REPORT

Boston Alternative Energy Facility – Environmental Statement

Chapter 21 Climate Change

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Boston Alternative Energy Facility

Royal HaskoningDHV
Enhancing Society Together

HASKONINGDHV UK LTD.

Rightwell House
Rightwell East
Bretton
Peterborough
PE3 8DW
Industry & Buildings
VAT registration number: 792428892

+44 1733 334455 **T**
+44 1733 262243 **F**
email **E**
royalhaskoningdhv.com **W**

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Author(s): Joe Parsons

Drafted by: Joe Parsons

Checked by: Alun McIntyre

Date: 21/10/2020 AM

Approved by: Paul Salmon

Date: 21/03/21 PS

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Executive Summary

This chapter of the Environmental Statement (ES) considers the contribution of the Boston Alternative Energy Facility ('the Facility') to regional and national Greenhouse Gas (GHG) emissions, and its resilience to the projected effects of climate change. As part of the assessment, a description of the current baseline GHG emissions within the Boston area is provided, along with a summary of the current climatic conditions in the region. Potential impacts during construction and operation of the Facility were considered.

GHG emissions arising from construction phase activities associated with road traffic movements and on-site plant use were calculated. The operational phase assessment considered two 'existing' pathways for the treatment of waste that would be processed at the Facility, compared to the anticipated GHG emissions arising from the operation of the Facility. GHG emissions were quantified from the thermal treatment process, marine vessel and road vehicle movements to and from the Application Site, and consumption of fuel by on-site equipment. The results of the assessment show that net GHG emissions, accounting for the offset of savings elsewhere in the UK energy generation sector, will not result in a significant impact on the UK's ability to meet its 2050 carbon reduction targets.

The climate resilience assessment identified that the parameters most likely to affect the Facility due to climate change were increased temperatures, drought conditions and surface and tidal flooding. The key components of the Facility were not considered to be vulnerable to increased temperatures or drought conditions. Due to the ongoing improvements to the flood defences near the site through the Boston Combined Strategy (BCS), which account for climate change (see **Chapter 13 Surface Water, Flood Risk and Drainage Strategy**), the Facility was not considered to be vulnerable to flood risk. Additional flood risk reduction measures are proposed to take place prior to the commencement of operations, affording the Facility additional protection against flooding. The flood defence line will also be increased by the Facility itself, by raising the level at the wharf.

21 Climate Change

21.1 Introduction

21.1.1 This chapter of the Environmental Statement (ES) considers climate change and comprises two assessments: a Greenhouse Gas (GHG) assessment; and a Climate Change Resilience (CCR) assessment.

21.1.2 The GHG assessment predicts the contribution of the Boston Alternative Energy Facility ('the Facility') to national and regional GHG emissions, and the 'net effect' of the Facility compared to two existing pathways for the existing treatment of waste that would be processed. The CCR assessment considers the resilience of the design and infrastructure associated with the Facility to the projected effects of climate change over the lifespan of the project.

21.2 International Agreements, Legislation, Policy and Guidance

International Agreements

United Nations Framework Convention on Climate Change

21.2.1 The United National Framework Convention on Climate Change (UNFCCC) is an intergovernmental environmental treaty and entered into force on 21 March 1994. The main objective is the *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."*

21.2.2 A regular series of international meetings of the UNFCCC have taken place since 1997 resulting in several important and binding agreements: the Copenhagen Accord (2009); the Doha Amendment (2012); and the Paris Agreement (2015).

21.2.3 The Doha Amendment included a commitment by parties to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The UK Climate Change Act 2008 has an interim 34% reduction target for 2020, which if achieved will allow the UK to meet and exceed its Kyoto agreement target. This interim target for the UK is likely to be met in 2020.

21.2.4 During the United Nations Climate Change Conference in Paris in 2015 (known as 'COP21') the following were key areas of agreement:

- Limit global temperature increase to below 2ºC, while pursuing efforts to limit the increase to 1.5ºC above the pre-industrial average temperature;

- Parties aim to reach global peaking of GHG emissions as soon as possible to achieve the temperature goal;
- Commitments by all Parties to prepare, communicate and maintain a Nationally Determined Contribution;
- Contribute to the mitigation of GHG emissions and support sustainable development;
- Enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change;
- Transparent reporting of information on mitigation, adaptation and support which undergoes international review; and
- In 2023 and every five years thereafter, a global stocktake will assess collective progress toward meeting the purpose of the Agreement.

21.2.5 At the 22nd Climate Change Conference of the Parties (COP22) in November 2016, the UK ratified the Paris Agreement to enable the UK to *"help to accelerate global action on climate change and deliver on our commitments to create a safer, more prosperous future"* (Department for Business, Energy and Industrial Strategy (BEIS), 2016). At the COP24 meeting, held in Katowice, Poland in December 2018, a set of rules for the Paris climate process were agreed.

