Environmental Statement: Volume I

Chapter 15: Sustainability and Climate Change

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15.0 SUSTAINABILITY AND CLIMATE CHANGE

15.1 Introduction

15.1.1 This chapter of the Environmental Statement (ES) addresses the potential effects of the proposed Open Cycle Gas Turbine (OCGT) power station and associated development (hereafter referred to as the 'Proposed Development') on sustainability and climate change.

15.1.2 As required by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations), all Environmental Impact Assessments (EIAs) submitted under the EIA Regulations need to consider:

- The impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions);
- The vulnerability of the project to climate change; and
- The impacts resulting from the interaction of identified environmental impacts of the project with climate change (in-combination assessment).

15.1.3 This chapter consists of the following separate aspects:

- A lifecycle greenhouse gas (GHG) impact assessment - to understand the impact of the Proposed Development on the climate;
- Consideration of the project's resilience to climate change - to understand the impacts of climate change on the Proposed Development itself; and
- A summary of sustainability impacts identified by all environmental disciplines.

15.1.4 An assessment of in-combination impacts has been scoped out of this assessment as the principal aspect of climate change considered to be relevant for the Proposed Development is the risk of extreme events and sea level rise including flood risk. The risks and impacts associated with this issue (including accounting for worsening impacts through climate change) are covered in the Flood Risk Assessment (Appendix 12A ES Volume III (Application Document Ref: 6.4)). Other aspects of in-combination climate impacts are not considered likely to be significant.

Table 15.1: In-Combination Impacts Scoped Out

In-combination impact considered	Rationale for being scoped out
Impacts of temperature change	The Proposed Development is unlikely to affect the ability of receptors in the surrounding environment to adapt to the impacts of temperature change.
Impacts of increased wind	The impacts of wind on receptors in the surrounding environment are scoped out as these are likely to be no worse relative to baseline conditions.

15.2 Legislation and Planning Policy Context

Legislative Background

EIA Directive 2011/92/EU

15.2.1 The EIA Directive 2011/92/EU (as amended by EIA Directive 2014/52) states that as of May 2017, an environmental impact assessment (where relevant) must include assessment of the impact of a proposed development on climate change (for example, the nature and magnitude of Greenhouse Gas (GHG) emissions), an assessment of the interaction between environmental impacts and climate change (in-combination assessment), and information on the vulnerability of the project to climate change.

Climate Change Act 2008

15.2.2 The Climate Change Act 2008 sets a legally binding target for the UK to reduce its GHG emissions from 1990 levels by at least 80% by 2050. This overall target is supported by a system of binding five-year 'carbon budgets' as well as an independent body to monitor progress, the Committee on Climate Change.

Planning our electric future: a White Paper for secure, affordable and low carbon electricity, 2011

15.2.3 The Planning our electric future White Paper (Ref 15-1) identifies a number of 'unprecedented' challenges to power generation in the UK including threats to security of supply (as existing coal-fired power stations close). As a result of this, the introduction of an Emissions Performance Standard (EPS) for UK power generation as an annual limit equivalent to 450 grams of carbon dioxide (CO_2) per kilowatt hour at baseload has been implemented through the Energy Act 2013.

A Green Future: Our 25 Year Plan to Improve the Environment, 2018

15.2.4 The 25 Year Environment Plan (Ref 15-2) published in January 2018, sets out the actions the UK Government will take to help the natural world regain and retain good health. The goals include mitigating and adapting to climate change and using resources from nature more sustainably and efficiently.

15.2.5 The Plan states: "We will take all possible action to mitigate climate change, while adapting to reduce its impact. We will do this by:

- Continuing to cut greenhouse gas emissions including from land use, land use change, the agriculture and waste sectors and the use of fluorinated gases. The UK Climate Change Act 2008 commits us to reducing total greenhouse gas emissions by at least 80 per cent by 2050 when compared to 1990 levels.
- Making sure that all policies, programmes and investment decisions take into account the possible extent of climate change this century.
- Implementing a sustainable and effective second National Adaptation Programme."

The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting, 2018

15.2.6 The second National Adaptation Programme (NAP) (Ref 15-3) sets out the UK Government's response to the second Climate Change Risk Assessment (CCRA), showing the actions government is, and will be, taking to address the risks and opportunities posed by a changing climate. It forms part of the five-yearly cycle of requirements laid down in the Climate Change Act 2008 to drive a dynamic and adaptive approach to building our resilience to climate change.

Planning Policy Context

National Policy Statements for Energy Infrastructure

15.2.7 Overarching National Policy Statement for Energy (EN-1) (Ref 15-4) emphasises the importance of a diverse mix of energy generating technologies, including renewables, nuclear and fossil fuels, to avoid over-dependence on a single fuel type and so ensure a more secure energy supply. The policy states that developers should consider opportunities for combined heat and power (CHP) and that all commercial scale (at or over 300 MW) fossil fuelled generating stations have to be 'carbon capture ready'.

15.2.8 National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) (Ref 15-5) covers fossil fuel generating stations and the impacts specifically associated with these types of power generation, including land use, transport infrastructure, water resources and grid connection. Carbon capture readiness and CHP criteria are provided in this NPS.

15.2.9 NPS EN-2 sets out additional policy requirements for energy generating capacity of over 50MW, including, for example, those for land use, transport infrastructure, water resources, grid connection, climate adaptation and good design as follows:

- Land use – the choice of a site may be affected by the quantity of chemicals that would be required to be stored at the site. This should be considered by an applicant;
- Transport infrastructure – new generating sites should be sited as close to existing multi modal transport links as possible. This is for the delivery and removal of construction materials, fuel, waste, materials and staff to and from the site. Where road transport is required, consideration should be given to upgrading road access as required;
- Water resources – applicants are required to ensure there is a sufficient water supply of the right quality to meet its anticipated demand;
- Grid connection – information should be provided on the anticipated grid connection and the likely environmental impact of that connection;
- Climate change adaptation – climate resilience should be considered by an applicant in their ES, including how the development would be resilient to higher temperatures for example; and
- Good design – EN-2 requires applicants to demonstrate that the development design has taken into consideration potential landscape and visual effects, noise and traffic impacts for example.

