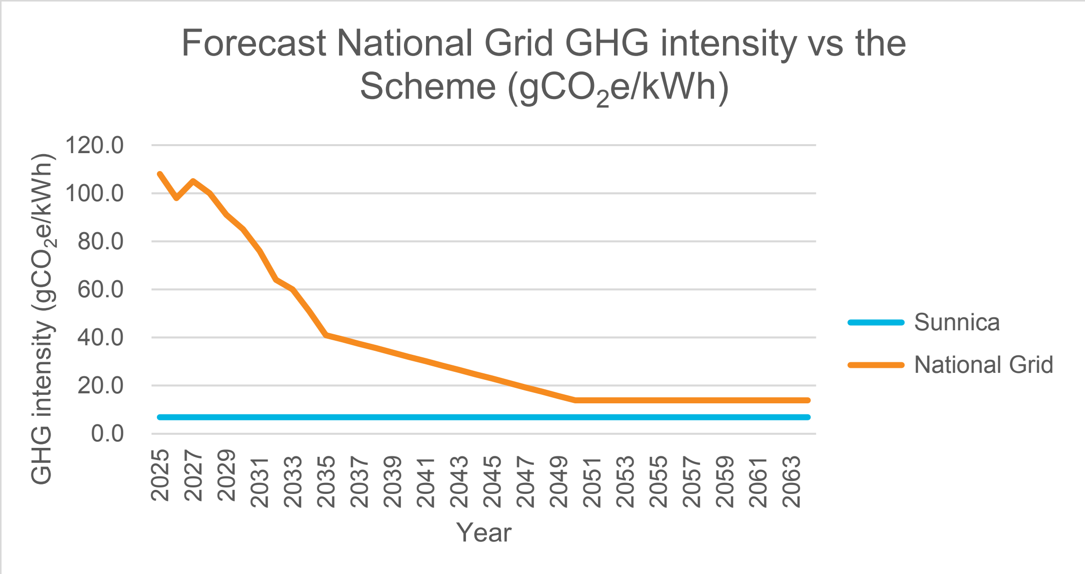

Plate 6-1: Forecast National Grid GHG intensity v the Scheme (gCO_2e/kWh) 2025-2065

6.8.30 Plate 6-1 demonstrates that the GHG intensity of the Scheme sits continually below the forecast grid average. This demonstrates the positive contribution energy generation from solar PV has to play in the transition to a low carbon economy.

6.8.31 The variation in GHG intensity between the projected National Grid average and the Scheme has been calculated for each year to determine the potential GHG emissions reductions as a result of the Scheme. Plate 6-2 demonstrates the GHG emissions reductions by year when compared against the projected grid GHG intensity as described above, based on the BEIS 2018 projections to 2035 and the National Grid FES 2019 Two Degrees scenario for 2050.

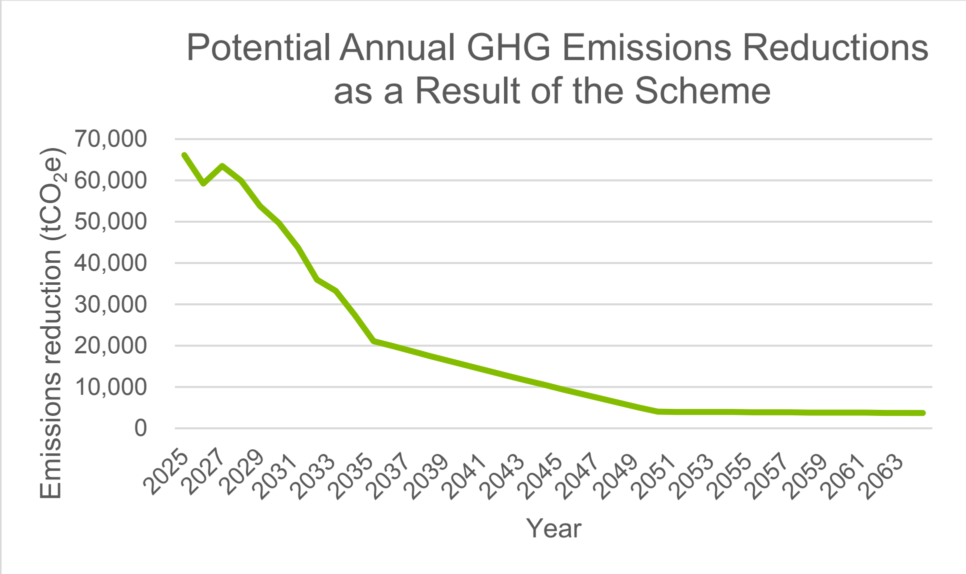

Plate 6-2: Potential annual GHG emissions reductions compared to the projected grid average (tCO_2e) 2025-2065