Kyoto Protocol

21.2.6 The Kyoto Protocol is an international agreement adopted in 1997 and was enacted in 2005. The Protocol is linked to the UNFCCC objective to reduce atmospheric concentrations of GHG to reduce the rate and extent of global warming. The Protocol applies to the reduction of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

21.2.7 The Protocol acknowledges that the economic development of a country is an important factor in the country's ability to combat climate change. Therefore, developed countries have an obligation to reduce their current emissions, as they are historically responsible for the current concentrations of atmospheric GHGs.

Legislation

The Climate Change Act 2008

21.2.8 The Climate Change Act 2008 provides a framework for the UK to meet its long-term goals of reducing GHG emissions to 'net-zero' (i.e. at least a 100% reduction) by 2050 ("climate mitigation"). This target was introduced by the Climate Change Act 2008 (2050 Target Amendment) Order 2019, which amended the previous

2050 GHG target of an 80% reduction compared to 1990 levels.

21.2.9 The Climate Change Act 2008 was enacted as part of the UK's responsibility and obligations as a signatory of the Kyoto Protocol 1997 (which did not become binding until 2005). The UK target covers the six main GHGs referenced in the Kyoto Protocol.

21.2.10 The Climate Change Act 2008 requires the Government to set legally-binding 'Carbon Budgets' to provide a constraint of GHG emissions in a given time period. The Carbon Budgets are set by the Committee for Climate Change (CCC) and provide a legally binding five year limit for GHG emissions in the UK. The first six Carbon Budgets have been placed into legislation and will run up to 2037 and are identified in **Table 21-1**.

21.2.11 The sixth Carbon Budget was published by the CCC in December 2020, which set out the level of GHG emissions that the UK can release from 2033 to 2037 (CCC, 2020). It was the first Carbon Budget to set out the path to the net-zero carbon emissions target.

21.2.12 The first Carbon Budget was met, and the UK is set to outperform on the second and third budgets. However, current projections suggest that the fourth Carbon Budget will not be met (CCC, 2018).

Table 21-1 The Six UK Carbon Budgets

Budget	Carbon Budget Level ($MtCO_2e$)	Reduction Below 1990 Levels
1st Carbon Budget (2008 to 2012)	3,018	25%
2nd Carbon Budget (2013 to 2017)	2,782	31%
3rd Carbon Budget (2018 to 2022)	2,544	37% by 2020
4th Carbon Budget (2023 to 2027)	1,950	51% by 2025
5th Carbon Budget (2028 to 2032)	1,725	57% by 2030
6th Carbon Budget (2033 to 2037)	965	78% by 2035

21.2.13 The Climate Change Act 2008 requires the UK Government to produce a Climate Change Risk Assessment (CCRA) every five years. The CCRA assesses current and future risks to, and opportunities for, the UK from climate change (to inform "climate adaptation" actions). In response to the CCRA, the Climate Change Act 2008 also requires Government to produce a National Adaptation Programme (NAP) (both discussed further below).

Climate Change Risk Assessment 2017

21.2.14 The Government produced its latest CCRA in 2017, the second assessment to be produced for the UK following the first release in 2012. The report concluded that among the most urgent risks for the UK are flooding and coastal change risks to communities, businesses and infrastructure. It identifies suggestions for reducing these risks, including the consideration of climate change in developing new infrastructure.

National Adaptation Programme

21.2.15 The National Adaptation Programme (NAP) sets the actions that the UK government will undertake to adapt to the challenges of climate change in the UK as identified in the CCRA. The NAP details the range of climate risks which may affect the natural environment, infrastructure, communities, buildings and services. Key actions are set out in the NAP which aim to address the identified high-risk areas, which include:

- flooding and coastal change risks to communities, businesses and infrastructure;
- risks to health, well-being and productivity from high temperatures;
- risks in shortages in the public water supply for agriculture, energy generation and industry;
- risks to natural capital; and
- risks to domestic and international food production and trade.

National Planning Policy

National Planning Policy Framework (NPPF)

21.2.16 The revised NPPF (Ministry of Housing, Communities and Local Government (MHCLG), 2019) was adopted in February 2019, which advises that the planning system should support the transition to a low carbon future. With respect to planning for climate change, the NPPF states:

> *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures"*

21.2.17 The NPPF also states:

> *"New development should be planned for in ways that:*

a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and,

b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."

National Policy Statements for Energy

21.2.18 The Overarching National Policy Statement (NPS) for Energy (EN-1) sets out in national policy for energy infrastructure in the UK.

21.2.19 The NPS advises that applicants and the IPC (now the Planning Inspectorate) should consider the effects of climate change when developing and consenting infrastructure. It recommends that new energy infrastructure needs to be resilient against the possible impacts of climate change to meet the UK's future energy needs. The NPS also advises that new energy infrastructure needs to consider the potential impacts of climate change when considering the location, design, build and operation of new energy infrastructure (Department of Energy and Climate Change (DECC), 2011a).