National Planning Policy Framework (2019)

15.2.10 The revised National Planning Policy Framework (NPPF) (Ref 15-6) was published in February 2019 and sets out the Government's planning policies for England and how these are expected to be applied..

15.2.11 Paragraph 5 of the NPPF makes clear that the document does not contain specific policies for determining applications for nationally significant infrastructure projects; these are to be determined in accordance with the decision making framework set out in the Planning Act 2008 and relevant NPSs, as well as any other matters that are considered both 'important and relevant' (which may include the NPPF itself).

15.2.12 However, several policies in the NPPF have particular relevance to the scope of the climate change and sustainability assessment as presented herein including achieving sustainable development (paragraphs 7-14) and meeting the challenge of climate change, flooding and coastal change (paragraphs 148-169).

15.2.13 Additionally, paragraphs 150 and 152 of the NPPF specifically set out how planning authorities are to promote the use and supply of renewable and low carbon energy – a central pillar of sustainable development.

Local Planning Policy

North Lincolnshire Local Development Framework

15.2.14 The North Lincolnshire Local Development Framework sits alongside and in some cases replaces the North Lincolnshire Local Plan which was adopted in May 2003 and is used to make planning decisions.

15.2.15 The North Lincolnshire Core Strategy (Ref 15-7), which was adopted in June 2011, sets out the long term vision for North Lincolnshire and provides a blueprint for managing growth and development in the area up to 2026.

15.2.16 Policy CS18 in the Core Strategy sets out measures for Sustainable Resource Use and Climate Change stating that the council will actively promote development that utilises natural resources as efficiently and sustainably as possible. This will include:

15.2.17 Meeting required national reductions of predicted CO_2 emissions by at least 34% in 2020 and 80% in 2050 by applying the following measures on development proposals. Requiring all industrial and commercial premises greater than 1000 square metres to provide 20% of their expected energy demand from on-site renewable energy until the code for such buildings is applied nationally. Where developers consider these codes and targets cannot be met on the basis of viability they will be required to provide proof through open book discussions with the council at the planning application stage:

- Ensuring development and land use helps to protect people and the environment from unsafe, unhealthy and polluted environments, by protecting and improving the quality of the air, land and water;
- Supporting renewable sources of energy in appropriate locations, where possible, and ensuring that development maximises the use of CHP, particularly at the South Humber Bank employment site and where energy demands for more than 2MW are required for development; and

- Supporting new technology and development for carbon capture and the best available clean and efficient energy technology, particularly in relation to the heavy industrial users in North Lincolnshire, to help reduce CO_2 emissions.

Other Guidance

15.2.18 In the absence of any widely accepted guidance on assessing the significance of the impact effect of GHG emissions, the EIA Guidance published by the Institute of Environmental Management and Assessment (IEMA) in 2017 has been followed. (Ref 15-8) This provides a framework for the consideration of greenhouse gas emissions in the EIA process, in line with the amending EIA Directive 2014/52/EU. The guidance sets out how to:

- Identify the GHG emissions baseline in terms of GHG current and future emissions;
- Identify key contributing GHG sources and establish the scope and methodology of the assessment;
- Assess the impact of potential GHG emissions and evaluate their significance; and
- Consider mitigation in accordance with the hierarchy for managing project related GHG emissions (avoid, reduce, substitute, and compensate).

15.2.19 The IEMA Guidance for assessing climate change resilience and adaptation in EIA (Ref 15-9) has also been followed. It provides guidance on how to consider the impacts of climate change within project design. The guidance sets out how to:

- Define climate change concerns and environmental receptors vulnerable to climate factors;
- Define the environmental baseline with changing future climate parameters; and
- Determine the resilience of project design and define appropriate mitigation measures to increase resilience to climate change.

15.3 Assessment Methodology and Significance Criteria

Impact Assessment and Significance Criteria

Lifecycle GHG Assessment

15.3.1 The GHG assessment adopts a lifecycle approach to calculate GHG emissions associated with the Proposed Development and to identify GHG 'hotspots' i.e. emission sources likely to generate the largest amount of GHG emissions – as shown in Table 15.2. This approach enables priority areas for mitigation to be identified and is consistent with the principles set out in IEMA guidance (Ref 15-8).

15.3.2 Where activity data[1] has allowed, GHG emissions have been quantified using a calculation-based methodology as per the following equation as stated in the Department

[1] Activity data is data based on a unit quantity of input or output from activities proposed during the construction and operation of the Proposed Development resulting in GHG emissions for example quantities of diesel in litres.

for Environment, Food and Rural Affairs (DEFRA) 2018 emissions factors guidance (Ref 15-10):

Activity data x GHG emissions factor = GHG emissions value

15.3.3 In line with the World Resources Institute's 2015 GHG Protocol, A Corporate Accounting and Reporting Standard (Ref 15-11) when defining potential impacts (or 'hotspots'), the seven Kyoto Protocol GHGs as far as feasible have been considered:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Sulphur hexafluoride (SF_6);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Nitrogen trifluoride (NF_3).

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

15.3.5 The key anticipated GHG sources which will be scoped into the assessment are summarised in Table 15.2 below.

Table 15.2: Key Anticipated GHG emission sources

Lifecycle stage	Activity	Primary emission sources	Assumption
Pre-construction stage	Enabling works	Land clearance	**Assumption:** The Proposed Development site (the 'Site') is situated in the vicinity of the Existing VPI CHP Plant Site and east of the Lindsey Oil Refinery (TLOR). No significant excavation waste is anticipated.
	Site clearance – removal of vegetation and trees	Loss of carbon sink	**Assumption:** Site comprises primarily of previously developed or disturbed land, including land within the operational envelope of the Existing VPI CHP Plant Site No downgrade is anticipated.
Product stage	Raw material extraction and manufacturing of products required to build the Proposed Development	Embodied carbon	**Assumption:** Material quantities were not available for the GHG assessment. Embodied carbon emissions have therefore been estimated based on the main structure dimensions using the WRAP Net Waste Tool (Ref 15-12