6.8.32 Due to the lower energy intensity of the Scheme compared to the national grid energy intensity projections (see Plate 6-1), a net GHG emissions saving will be achieved as a result of the Scheme as solar power is a less GHG intensive form of energy generation than the national gird average, which includes generation using fossil fuels. The net GHG emissions saving can be estimated by subtracting the total lifecycle GHG emissions (161,768 tCO_2e, as presented in Table 6-15) from the total GHG emissions savings of 744,061 tCO_2e achieved during the operational phase of the Scheme (as demonstrated by Plate 6-2). This gives a net GHG emissions saving of approximately 582,293 tCO_2e over the assessed lifetime of the Scheme.

Significance of Effect (Construction)

6.8.33 GHG emissions from construction have been assessed to identify the significance of their impact. Table 6-17 presents the estimated construction emissions against the carbon budget periods during which they arise. Construction emissions will fall under the 3rd and 4th UK carbon budgets.

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

Table 6-17: UK carbon budgets relevant to construction period

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Annual Construction Emissions During Carbon Budget Period (tCO_2e)	Construction Emissions as a Proportion of Carbon Budget
3rd Carbon Budget (2018 to 2022)	508,800,000	63,485	0.0125%
4th Carbon Budget (2023 to 2027)	390,000,000	63,485	0.0163%

6.8.35 Annual emissions from the construction of the Scheme do not contribute to equal to or more than 1% of the annualised 3rd or 4th carbon budgets. The magnitude of effect is therefore considered low. GHG emissions from the construction of the Scheme are therefore considered to have a **minor adverse** effect on the climate.

Significance of Effect (Operation)

6.8.36 The Scheme will be operational from 2025, therefore operational emissions up to 2032 (the end of the 5th carbon budget) will fall under the 4th and 5th UK carbon budgets, beyond which point no carbon budgets have yet been published. Table 6-18 presents the estimated operational emissions against the carbon budget periods during which they arise.

Table 6-18:UK carbon budgets relevant to operation phase (up to 2032)

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Average Annual Operational Emissions During Carbon Budget Period (tCO_2e)	Operational Emissions as a Proportion of Carbon Budget
4th Carbon Budget (2023 to 2027)	390,000,000	1,223	0.0003%
5th Carbon Budget (2028 to 2032)	353,000,000	1,049	0.0003%

6.8.37 Operational emissions to 2032 do not contribute to equal to or more than 1% of the annualised 4th or 5th carbon budgets. The magnitude of effect is therefore considered low.

6.8.38 Beyond 2032, it is anticipated that operational emissions will decrease over time as a result of grid decarbonisation and machinery and vehicle electrification in line with the UK's net zero carbon emissions target for 2050. Therefore, operational emissions are anticipated to decrease in line with the tightening of the UK carbon budgets over time. Also, the overall GHG reductions achieved by the Scheme are considered to offset and outweigh any GHG impacts associated with the operational phase of the Scheme. The magnitude of effect is therefore considered low.

6.8.39 Any GHG emissions during this time period that are not neutral or better would be considered to be adverse based on the significance criteria. Therefore, GHG emissions from the operation of the Scheme are therefore considered to have a **minor adverse** effect on the climate, both for the years up to 2032 and from 2033 onwards.

Significance of Effect (Decommissioning)

6.8.40 While there will be GHG emissions associated with the decommissioning phase of the Scheme, actual emissions are anticipated to be lower as the figures presented in Table 6-14 represent a robust worst-case scenario, as discussed above. Also, the overall GHG reductions achieved by the Scheme are considered to offset and outweigh any GHG impacts associated with the decommissioning phase of the Scheme. Therefore, the magnitude of impact is considered to be low.