21.2.20 The NPS states that the GHG emissions of individual applications do not need to be benchmarked against UK Carbon Budgets, and GHG emissions are not a reason to prevent project consent. However, as the chapter is provided to comply with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2018, a GHG assessment is included, as part of the overall consideration of climate change impacts.

21.2.21 The NPS also states at paragraphs 4.8.6 and 4.8.7:

"The IPC should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections available at the time the ES was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure."

"Applicants should apply as a minimum, the emissions scenario that the Independent Committee on Climate Change suggests the world

is currently most closely following – and the 10%, 50% and 90% estimate ranges. These results should be considered alongside relevant research which is based on the climate change projections."

21.2.22 The NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b) advises that the proposals for new development should consider how they will be resilient to an increase in the risk of flood and drought affecting river flows.

Local Planning Policy

South-East Lincolnshire Local Plan

21.2.23 The South-East Lincolnshire Local Plan was adopted on 8 March 2019 (South-East Lincolnshire Joint Strategic Planning Committee, 2019) and is the new Local Plan for Boston Borough Council (BBC), as well as South Holland District Council and Lincolnshire County Council (LCC). The following policies are of relevance to climate change.

*"**Policy 4: Approach to Flood Risk***

Development proposed within an area at risk of flooding (Flood Zones 2 and 3 of the Environment Agency's flood map or at risk during a breach or overtopping scenario as shown on the flood hazard and depths maps in the Strategic Flood Risk Assessment) will be permitted, where:

[…]

3. The application is supported with a site-specific flood risk assessment, covering risk from all sources of flooding including the impacts of climate change…"

*"**Policy 28: The Natural Environment***

A high quality, comprehensive ecological network of interconnected designated sites, sites of nature conservation importance and wildlife-friendly greenspace will be achieved by protecting, enhancing and managing natural assets:

[…]

3. Addressing gaps in the ecological network:

[…]

iv. conserving or enhancing biodiversity or geodiversity conservation features that will provide new habitat and help wildlife to adapt to climate change, and if the development is within a Nature Improvement Area (NIA), contributing to the aims and objectives of the NIA."

*"**Policy 31: Climate Change and Renewable and Low Carbon Energy***

A. *Climate Change*

All development proposals will be required to demonstrate that the consequences of current climate change has been addressed, minimised and mitigated by:

1. *employing a high-quality design;*
2. *the adoption of the sequential approach and Exception Test to flood-risk and the incorporation of flood-mitigation measures in design and construction to reduce the effects of flooding, including SuDS schemes for all 'Major' applications;*
3. *the protection of the quality, quantity and availability of water resources, including for residential developments, complying with the Building Regulation water efficiency standard of 110 litres per person per day;*
4. *reducing the need to travel through locational decisions and, where appropriate, providing a mix of uses;*
5. *incorporating measures which promote and enhance green infrastructure and provide an overall net gain in biodiversity as required by Policy 28 to improve the resilience of ecosystems within and beyond the site.*

B. *Renewable Energy*

With the exception of Wind Energy, the development of renewable energy facilities, associated infrastructure and the integration of decentralised technologies on existing or proposed structures will be permitted provided, individually, or cumulatively, there would be no significant harm to:

1. *visual amenity, landscape character or quality, or skyscape considerations;*

2. *residential amenity in respect of: noise, fumes, odour, vibration, shadow flicker, sunlight reflection, broadcast interference, traffic;*

3. *highway safety (including public rights of way);*

4. *agricultural land take;*

5. *aviation and radar safety;*

6. *heritage assets including their setting; and*

7. *the natural environment.*

Provision should be made for post-construction monitoring and the removal of the facility and reinstatement of the site if the development ceases to be operational. Proposals by a local community for the development of renewable and low-carbon sources of energy, in scale with their community's requirements, including supporting infrastructure for renewable energy projects, will be supported and considered in the context of contributing to the achievement of sustainable development and meeting the challenge of climate change and against criteria B1-7."

Guidance

Institute for Environmental Management and Assessment (IEMA) 2017– Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance

21.2.24 IEMA has published guidance to inform the consideration of GHG emissions within an EIA (IEMA, 2017). The guidance sets out the areas for consideration at all stages of the assessment, and provides guidelines for, and requirements of, an assessment.

IEMA 2020 – Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

21.2.25 IEMA has also published a framework for the consideration of climate change resilience and adaptation in the EIA process. The guidance advises that the future climate at the development site should be identified, and how adaptation and resilience measures have been built into the design of a development (IEMA, 2020).

21.3 Consultation

21.3.1 Consultation undertaken throughout the pre-application phase informed the approach and information provided in this chapter. A summary of the consultation of relevant to climate change is detailed in **Table 21-2**.