Lifecycle stage	Activity	Primary emission sources	Assumption
Construction process stage	Transport of workforce	GHG emissions from vehicles	**Assumption:** Car and LGV journeys for approximately 150 full-time members of staff (based on peak construction).
	Transport of construction materials	GHG emissions from HGVs	**Assumption:** Maximum of 26 two-way HGV movements per day (based on peak construction).
	Waste disposal	GHG emissions from waste disposal route	**Assumption:** Scoped out as construction wastes are not expected to be significant and will be managed through a Site Waste Management Plan. Any spoil arising from site clearance and preparation works is envisaged to be retained on site for beneficial use. Therefore, significant effects from waste are not anticipated.
Operation stage	Fuel combustion and energy use	GHG emissions from natural gas combustion and energy use	**Assumption:** An OCGT plant of up to 299MW electrical output.
		GHG emissions from diesel generator	**Assumption:** Scoped out as deemed negligible; will only be running for 150 hours per year.
	Transport of workforce	GHG emissions from vehicles	**Assumption:** Car journeys for approximately 15 full-time members of staff.
	Transport of operational and maintenance equipment	GHG emissions from HGVs	**Assumption:** Maximum of 3 two-way HGV movements per day.
	Waste disposal	GHG emissions from waste disposal route	**Assumption:** Scoped out as wastes arising are anticipated to be very minor in nature from the operational power plant and would be managed by adopting the procedures already in place.
	The gas supply	GHG emissions from the AGI and fugitive emissions from the gas pipeline	**Assumption:** Emissions are expected to be minimal from a new pipeline connecting to an Existing AGI based on good design.
Decommissioning Stage	Removal of plant	GHG emissions from vehicles, energy use and material re-use/ waste disposal routes	**Assumption:** At this stage, it is unknown what the impact and effects of decommissioning will be in relation to climate change and sustainability. A qualitative statement on GHG emissions from decommissioning has been provided.

15.3.6 The global climate has been identified as the receptor for the purposes of the GHG emissions impact assessment. However, to enable significance evaluation of the estimated GHG emissions arising from the construction of the Proposed Development, the UK GHG inventory and specifically the UK carbon budgets have been used as a proxy for the global climate. The sensitivity of the receptor, the UK carbon budgets (as a proxy for the global climate), has been defined as high. The rationale for this is as follows:

- Any additional GHG impacts could compromise the UK's ability to reduce its GHG emissions and therefore meet its future carbon budgets; and
- The extreme importance of limiting global warming to below 2°C above pre-industrial levels, while pursuing efforts to limit such warming to 1.5°C as set out in the United Nations Paris Agreement (Ref 15-13).

15.3.7 The UK carbon budgets are in place to restrict the amount of GHG emissions the UK can legally emit in a five year period (Ref 15-14). The UK is currently in the 3rd carbon budget period, which runs from 2018 to 2022.

15.3.8 Construction of the Proposed Development will be undertaken during the 3rd carbon budget (2018-2022).

15.3.9 Table 15.3 shows the current and future UK carbon budgets up to 2033, which require a decline in the amount of GHGs the UK can legally emit in the future. This means that any source of emissions contributing to the UK's carbon inventory is going to have a more significant impact on the UK carbon budgets in the future.

Table 15.3: 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

15.3.10 Due to the absence of any defined industry guidance for assessing the magnitude of GHG impacts for EIA, standard GHG accounting and reporting principles will be followed to assess impact magnitude.

15.3.11 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 15-15) and the Publically Available Specification (PAS) 2050 (2011) specification (Ref 15-16) allow emissions sources of <1% contribution to be excluded from emission inventories, and these inventories to still be considered complete for verification purposes. This would therefore suggest that a development with emissions of <1% of the UK inventory and relevant carbon budget would be minimal in its contribution to the wider national GHG emissions. . This criterion will be used to assess the magnitude of the GHG impact and the associated criteria are outlined in Table 15.4 below.

Table 15.4: Magnitude criteria for the Lifecycle GHG Impact Assessment

Magnitude	Magnitude criteria
High	GHG emissions represent more than 1% of total emissions from the relevant 5 year UK carbon budget in which they arise.
Low	GHG emissions represent 1% or less of total emissions from the relevant 5 year UK carbon budget in which they arise.

15.3.12 The significance of effects of the Proposed Development will be determined using the matrix in Table 15.5. This differs from the criteria presented in Chapter 2: Assessment Methodology by omitting the 'Very Low' and 'Medium' categories for sensitivity and omitting the 'Very Low' and 'Medium' categories for magnitude. This is because the sensitivity of the receptor, UK carbon budget (as a proxy for the global climate) to increases in GHG emissions is always high, and the magnitude of the impact is determined by a boundary of less than or more than 1% of the carbon budgets.. This is in line with the IEMA guidance (Ref 15-8), which states that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments.

15.3.13 As noted above, the sensitivity of the receptor, the UK carbon budget (as a proxy for the global climate) has been defined as high.

Table 15.5: Significance of effects matrix for the Lifecycle GHG Impact Assessment

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

Climate Change Resilience Assessment

15.3.14 The EIA Regulations require the inclusion of information on the vulnerability of the Proposed Development to climate change. Consequently a high level review of climate change resilience for the Proposed Development has been conducted which identifies potential climate change impacts, and considers their potential magnitude, likelihood of occurrence, and potential impacts on the Proposed Development.

15.3.15 The assessment has included all infrastructure and assets associated with the Proposed Development. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UK Climate Projections 2018 (UKCP18) climate change projections (Ref 15-17).

15.3.16 The assessment of potential impacts and the Proposed Development's vulnerability takes into account the mitigation measures that have been designed into the Proposed Development.

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

Sustainability

15.3.18 There is no specific guidance or legal requirement to include sustainability within the EIA process. This sustainability review provides a qualitative exploration of the sustainability of

the Proposed Development as a whole and for integrating sustainability considerations throughout the lifecycle of the Proposed Development. It summarises the features and attributes of the Proposed Development assessed in other chapters of this ES that will contribute to or affect each of the sustainability criteria, including:

- Minimising use of material resources in construction materials;
- Minimising use of greenfield land;
- Minimising water use;
- Impacts on ecology;
- Impacts on air quality;
- Impacts on transport;
- Impacts on job creation; and
- Impacts on flood protection and water quality.