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

Overall GHG Impact

6.8.42 While the GHG emissions during construction, operation (including maintenance), and decommissioning are considered to result in minor adverse effects on the climate, these impacts are accounted for in the Scheme's energy intensity figure presented in Plate 6-1, and are also therefore considered within the net GHG emissions reduction over the lifecycle of the Scheme, as demonstrated in Plate 6-2.

6.8.43 As the GHG intensity figure for the Scheme sits continually below the forecast grid average, GHG emissions savings are achieved throughout the assessed lifetime of the Scheme. Therefore, the GHG emissions during construction, operation (including maintenance), and decommissioning of the Scheme can be considered to be 'offset' by the net positive impact of the Scheme on GHG emissions and the UK's ability to meet its carbon targets.

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

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

Combined Effects on Receptors

6.8.46 The impact of GHG emissions has been assessed for the Scheme as a whole and not on individual receptors. Therefore, an assessment of the combined effect on receptors has not been included.

Climate Change Resilience Review

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

Construction (2023)

6.8.48 During the construction process, receptors may be vulnerable to a range of climate risks. These could include:

- Inaccessible construction site due to severe weather event (flooding, snow and ice, storms) restricting working hours and delaying construction;
- Health and safety risks to the workforce during severe weather events;

- Unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
- Damage to construction materials, plant and equipment, including damage to temporary buildings/ facilities on the DCO Site such as offices, compounds, material storage areas and worksites, for example from stormy weather.

Operation (2025 to 2065)

6.8.49 During the operational phase, the Scheme may be vulnerable to a range of climate change risks, which could include:

- Increased frequency and severity of extreme weather events (such as heavy and/or prolonged precipitation, storm events and heatwaves) leading to damage to infrastructure/ assets;
- Increased winter precipitation leading to surface water flooding and standing water; and
- Increased summer and winter temperatures leading to an increase in the ambient temperature of BESS units, resulting in higher ventilation and cooling requirements.

Decommissioning (2065)

6.8.50 During the decommissioning process, receptors may be vulnerable to the same climate risks as those listed above for the construction process (see paragraph 6.8.47). However, due to the projected increase in severity of climate change over time, the climate change impacts are likely to be more severe during the decommissioning phase.

6.8.51 **Section 6.7** outlines a number of adaptation measures that have been built into the Scheme to increase its resilience to climate change.

6.8.52 The CCR review has considered the measures which are integrated into the design (see **Section 6.7**). These are considered an adequate response to the projected climate change impacts to which the Scheme would be exposed.

Combined Effects on Receptors

6.8.53 The resilience of the Scheme to projected future climate change impacts has been considered for the Scheme as a whole and not for individual receptors. Therefore, an assessment of the combined effect on receptors has not been included.

6.9 Additional Mitigation and Enhancement Measures

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

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

6.10 Residual Effects

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

6.10.2 There will be unavoidable GHG emissions resulting from both the construction, operation and decommissioning phases of the Scheme as materials, energy and fuel use, and transport will be required. However, as the overall impact of the Scheme is major beneficial, it is not appropriate to define any mitigation measures further to the ones detailed in **Section 6.7**.

6.10.3 Table 6-19 outlines the likely residual construction effects after mitigation.

Table 6-19 Summary of Residual Effects

Receptor	*Description of impact*	*Significance of effect without mitigation*	*Mitigation/Enhancement measure*	*Residual effect after mitigation*
Climate				
Construction (2022-2025)	GHG emissions as a consequence of construction activities	**Minor Adverse**	The overall beneficial impact of the Scheme itself is considered to offset any GHG emissions during construction	**Minor Adverse**
Operation (2025-2065)	GHG emissions as a consequence of operational activities	**Minor Adverse**	The overall beneficial impact of the Scheme itself is considered to offset any GHG emissions during operation	**Minor Adverse**
Decommissioning (2065-2067)	GHG emissions as a consequence of decommissioning activities	**Minor Adverse**	The overall beneficial impact of the Scheme itself is considered to offset any GHG emissions during decommissioning	**Minor Adverse**
Overall	Reductions of GHG emissions compared to projected National Grid GHG intensity	**Major Beneficial**	No mitigation required	**Major Beneficial**

6.11 Cumulative Effects

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

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

6.11.3 It should also be noted that other schemes falling under the EIA Regulations will also need to consider climate change assessment within their own planning application.

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

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