Table 21-2 Consultation and Responses

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
Planning Inspectorate, July 2018	The Scoping Report refers to guidance applicable to the assessment. The Applicant should ensure that the guidance applied to the assessment and the methodology that is adopted are fully explained within the ES.	Guidance applied to the assessment is detailed in **Section 21.2**.
	The ES should clearly state within the GHG assessment the lifecycles of the Proposed Development that will be included within the assessment.	Scenarios considered in the GHG assessment are set out in **Section 21.4**.
	The ES should state any assumptions made in calculating the predictive GHG emission; any limitations to the calculations; and any uncertainties this presents for the assessment of GHG emissions.	Assumptions and limitations in the calculated of GHG emissions are set out in **Section 21.4**.
Section 42 Consultation Response – Lincolnshire County Council, 1st August 2019	The proposed facility is situated in a low lying area which could be vulnerable to sea level rise. It is understood a more in-depth climate change risk assessment will be completed as the proposal is progressed. Certain assurances regarding the mitigation of the risks of pollution as a result of flooding are likely to be required by the Environment Agency. The Council would also like to receive copies of this correspondence.	The vulnerability of the Facility to climate change is assessed in the CCR assessment in **Section 21.6**. Details of mitigation to minimise the risks of pollution after a flooding event are provided in **Chapter 13 Surface Water, Flood Risk and Drainage Strategy**.
	There is considerable debate globally as to whether or not this type of facility is producing 'renewable' energy. There is still a significant amount of environmental damage created through processing waste in this way. Waste is not classified as typically a 'renewable source', therefore additional information indicating how this type of disposal fits in with renewable sources would be favourable.	Refused derived fuel (RDF) waste is referred to in EN-3, which serves the purpose of defining the policy for renewable energy in the UK. Refer to **Chapter 2 Project Need** for further information.
	It must be noted that there is a 'Carbon Zero' ambition by 2050. It should be	The implications of the Facility on the UKs ambitions to be Carbon Zero by 2050 are

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	demonstrated that this development would not have significant implications on meeting this carbon zero target.	detailed in **Section 21.6**.
Boston Borough Council, 6th August 2019	In addition, we noted above the potential to explore further waste import from other areas of the county, as a means of reducing the climate footprint of our current waste haulage arrangements (as above under Waste Strategy).	The current understanding is that there is the potential for incorporating local waste (i.e. waste that is currently received by the Slippery Gowt Transfer Station) into the feedstock for the Facility, as long as it is baled. This is subject to negotiation with LCC (as Waste Disposal Authority) and other relevant authorities under the Lincolnshire Waste Partnership and would be subject to the relevant procurement rules. Given that this waste is currently contracted to North Hykeham, the DCO application cannot include the waste as part of the feedstock for the Facility. If this were to change, the option for including it within the overall total feedstock would be considered by the Applicant and LCC. However, the assumption is based upon the waste being received by the Slippery Gowt Transfer Station is residual household waste from Boston and South Holland (plus some East Lindsay waste). It should not be seen to be a mechanism to divert waste from other Lincolnshire Local Authority areas that do not currently use this transfer station.

21.3.2 One representation to the Scoping Opinion submitted by Natural England referred to climate change, and specifically requested Alternative Use Boston Projects Ltd ('the Applicant') provide provisions for maintaining ecological networks in the face of climate change. The representation states:

> *"The NPPF requires that the planning system should contribute to the enhancement of the natural environment 'by establishing coherent ecological networks that are more resilient to current and future pressures' (NPPF Para 109), which should be demonstrated through the ES."*

21.3.3 The impact of climate change on ecological networks is considered in **Chapter 12 Terrestrial Ecology** and **Chapter 17 Marine and Coastal Ecology**.

21.4 Assessment Methodology

21.4.1 The climate change assessment comprised two separate assessments. A GHG assessment was undertaken to predict emissions arising from construction and operational phase activities associated with the Facility. The operational phase assessment considered emissions associated with two 'Do Nothing' scenarios, as detailed in paragraph 21.4.20 to calculate 'baseline' GHG emissions from the existing pathways for the RDF which would be used at the Facility. In addition, a 'Do Something' scenario was considered, which calculated the GHG emissions associated with the delivery of RDF to the Facility, and process emissions.

21.4.2 The assessment considered the predicted net contribution of the Facility during operation to UK and global GHG emissions, rather than gross, point-source emissions associated with the Facility. As the effects of GHG emissions are realised at a global, rather than local level, this net overall effect is a key factor in determining the effect of the Facility.

21.4.3 A CCR assessment was undertaken to evaluate the resilience and vulnerability of the design and infrastructure associated with the Facility to the projected effects of climate change during its operation. The construction phase (including commissioning) is anticipated to be up to 48 months, between 2022 and 2026. Effects of climate change, as distinct from weather, are not considered to be significant during construction and are therefore excluded from consideration in the CCR assessment.

21.4.4 The methodologies for both assessments are set out below.

Study Area

Greenhouse Gas Assessment

21.4.5 GHG emissions arising from the construction and operational phase of the Facility were predicted within a defined 'project boundary', in accordance with the GHG Protocol (World Resources Institute and World Business Council on Sustainable Development, 2015). The 'project boundary' was defined as the Application Site boundary of the Facility, and the routes that marine vessels and road vehicles use to travel to and from the Application Site. In addition, existing waste disposal routes were included in the project boundary for the 'Do Nothing' operational scenarios, which included landfill sites in the UK, and Energy from Waste (EfW) facilities in Europe.