15.3.19 It sets out actions which could be taken during the design, construction and operation that would further assist in delivering sustainability benefits for the local and wider area.

Extent of Study Area

15.3.20 The study area for the lifecycle GHG assessment is set by the redline boundary of the Proposed Development, but also encompasses a wider extent to include GHG emissions arising outside of this boundary, including:

- The embodied GHG emissions from construction materials; and
- GHG emissions associated with the transportation of materials and workers to the site, as well as the disposal of waste arising from the construction and operational stages.

15.3.21 For the climate change resilience assessment, the study area is the Proposed Development itself. This uses data available at a local and regional scale as applicable.

15.3.22 The sustainability assessment covers the Site plus the likely effects on the surrounding local environment.

Sources of Information/Data

15.3.23 Activity data has been sourced where possible for the lifecycle GHG assessment.

15.3.24 Historic climate data for the climate change resilience assessment was obtained from the Met Office website (Ref 15-18). Future climate projections were sourced from the UKCP18 which have been developed by the UK Climate Impacts Programme (UKCIP) (Ref 15-17).

15.3.25 Many of the sustainability issues are discussed within other specific chapters, due to overlap between subject areas, and therefore chapters are referenced as relevant.

15.4 Consultation

15.4.1 A summary of comments raised via the formal scoping opinion is summarised in Table 15.6 below.

Table 15.6: Consultation Summary Table

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
Secretary of State (SoS)	July 2018 (Scoping Opinion)	The Scoping Report states that the ES will incorporate an assessment of the design against "established sustainability criteria". The ES must define what these criteria are, providing references to standards and guidance where relevant.	The sustainability assessment methodology is set out in this Section 15.3.18 of this ES Chapter.
		Outputs of the climate based assessments are proposed to be submitted as a standalone CCIR. The Inspectorate considers that this report should be appended to, and form part of, the ES, where it is relevant to the assessment of likely significant climate effects.	The full climate change impacts are included within this ES Chapter. A separate CCIR would reiterate the information provided in this ES chapter. Hence, no CCIR has been included.
		No methodology is provided regarding the assessment of effects of impacts due to the Proposed Development's effect on the local area's climate resilience. As a result the Inspectorate is unable to provide any comment on the suitability of the approach. Regarding lifecycle GHG impacts climate change resilience, except for a high level outline of the proposed assessment content, no specific methodology is proposed. The methodology for the assessment must be clearly set out in the ES, explaining the significance criteria used to identify any significant climate effects. The Applicant should clearly state the range of any climate projections used for the purposes of adaptation or resilience assessments.	The methodology for the climate change resilience assessment is set out in Section 15.3 of this ES. The assessment methodology and significance criteria for the lifecycle GHG assessment and the climate change resilience assessment are set out in Section 15.3 of this ES Chapter. Climate projections for the climate change resilience assessment are included in this ES. These are provided for the RCP[2]8.5 pathway for the 2050s climate period.

[2] RCP Pathways: 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." In accordance with UKCP18 guidance, RCP8.5 has been used as it is the closest equivalent to the high emissions scenario within the UKCP09 data, the use of which was best practise prior to the release of UKCP18 data

Consultee	Date (method of consultation)	Summary of consultee comments	Summary of response/ how comments have been addressed
		No information has been provided in the Scoping Report on the decommissioning activities or whether the Applicant intends to assess effects arising from decommissioning. The Inspectorate considers that decommissioning impacts should be addressed and the assessment in the ES must also justify the approach taken to identifying all emissions (including those that are direct or indirect) and considered within the assessment.	The impacts of decommissioning have been considered in this assessment. A qualitative assessment of GHG impacts from decommissioning has been provided at paragraph 15.7.44 and 1

15.5 Changes Since the Preliminary Environmental Information (PEI) Report

15.5.1 The changes in the Proposed Development since the publication of the PEI Report are presented in Chapter 4: Proposed Development. It is not considered that the changes described in that Chapter have any effect on this assessment.

15.6 Use of the Rochdale Envelope

15.6.1 A focussed use of the Rochdale Envelope approach has been adopted to present a worst case assessment of potential environmental effects of the different parameters of the Proposed Development that cannot yet be fixed. The parameters included within the Rochdale Envelope are described in Chapter 4: Proposed Development.

15.6.2 Changes within the parameters described are not considered to have any effect on this assessment.

15.7 Baseline Conditions

Existing Baseline

Lifecycle GHG Assessment

15.7.1 The baseline for the GHG assessment is a scenario whereby the Proposed Development does not proceed. This assumes a business as usual scenario where there will be no construction at the Site.

15.7.2 For the operational assessment the baseline will consider GHG emissions arising from existing UK power generation activities.

Climate Change Resilience

15.7.3 The existing baseline for the climate change resilience assessment is the current climate in the location of the Proposed Development. Historic climate data obtained from the Met Office website (Ref 15-18) recorded by the closest meteorological station to the Proposed Development (Cleethorpes Station) for the 30 year climate period of 1981-2010 is summarised in Table 15.7 below.

Table 15.7: Met Office data (Cleethorpes Station) for the 30 year climate period of 1981-2010

Climatic Factor	Month	Climate Figure
Average annual maximum daily temperature (^{o}C)	-	13.6
Warmest month on average (^{o}C)	July & August	20.7
Coldest month on average (^{o}C)	January	1.7
Mean annual rainfall levels (mm)	-	587.9
Wettest month on average (mm)	November	60.2
Driest month on average (mm)	February	38.0

15.7.4 The Met Office baseline climate averages for the North England region identify gradual warming between 1961 and 2010, as well as increased rainfall. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in Table 15.8 below.

Table 15.8: Climate Variations from 1961 to 2010 in the North England region

Climate Period	Climate Variables	
	Mean maximum annual temperatures (°C)	Mean annual rainfall (mm)
1961-1990	11.8	942.2
1971-2000	12.1	946.5
1981-2010	12.4	969.8

15.7.5 Examples of extreme weather event that have taken place in the past ten years include, but are not limited to (Ref 15-19):

- Severe flooding in 2012, 2013 and 2015;
- High impact cold weather events in 2004, 2009 and 2018;
- High temperatures and heatwaves in 2003, 2012, 2015, 2017 and 2018; and
- Storm and high wind events in 2013 and 2014.

Sustainability

15.7.6 For sustainability, this chapter summarises the findings of a number of other assessments within this ES. Baseline information can be found in the relevant chapters from ES Volume I which are referenced throughout this assessment:

- Chapter 6: Air Quality, Chapter
- Chapter 7: Traffic and Transportation
- Chapter 9: Ecology

- Chapter 12: Surface Water, Flood Risk and Drainage

Future Baseline

Lifecycle GHG Assessment

15.7.7 The future baseline for the lifecycle GHG assessment is a business as usual scenario whereby the Proposed Development does not go ahead, for those lifecycle stages that have been scoped into the assessment.

15.7.8 The baseline for the operational assessment will consider GHG emissions from future power generation capacity. GHG emissions from the Proposed Development will be put into context against this baseline to understand the impact on UK carbon budgets.

Climate Change Resilience

15.7.9 The future baseline is expected to differ from the present day baseline. UK Climate Projections published in 2018 (UKCP18) have been developed by the UK Climate Impacts Programme (UKCIP) (Ref 15-17) to provide projections for future climate scenarios and trends. The UKCP18 data is the most robust source of information on the UK's future climate.

15.7.10 UKCP18 provides climate change projections for pre-defined 30 year climate periods (for example 2010-2039, 2040-2069, and 2070-2099), at annual and seasonal levels for changes to mean climatic conditions over land areas. For the purpose of the Proposed Development, UKCP18 projections for the following average climate variables have been obtained and analysed against a baseline of 1981-2010:

- Change in mean summer temperature (°C);
- Change in mean winter temperature (°C);
- Precipitation rate anomaly in summer (%); and
- Precipitation rate anomaly in winter (%).

15.7.11 A range of possible Representative Concentration Pathway (RCPs), selected from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (Ref 15-19), have been used by UKCP18 to inform differing future emission trends. The four scenarios are RCP2.6 RCP4.5 RCP6.0 and RCP8.5. RCP8.5 is the closest to the UKCP09 high emissions scenario previously used for climate assessment.

Table 15.9: RCP Pathways

RCP	Description
RCP2.6	Represents a pathway where greenhouse gas emissions are strongly reduced, resulting in a best estimate global average temperature rise of 1.6°C by 2100 compared to the pre-industrial period.
RCP4.5	Medium stabilisation pathway, with some level of mitigation, resulting in a best estimate global average temperature rise of 2.4°C by 2100 compared to the pre-industrial period.
RCP6.0	Medium stabilisation pathway, with some level of mitigation, resulting in a best estimate global average temperature of 2.8°C by 2100 compared to the pre-industrial period.
RCP8.5	A pathway where greenhouse gas emissions continue to grow unmitigated, leading to a best estimate global average temperature rise of 4.3°C by 2100 compared to the pre-

RCP	Description
	industrial period.

15.7.12 IPCC Fifth Assessment Report (Ref 15-19) provides evidence to suggest that current global population and urbanisation trends, slow uptake of renewable energy sources, delay in nuclear power growth, and slow development of international climate change policy means that it is most likely that global emissions will follow the predicted RCP8.5 pathway.

15.7.13 UKCP18 also allows for future climate projections across a range of probability levels to be assessed, ranging from 10% probability to 90% probability:

- 10% probability level – this demonstrates what the future change is unlikely to be less than. There is a 90% chance the projected change will be more than this.
- 50% probability level – this is known as the central estimate, with an even chance of it occurring and not occurring.
- 90% probability level – this demonstrates what the future change is unlikely to be more than. There is a 10% chance the projected change will be more than this.

15.7.14 Taking into account the expected design life of the project, the UKCP18 for the RCP8.5 pathway were applied to the location of the closest weather station to the Proposed Development (Cleethorpes Climate Station). Table 15.10 summarises climate projections for relative to a 1981-2010 baseline.

Table 15.10: Probabilistic Climate Projections for RCP 8.5 at Cleethorpes Station (changes shown relative to a 1981-2010 baseline)

Climate Variable		2050s climate period projections
Change in mean winter temperature (°C)	50% probability (central estimate)	+1.6
	Range 10% to 90%	-0.4 to +2.9
Change in mean summer temperature (°C)	50% probability (central estimate)	+2.2
	Range 10% to 90%	+0.8 to +3.6
Precipitation rate anomaly in winter (%)	50% probability (central estimate)	+8%
	Range 10% to 90%	-4% to +21%
Precipitation rate anomaly in summer (%)	50% probability (central estimate)	-18%
	Range 10% to 90%	-38% to +3%

Sustainability

15.7.15 This chapter summarises and assesses the findings of a number of other assessments within this ES. Future baseline information can be found in the relevant chapters referenced throughout this assessment.

15.8 Development Design and Impact Avoidance

15.8.1 The consideration of alternatives and design evolution was undertaken with the aims of preventing or reducing adverse environmental effects, including those related to sustainability and climate change, whilst maintaining operational efficiency and cost effectiveness.

15.8.2 To minimise impacts during construction a framework CEMP (Application Document Ref. 6.4.3) will be submitted with the DCO application. This will identify all best practice procedures, including environmental best practice such as the processing and re-use of all recovered materials onsite where practical.

15.8.3 During operation, the Proposed Development will support the national electricity transmission system by providing additional temporary generation at times of peak demand. It will also complement the intermittent nature of renewable energy sources supporting the move to decarbonisation of the grid. The Proposed Development is expected to operate for up to 1,500 hours per year on a rolling average

15.8.4 The Proposed Development design is based on Best Available Techniques (BAT) for OCGT plants, which act to minimise impacts on air quality, emissions, and energy and water use.

15.8.5 The plant will also be subject to regular planned maintenance in order to optimise the efficiency of the equipment on Site.

15.9 Likely Impacts and Effects

15.9.1 The following sections describe the likely impacts and effects of the Proposed Development on climate change and the vulnerability of the Proposed Development to climate change in both the construction and operational phases, as well as the sustainability of the Proposed Development.