Climate Change Resilience Assessment

21.4.6 The study area for the CCR assessment is defined as the Application Site

boundary and associated transport networks, including access for vessels at the Haven and road transport links.

Data Sources

21.4.7 The assessment was undertaken with reference to several sources, as detailed in **Table 21-3.**

Table 21-3 Key Information Sources

Data Source	Reference
UK Climate Projections (UKCP) Database	Met Office, 2018, https://www.metoffice.gov.uk/research/collaboration/ukcp
Met Office Holbeach Meteorological Station	Met Office, 2019, https://www.metoffice.gov.uk/public/weather/climate/u12h2kdgz
Greenhouse Gas Reporting, Conversion Factors 2019	BEIS, 2020a, https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020
Emissions of Carbon Dioxide for Local Authority Areas	BEIS, 2020b, https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas
GloMEEP	GloMEEP, 2018, Port Emissions Toolkit, Guide Number 01, Assessment of Port Emissions
Christensen *et al*, 2015	Christensen, T. H., Damgaard, A., & Astrup, T. F. (2015). Waste to energy the carbon perspective. Waste Management World, (January-February 2015), 24-28.

Impact Assessment Methodology

Greenhouse Gas Assessment

Approach

21.4.8 The GHG assessment was undertaken in accordance with the methodology defined in the GHG Protocol, developed by the World Resources Institute and World Business Council on Sustainable Development (2015). The GHG Protocol defines three emission scopes, which are detailed below:

- Scope 1 emissions: “direct” GHG emissions arising from a project, such as those associated with fossil fuel consumption by vehicles and plant under the control of the Applicant (or construction contractor) at the Application Site;
- Scope 2 emissions: “indirect” GHG emissions from the production of electricity and gas (i.e. off-site and usually by third parties) consumed by plant and equipment; and

- Scope 3 emissions: “indirect emissions arising from supporting activities” (e.g. work upstream and / or downstream, the activities of sub-contractors and ancillary travel) associated with a project. This includes third party marine vessel and road traffic vehicles, which are not under the direct control of the Applicant.

21.4.9 The term ‘GHG’ in this assessment encompasses three gases, namely CO_2, CH_4 and N_2O. Emissions of other ‘Kyoto’ gases are not considered significant in the context of the Facility and they are excluded from consideration. Where practicable, the results in this assessment were expressed in carbon dioxide equivalent (CO_2eq) which recognises that different gases have notably different global warming potential (GWP)[1].

Construction Phase

21.4.10 The construction phase GHG assessment quantified GHG emissions, considered to be net contributions to the global system, from the following sources:

- construction and staff traffic movements to and from the Application Site;
- the use of construction plant and equipment; and
- the use of a diesel generator to provide power to construction activities on the Application Site.

21.4.11 Due to the lack of available information regarding anticipated volumes of construction materials, GHG emissions associated with embodied GHGs in was not carried out. Although embodied GHG emissions in materials could be a large contributor to the overall GHG footprint during construction, they are considered to be an unavoidable one-off emission source over a time limited period, and therefore will not materially affect the outcome of the assessment.

21.4.12 As most of the construction plant and equipment are likely to be diesel powered, Scope 2 GHG emissions associated with the consumption of electricity during the construction phase are anticipated to be minimal and were not considered in the assessment.

21.4.13 The approach to determine GHG emissions from road transport movements and on-site equipment use is provided below.

Road Transport Movements

21.4.14 Road transport movements during the construction phase will be associated with workers travelling to the site via car, and Heavy Goods Vehicle (HGV)

[1] *GWP of a GHG is a measure of how much heat is trapped by a certain amount of gas in the atmosphere relative to carbon dioxide.*

movements. An average trip length of 50 km (each way) for HGV movements, and 10 km (each way) for cars was assumed, based upon advice from the Traffic Consultants. Emission factors were obtained from the BEIS (BEIS, 2020a).

21.4.15 Traffic movements during construction of the Facility were obtained from the Transport Consultants for the Facility. Assumptions made for this assessment correspond to those made for the transport and air quality assessments undertaken in **Chapter 19 Traffic and Transport** and **Chapter 14 Air Quality** respectively. The construction phase traffic movements used to calculate GHG emissions are provided in **Table 21-4**.

Table 21-4 Construction Phase Traffic Movements

Vehicle	Average Daily Trips	Annual Trips*	Average Trip Length (km)	Annual Distance (km)
Cars	375	114,009	10	1,140,086
HGVs	70	21,2810	50	1,064,000
*Assumed 6 day working week, with no bank holiday or public working holiday (8 days)				

On-Site Plant Vehicles

21.4.16 Emissions associated with fuel consumption from on-site vehicles and equipment during construction were calculated from those known at the time of assessment, as listed in **Table 21-5**. The engine power for each vehicle and equipment were obtained from manufacturer specifications.