15.9.2 The primary GHG emissions sources reported have been rounded to the nearest 10 tCO_2e.

Construction

Lifecycle GHG Assessment

15.9.3 The Proposed Development will involve the construction of the following main structures:

- Single gas turbine and generator;
- Gas turbine building;
- Exhaust stack;
- Air Intakes;
- Control room workshops, stores;
- Kiosks within AGI compound; and
- Demin tanks, firewater tanks.

15.9.4 The construction of the above will result in GHG emissions particularly during the 'product stage' (emissions from manufacture and supply of construction materials such as concrete and steel).

15.9.5 The total emissions associated with the three year construction stage of the Proposed Development are estimated to equal approximately 19,150 tCO_2e. This number is conservative, based on peak construction figures. A breakdown of construction emissions is shown in Table 15.11.

15.9.6 Emissions from the three year construction period (spanning the time period 2018 - 2022) equate to 0.001% of the UK 3rd carbon budget of 509 Mt CO_2e and therefore are not significant in the context of UK emissions.

Table 15.11: Construction GHG emissions

Lifecycle stage	Project activity / Emissions source	Total construction GHG emissions over design life (tCO_2e)
Construction	Embodied carbon	18,590
	Transportation of workforce	140
	HGV movements	420
	Total	**19,150**

Sustainability

Reducing the Use of Natural Resources in Construction Materials

15.9.7 Throughout the ongoing design process, the Applicant would seek to ensure that the Proposed Development is designed, constructed and implemented to minimise the creation of waste and maximise the use of recycled materials. A primary principle of sustainable procurement is to question the need/ requirement for the commodity in question.

15.9.8 To minimise the use of natural resources and unnecessary materials, suitable infrastructure already associated with the Site should be re-used where possible; for example, the Site access routes, internal roadways and car parking.

Minimising use of Greenfield land

15.9.9 The Proposed Development is situated in the vicinity of the Existing VPI CHP Plant and east of the TLOR in North Killingholme, Lincolnshire. It comprises primarily of previously developed or disturbed land, including land within the operational envelope of the Existing VPI CHP Plant Site and is identified in the Local Plan for industrial and warehouse based development.

Flood Protection and Water Quality

15.9.10 Chapter 12: Surface Water, Flood Risk and Drainage states that site staff will be trained on procedures and guidance, including pollution plans, to reduce the risk of water pollution during construction works. It will be a contractual requirement of the contractor to ensure that runoff from the Site does not cause pollution or flooding.

15.9.11 Flood resilience measures will be incorporated into the Proposed Development to minimise damage and reduce recovery time. Measures have been identified for inclusion at construction stage to protect the Proposed Development in the event of flooding during operation – see the Operation section below for further details.

15.9.12 Chapter 12: Surface Water, Flood Risk and Drainage of this ES sets out the conclusions of the Flood Risk Assessment (FRA) (which is included at Appendix 12A (ES Volume III (DCO Document Reference 6.4.25)), as well as water quality impacts. The FRA for the Proposed Development concludes that development of the Site would not increase the risk of flooding from fluvial, tidal, groundwater or overland flow sources.

15.9.13 During construction, there is an elevated risk of leakage or accidental spillage of construction materials and potential pollutants used on Site, migrating to nearby surface watercourses.

15.9.14 Following implementation of various mitigation measures (see Chapter 12: Surface Water, Flood Risk and Drainage), including implementation of a CEMP, the likelihood of water contamination is low. Potential impacts on water quality, water supply, recreation and biodiversity in the water environment are found to be of low magnitude with minor adverse or negligible effects (not significant).

Transport

15.9.15 The traffic and transport assessment is considered in Chapter 7: Traffic and Transportation. The air quality and noise assessments in Chapter 6: Air Quality and Chapter 8: Noise and Vibration also consider how transport affects air quality and noise receptors.

15.9.16 Chapter 7: Traffic and Transportation confirms that change in total traffic associated with the Proposed Development is 26 two-way HGV movements and 85 construction staff car/LGV two-way movements per day during peak construction.

15.9.17 During the construction phase, the following mitigation measures will be applied to manage construction traffic:

- A Construction Worker Travel Plan (CWTP) will be prepared prior to construction to identify measures and procedures to reduce single-occupancy car use and encourage more sustainable forms of transport; and
- A Construction Traffic Management Plan (CTMP) will be prepared to identify measures to control the routing and impact that HGVs will have on the local road network during construction.

Outline drafts of these documents are included as Appendices to this ES (Volume III, DCO Document Reference 6.4).

Ecology

15.9.18 Chapter 9: Ecology considers the potential impacts and associated effects of the Proposed Development, on ecological receptors. Surveys have identified expected disturbance, air quality and habitat loss effects as a result of the Proposed Development.

15.9.19 The Proposed Development will result in no significant effects on qualifying wintering bird species of the Humber Estuary SPA/ Ramsar as a result of noise or visual disturbance to

functionally linked habitat adjacent to the Site. There will be no adverse air quality or surface water quality effects on any statutory or non-statutory designation.

15.9.20 A Biodiversity and Enhancement Management Plan has been prepared to support the Application (ES Volume III, Application Document Ref. 6.4), including setting out biodiversity and enhancement and management prescriptions.

Job creation

15.9.21 As well as environmental demands, sustainable development also considers the social and economic demands. The Proposed Development will result in the creation of jobs during site enabling, construction, operation and decommissioning phases. It is anticipated to provide around 150 temporary jobs at the peak of the construction period. Further details of socio-economic impacts are presented in Chapter 14: Socio-Economics.

Operation and Maintenance

Lifecycle GHG Assessment

15.9.22 Peaking plants, such as the Proposed Development, are used to rapidly supply electricity to the network when required by the National Grid. These plants can be fired up at short notice to help cope with periods of high demand or low electricity supply nationally (for example when the wind is not blowing to enable sufficient output to be achieved from the wind farms in the UK), or when required to provide ancillary services to support the National Grid. Peaking plants are therefore a key component of the UK energy strategy to transition towards a decarbonised electricity grid.

15.9.23 The Proposed Development is expected to operate for up to 1,500 hours per year on a rolling average. Its function would be to support the national electricity transmission system by providing additional temporary generation at times of peak demand and to complement the intermittent nature of renewable energy sources. Its role is therefore to support the UK's decarbonisation aims.