21.4.17 The known list of construction equipment includes cranes, concrete pumps and a diesel generator to provide power to the site. During the initial stages of construction, each work area will have a local 100 KVA power generator. A larger 3,300 KVA diesel generator will then be established for the remainder of the construction phase. For the purposes of the GHG assessment, emissions were calculated from the use of the permanent 3,300 KVA diesel generator to provide a conservative assessment.

Table 21-5 Site Vehicles to be Used During the Construction Phase (Indicative of Market Equipment)

Vehicle	Number of Vehicles	Assumed Engine Power (kW)
500 Te Terrain Crane	1	240
220 Te Terrain Crane	1	143
160 Te Terrain Crane	1	400
100 Te Terrain Crane	1	129
35 Te Derigging Crane	1	205
40 Te City Crane	1	210

Vehicle	Number of Vehicles	Assumed Engine Power (kW)
Concrete Pumps	2	160
3300 KVA Diesel Generator	1	2,640

21.4.18 The engines for each of the vehicles were assumed to operate at 80% load for the full duration of the working day (12 hours a day) throughout the construction phase. This is likely to be a conservative approach, particularly with respect to the use of cranes during construction.

21.4.19 The number of mobile and earth moving vehicles, such as excavators, will be confirmed as the detailed design progresses, and therefore were not considered as part of the GHG assessment. Use of these vehicles is likely to be intermittent after the initial earthworks phase of the Facility, and therefore are unlikely to be a significant source of GHG emissions during the construction phase.

Operational Phase

21.4.20 The Facility is anticipated to process 1,200,000 tonnes of RDF per year. The current disposal routes for the RDF waste that will be used at the Facility is subject to UK market forces, but it is likely that most of the waste is either landfilled in the UK or exported to energy recovery (i.e. EfW) facilities in Europe. Three scenarios were therefore considered to calculate gross annual GHG emissions associated with the existing baseline, and proposed development options:

- Scenario 1: 'Do Nothing 1', where it was assumed that 100% of the RDF waste is landfilled within the UK;
- Scenario 2: 'Do Nothing 2', where it was assumed that 50% of the RDF waste is landfilled in the UK, and 50% is transported overseas and processed within energy recovery facilities (thermal treatment / EfW); and
- Scenario 3: 'Do Something', where the RDF waste is transported to the Facility and electricity is produced following the thermal treatment process.

21.4.21 The current waste treatment routes for the RDF that would be processed in the Facility are subject to UK market forces and will fluctuate. So, the 'Do Nothing' scenarios are considered to be indicative only to provide context for the impact of the Facility itself.

21.4.22 RDF contains many different waste materials, some of which contain 'carbon', which could be either biogenic carbon such as food waste, or fossil-based such as plastic. GHG emissions arising from the waste disposal options considered in this assessment are highly sensitive to the composition of the waste, particularly the fossil carbon content for thermal treatment processes, and biogenic carbon for landfilled waste.

21.4.23 The exact composition of the waste to be processed at the Facility is not currently known. GHG emissions from the Facility were calculated based on first principles using the anticipated CO_2 content of the exhaust gas from the thermal treatment process. This was compared to existing waste disposal routes, using known emission factors for landfilled waste in the UK, and existing EfW facilities in Europe.

21.4.24 The Facility will generate 102 megawatts electric (MWe) (gross) of renewable electricity. A proportion of this will supply the Facility (parasitic load), including the feedstock management and lightweight aggregate (LWA) facilities. Therefore, 80 MWe is planned to be exported to the National Grid. As the Facility will generate its own renewable power, there are not anticipated to be any notable Scope 2 GHG emissions during the operational phase.

21.4.25 The GHG emission sources considered for each Scenario are provided in **Table 21-6**. Further information regarding the approach undertaken to calculate GHG emissions for each source is provided below.

Table 21-6 GHG Emissions Sources Considered for Each Scenario

Scenario	Parameter
Scenario 1 - (Do Nothing 1, 100% UK Landfill)	Landfilled UK Waste
Scenario 2 - (Do Nothing 2, 50% UK Landfill, 50% Exported to EfW Facilities)	Landfilled UK Waste
	EfW Generation in other countries
	Marine Vessel Movements (UK to other countries)
Scenario 3 – (Do Something, Operational Emissions Associated with the Facility)	EfW Generation
	Marine Vessel Movements (UK to UK)
	Road Transport Movements
	Combustion of Fuel from On-site Plant

21.4.26 Electricity will be generated for the UK market as a result of the thermal treatment process in Scenario 3. Therefore, net CO_2eq emissions, which account for the production of electricity, were calculated to determine the 'net effect' to GHG emissions associated with the operation of the Facility.