15.9.24 Several broad assumptions have been developed to calculate the GHG emissions from the operation of the Proposed Development:

- The Proposed Development is a gas-fired OCGT generating station and is assumed to operate for 1,500 hours per annum;
- The generation capacity is assumed to be 299MWe;
- The assumed electrical efficiency is assumed worst case of 38%; and
- No additional electricity supply is needed for operation of the OCGT generating station.

15.9.25 Annually, the total operational GHG emissions from the Proposed Development would be to approximately 274,780 tCO_2e. Within each of the 4th and 5th carbon budget time periods this would equate to less than 1% of total emissions permitted under each budget. Emissions from the Proposed Development are therefore not significant in the context of the UK achieving its carbon emissions targets.

15.9.26 Due to the nature of their short term, intermittent operation, peaking plants are less efficient in terms of gCO_2e per kWh than the current grid average. The Proposed development is estimated to emit 538gCO2e/kWh in comparison to a grid average of

225gCo2/kWh in 2017. This must be taken in context however as the combined operation of all peaking plants in the UK currently equates to less than 1% of total emissions from grid power generation (Ref 15-20). Peaking plants form an essential part of the generation fleet and gas-fired OCGT is the most efficient low carbon method of providing that (given that battery storage is not a stage of development that could match OCGT) in the transition towards a decarbonised grid.

15.9.27 A breakdown of operational emissions is shown in Table 15.12.

Table 15.12: Operational GHG emissions

Lifecycle stage	Project activity / Emissions source	Annual GHG emissions (tCO_2e)
Operation	Energy and fuel	274,740
	Transportation of workforce	10
	HGV movements	30
	Total	**274,780**

Climate Change Resilience

15.9.28 Potential impacts associated with climate change which could affect the vulnerability of the Proposed Development are presented in Table 15.13 together with an appraisal of the likelihood that these would affect the Proposed Development,

Table 15.13: Potential climate impacts and resilience measures

Climate variable projections	Potential Impacts on the Proposed Development	Appraisal/ Mitigation Measures
Projected increase in mean summer and winter temperatures	Overheating of equipment in summer months	This is not likely to cause overheating but may result in a loss of efficiency as the unit will be air cooled. However, as the unit will only operate intermittently, this is not likely to result in significant effect on performance
Projected increase in winter precipitation	• Vulnerability to higher river flows, requiring higher maintenance of the plant • Flooding of site; resulting in possible generation unit shutdown, water damage to infrastructure, and pipeline fracture due to erosion. • Flooding of access routes to Site resulting in commodity supply disruption; increased staff shifts; insufficient staff to maintain safe plant operation; partial or complete shutdown	The area is protected by flood defences that were designed with climate change effects in mind. Flooding risk (tidal, fluvial and pluvial) will be taken into account in detailed design See Appendix 12A ES Volume III (Application Document Ref6.4.)
Projected decrease in mean summer precipitation	Reduced fresh water availability	Water demands will be minimal as the OCGT is air cooled

Climate variable projections	Potential Impacts on the Proposed Development	Appraisal/ Mitigation Measures
Extreme weather events (such as heavy and/or prolonged precipitation and storm events)	Damage to installations	Risk of pluvial flooding will be included in the design. See Appendix 12A ES Volume III (DCO Document Reference 6.4.25)

Sustainability

Minimising Use of Water

15.9.29 The Proposed Development will consider measures to conserve water during operation, which increases the Proposed Development's resilience to future temperature rises and potential droughts as a result of climate change.

Flood Protection and Water Quality

15.9.30 Chapter 12: Surface Water, Flood Risk and Drainage sets out the conclusions of the FRA (which is included at Appendix 12A (ES Volume III, DCO Document Reference 6.3)) as well as measures to minimise water pollution. The FRA concludes that development of the Site would not increase the risk of flooding from fluvial, tidal, groundwater or overland flow sources.

15.9.31 The operator's Environmental Management System (EMS) will include impact avoidance measures such as accidental pollution plans and provision of spillage kits, and containment measures such as bunds.

15.9.32 An Outline Drainage Strategy has been produced as part of the FRA; this will be developed through detailed design and will incorporate features such as:

- Greenfield runoff rate restriction for surface water discharge from the Proposed Development achieved by on-site attenuation of surface water runoff;
- Use of soil interceptors where appropriate; and
- Use of Sustainable Drainage Systems (SuDS) techniques including swales, permeable paving and soakaways to attenuate flow of water will be considered at the detailed design stage.

15.9.33 Following the implementation of the above design measures, the likelihood of water contamination is low. Potential impacts on water quality, water supply, recreation and biodiversity in the water environment are found to be of low magnitude with minor adverse or negligible effects (see Chapter 12: Surface Water, Flood Risk and Drainage).

15.9.34 Flood resilience measures will be incorporated into the Proposed Development to minimise damage and reduce recovery time. Consideration has been given to the effect of climate change on river levels. Flood proofing measures such as resistant building materials and emergency response procedures have also been identified as possible options for inclusion, subject to detailed design.

Air Quality

15.9.35 The Proposed Development will comply with the European Industrial Emissions Directive (IED). This means minimisation of the impact of emissions to air, soil, surface and ground water, to the environment and human health. The operation of the Proposed Development will be governed by an Environmental Permit.

15.9.36 Chapter 6: Air Quality assesses the effect of emissions from the Proposed Development on short and long-term human health receptors, ecological receptors, and annual critical levels.

15.9.37 The effect of emissions from the Proposed Development is negligible for most receptors, with the worst affected receptor being assessed as minor (E9 Station Road Fields LW – ecological receptor). No significant effects on soil, surface water or groundwater are identified in Chapters 12: Surface Water, Flood Risk and Drainage and 11: Ground Conditions and Hydrogeology.

Transport

15.9.38 The traffic and transport assessment is considered in Chapter 7: Traffic and Transportation.

15.9.39 Chapter 7: Traffic and Transportation confirms that once operational there will be approximately 15 permanent staff and an anticipated maximum of 3 HGV movements per day. The overall effects during operation, maintenance and planned outages are therefore considered to be negligible adverse (not significant).

Ecology

15.9.40 Chapter 9: Ecology considers that there are no significant operational effects predicted and therefore there is no requirement for mitigation.

Job Creation

15.9.41 As well as environmental demands, sustainable development also considers the social and economic demands. It is estimated that the total net employment for the site is 15 employees. Temporary and contractor employees associated with maintenance activities will also be employed as required.

Decommissioning

15.9.42 The plant is capable of a life expectancy of 40 years or more, depending on running hours. Eventually decommissioning would involve the removal of the Proposed Development. The Gas Connection and Electricity Connection would be disconnected and made safe. The OCGT could either be removed as a unit for reuse elsewhere (depending on its condition) or alternatively dismantled on site and removed.

15.9.43 At this stage, there is limited information available regarding decommissioning methods and timescales, hence it is unknown what the impact and effects of decommissioning will be in relation to climate change and sustainability. However, in comparison to GHG emissions from construction and operation, these are likely to be not significant.

15.10 Mitigation and Enhancement Measures

15.10.1 Embedded mitigation measures have been incorporated within the design of the Proposed Development or are standard practice measures that have been committed to as summarised earlier in Section 15.6 of this Chapter.

15.10.2 As the output capacity of the Proposed Development is less than 300MW, the power station does not fall under the provisions of the Carbon Capture Readiness (Electricity Generating Stations) Regulations 2013 (the CCR Regulations). Therefore, no space allocation for future retrofit of carbon capture technology has been included within the Site.

15.11 Limitation or Difficulties

15.11.1 At this stage, the absence of available data is a limitation, particularly for calculating the embodied carbon of the Proposed Development. Where data has not been available, estimates (using professional judgment and knowledge from similar developments) have been used.

15.11.2 Limitations associated with the approach taken for the climate change resilience review relate to uncertainties inherent within UKCP18 data (Ref 15-16).

15.11.3 Climate change science is based on a range of complex models, assumptions and limitations. To provide some level of confidence in the assessment, leading climate change data and science from the UK Climate Projections (UKCP18) programme has been used. This is the result of over seven years work by the Met Office's Hadley Centre and over thirty years of work from other contributing organisations. UKCP18 builds upon UKCP09 to provide the most up-to date assessment of how the climate of the UK may change over the 21st century.

15.12 Residual Effects and Conclusions

15.12.1 Due to the nature of an OCGT power station, there will be residual effects no matter the level of mitigation measures implemented. This includes unavoidable GHG emissions resulting from all phases of the Proposed Development, as a result of the combustion of fuel and required materials and transport.

15.12.2 The Overarching National Policy Statement for Energy (EN-1) places value on the importance of a diverse mix of energy generating technologies, drawing attention to the urgent national need for new electricity generating capacity. The NPPF also encourages the move to a low carbon future, and planning new development to reduce greenhouse gas emissions. The Proposed Development will meet existing shortfall as other less efficient power stations are going off line, and will provide a secure energy supply to the national grid.

15.12.3 Whilst the UK is moving towards decarbonising the grid, efficient gas-fired power stations are required as an important element of the overall transition fuel mix in order to ensure the UK's energy security.

15.12.4 The Proposed Development would provide additional peak power generation capacity, which would contribute to providing a secure energy supply to the national grid, and would be used for short periods of time, only operating for up to the maximum allowed under its

Environmental Permit, which is anticipated to be approximately 1,500 hours per annum on a rolling five year average.

15.12.5 Climate change resilience outputs demonstrate that the effects of increases in mean summer and winter temperatures, as well as changes in precipitation on the Proposed Development have been considered through consideration of material lifetime, maintenance regimes and flood risk attenuation measures.

15.12.6 The Proposed Development has several characteristics incorporated into its design, construction and management which meet the key sustainability requirements as set out in national, regional and local policy.

15.13 References

Ref 15-1 DECC (2011) Planning our electric future: a White Paper for secure, affordable and low carbon electricity.

Ref 15-2 HM Government (2018) A Green Future: Our 25 Year Plan to Improve the Environment

Ref 15-3 DEFRA (2018) The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting

Ref 15-4 Department of Energy and Climate Change (2011), Overarching National Policy Statement for Energy (EN-1), July 2011

Ref 15-5 Department of Energy and Climate Change (2011), National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)

Ref 15-6 National Planning Policy Framework, 2019

Ref 15-7 North Lincolnshire Council (2011) The North Lincolnshire Framework: Core Strategy Adopted *[Available at: http://www.planning.northlincs.gov.uk/planningreports/corestratergy/adopteddpd/FullCoreStrategy.pdf accessed February 2019]*

Ref 15-8 IEMA (2017) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance

Ref 15-9 IEMA (2015) Environmental Impact Assessment Guide to: Climate Change Resilience and Adaptation

Ref 15-10 DEFRA (2018) 2018 Emissions Factors. [*Available at https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018 accessed February 2019]*

Ref 15-11 World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) (2015) Greenhouse Gas Protocol Corporate Accounting and Reporting Standard

Ref 15-12 Waste Resource Action Programme (WRAP), Net Waste Tool http://nwtool.wrap.org.uk/ToolHome.aspx

Ref 15-13 United Nations Framework Convention on Climate Change (UNFCC) (2015) Paris Agreement

Ref 15-14 Committee on Climate Change (2017) UK Carbon Budgets

Ref 15-15 DECC (2013) Guidance on Annual Verification for emissions from Stationary Installations

Ref 15-16 British Standards Institution (2011) PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services

Ref 15-17 UK Climate Impacts Programme (UKCIP) (2018) UK Climate Projections

Ref 15-18 Met Office, Cleethorpes Climate. *[Available at: https://www.metoffice.gov.uk/public/weather/climate/gcx4kb837 accessed September 2018]*

Ref 15-19 Met Office (2018) Past weather events. *[Available at: https://www.metoffice.gov.uk/climate/uk/interesting accessed February 2019]*

Ref 15-19 IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Ref 15-20 Staffell, I (2017) Measuring the progress and impacts of decarbonising British electricity. *Energy Policy*. 102, pp.463-475.