Scenario 1: Do Nothing 1 (100% Landfilled UK)

21.4.27 Under Scenario 1, all of the 1,200,000 tonnes of RDF waste that would be processed each year at the Facility is disposed at landfill sites within the UK. It was assumed that 64% of the RDF is domestic, and 36% is industrial and commercial waste, as detailed in **Plate 2.1** in **Chapter 2 Project Need**. Emission factors for landfilled waste in the UK were obtained from BEIS (BEIS, 2020a). The

emission factor encompasses 'gate to grave' emissions, which includes collection, transportation and landfill GHG emissions.

Scenario 2: Do Nothing 2 (50% Landfilled UK, 50% Exported to EfW Facilities in Europe)

21.4.28 For Scenario 2, it was assumed 600,000 tonnes (50%) of the RDF waste is landfilled in the UK, where the same methodology as Scenario 1 was adopted. In addition, it was assumed that the remaining RDF waste would be exported overseas to be used in EfW facilities. GHG emissions (gross) were therefore considered from the transport of the waste by marine vessel, and from the thermal treatment process to generate electricity.

Marine Vessels

21.4.29 It was assumed that the RDF is transported by cargo vessels from the UK to be processed in other countries. The distances travelled by cargo vessels was derived using RDF export data from England in 2019, which included ports in Europe and the USA. For the purposes for this scenario, the export of RDF was limited to Europe. It was assumed that the origin port in the UK for the RDF exports was Tilbury, and cargo vessels less than 10,000 DWT (dead weight tonne) were utilised to transfer the waste. The assessment only calculated emissions associated with the outbound trip carried out by the vessel, as any emissions associated with further journeys would be accounted for by a separate entity, organisation or process.

21.4.30 Emission factors were obtained from guidance provided by the GloMEEP Project Coordination Unit and the International Association of Ports and Harbors (IAPH) (GloMEEP & IAPH, 2018). The cargo vessels were assumed to travel at an average speed of 28.2 km/hr (GloMEEP & IAPH, 2018). Emission parameters for the cargo vessels are provided in **Table 21-9.**

European Energy from Waste Process

21.4.31 The specific operating parameters of the European facilities that receive the exported RDF will vary according to each specific facility, and the emissions intensity is driven by a range of factors, including the composition of the waste. Therefore, a range of 250 – 600 kg of CO_2 emissions per tonne of waste processed at EfW facilities in Europe were considered in the assessment (Christensen *et al.*, 2015). This GHG intensity range is similar to similar facilities in Scotland determined in a recent study by Zero Waste Scotland (Zero Waste Scotland, 2020).

Scenario 3 – Do Something

21.4.32 Scenario 3 accounted for GHG emissions that would be released during operation of the Facility. The assessment considered emissions from the thermal treatment process, movement of marine vessels and road traffic vehicles, and from the use of on-site plant and equipment.

Thermal Treatment Process

21.4.33 Around 1,200,000 tonnes of RDF will be supplied to the thermal treatment plant each year.

21.4.34 The Facility will also include the connection of two of the three thermal treatment lines to CO_2 recovery plants. Full details of the CO_2 plants are provided in **Chapter 5 Project Description**. The plants will recover a total 5,000 kg of CO_2 per hour per line, across the two lines (80,000 tonnes CO_2 per annum based upon 8,000 hours operation per line), which will be used for off-site uses in various industries and some retained on site as part of the fire-fighting system.

21.4.35 The information used to calculate GHG emissions associated with the thermal treatment process are provided in **Table 21-7**, which were assumed to be in operation for 8,000 hours of the year.

Table 21-7 Parameters Used to Calculate GHG Emissions per Line

Parameter	Unit	Value
Flue Gas to Stack per Line (dry)	kg / hour	287,641
Volume of CO_2 in Exhaust Gas	%	9.99
CO_2 Released per Line	tonnes / hour	28.7
CO_2 Released per Line	tonnes / year	229,883
Total CO_2 Emissions from Thermal Treatment Process without CO_2 Recovery	tonnes / year	689,647
CO_2 Recovery per Line	kg / hour	5,000
CO_2 Recovery for Two Lines	tonnes / year	80,000
Total CO_2 Emissions from Thermal Treatment Process with CO_2 Recovery	tonnes / year	609,649

Vessel Movements

21.4.36 RDF will be delivered to the site via cargo vessels, with an average load of 2,500 tonnes per call. In addition, LWA material will be exported from the Application Site via bulk carriers with an average load of 3,000 tonnes.

21.4.37 It was assumed that the RDF waste would be supplied equally from 12 UK ports. The travel time and distance to each port is provided in **Table 21-8**. The destination for the LWA export is currently unknown, but it is likely to be to a port on the south- east coast of the UK. Therefore, an average distance of 300 km per LWA export was assumed in the assessment.

Table 21-8 Distance and Duration of Vessel Movements Delivering RDF from Port to Application Site

Port	Number of Vessel Movements	Distance to Application Site (km)	Average Speed (km/hour)	Hours per Trip	Total Annual Activity Hours
Clydeport	40	1,459	28.2	51.7	2,070
Montrose	40	475	28.2	16.8	674
Grangemouth	40	510	28.2	18.1	723
Fleetwood	40	1,405	28.2	49.8	1,993
Hartlepool	40	260	28.2	9.2	369
Hull	40	123	28.2	4.4	174
Great Yarmouth	40	150	28.2	5.3	213
Ridham	40	337	28.2	12.0	478
Sheerness	40	327	28.2	11.6	464
Southampton	40	545	28.2	19.3	773
Port Talbot	40	113	28.2	4.0	160
Belfast	40	1,446	28.2	51.3	2,051

21.4.38 Vessel parameters and emission factors were obtained from GloMEEP and IAPH guidance (2018). Emissions were calculated from propulsion and auxiliary engines whilst the vessels are cruising, and in a Reduced Speed Zone (RSZ). The RSZ was assumed to be whilst the vessels are travelling on The Haven, where each vessel would require one hour to travel each way. Emission parameters for the marine vessels delivering RDF waste and removing LWA are provided in **Table 21-9**.

Table 21-9 Vessel Parameters for Vessels Delivering RDF and Removing LWA

Product	Vessel Type	Average Vessel Load (tonnes)	Propulsion Engine Capacity (kW)	Auxiliary Engine Capacity (kW)
RDF	Cargo Vessel (> 10,000 DWT)	2,500	1,008	193
LWA	Bulk Carrier (> 5,000 DWT)	3,000	1,879	193

Road Transport Movements

21.4.39 Road transport movements during the operational phase will be associated with workers travelling to and from the Application Site via car, and HGV movements. An average trip length of 50 km (each way) for HGV movements, and 10 km (each way) for cars was assumed. Emission factors were obtained from BEIS (BEIS, 2020a).

21.4.40 Traffic movements during operation of the Facility were obtained from the Transport Consultants for the project. Assumptions made for this assessment correspond to those made for the transport and air quality assessments undertaken in **Chapter 19 Traffic and Transport** and **Chapter 14 Air Quality** respectively. The operational phase traffic movements used to calculate GHG emissions are provided in **Table 21-10**.

Table 21-10 Operational Phase Traffic Movements

Vehicle	Daily Trips	Annual Trips	Average Trip Length (km)	Annual Distance (km)
Cars	173	53,824	10	538,241
HGVs	30	9,360*	50	468,000
*Assumed 6 working days per week				

On-Site Plant and Vehicles

21.4.41 The operational phase GHG assessment also considered emissions associated with fuel consumption from on-site vehicles, which included those listed in **Table 21-11**. The engine power for each vehicle were obtained from manufacturer specifications.

Table 21-11 Site Vehicles to be Used During the Operational Phase (Indicative of Market Equipment)

Vehicle	Number of Vehicles	Assumed Engine Power (kW)
Liebherr LH 110 Port Litronic	4	300
Forklifts	4	55
>30 Te Tractor Unit	2	403
Operations Vans	2	127
Multi Seat Crew Bus	1	209

21.4.42 The engines for each of the vehicles were assumed to operate at 80% load for 21 hours a day to present a conservative scenario.

Emission Factors

21.4.43 Emission factors used in the assessment for the sources detailed above are detailed in **Table 21-12**. Where possible, emission factors in units of CO_2eq were obtained. Where emission factors were not available for CO_2eq, a calculation was undertaken which used the functionally-equivalent amount or concentration of CO_2 as the 'reference'.

Table 21-12 Emission Factors for Fuel Oil On-Site Vehicles during the Operational Phase

Parameter	CO_2eq emission factor	CO_2 emission factor	CH_4 emission factor	N_2O emission factor	Emission Factor Unit	Source
Landfilled Municipal Waste (UK)	437.4	N/A	N/A	N/A	kg per tonne of waste	BEIS, 2020a
Landfilled Commercial and Industrial Waste (UK)	458.2	N/A	N/A	N/A	kg per tonne of waste	BEIS, 2020a
Marine Vessel Propulsion Engines	N/A	683	0.03	0.01	g per kWh	GloMEEP & IAPH, 2018
Marine Vessel Auxiliary Engines	N/A	722	0.03	0.01	g per kWh	GloMEEP & IAPH, 2018
Gas Oil Consumption by On-site Plant	0.257	N/A	N/A	N/A	kg per kWh	BEIS, 2020a
Existing Energy from Waste Facility	250 - 600	N/A	N/A	N/A	kg per tonne of waste	Christensen, 2015
HGV Movements	0.865	N/A	N/A	N/A	kg per km	BEIS, 2020a
Car Movements	0.168[a] 0.163[b]	N/A	N/A	N/A	kg per km	BEIS, 2020a

[a] – Assumed a ratio of 45% petrol cars, 54% diesel cars and 1% electrical cars, in line with DfT projections for the start of the construction phase (DfT, 2018)
[b] - Assumed a ratio of 44% petrol cars, 51% diesel cars and 5% electrical cars, in line with DfT projections for the start of the operational phase (DfT, 2018)

21.4.44 The emission factors listed in **Table 21-12** are considered to be representative of GHGs released from activities in the present day (2020 or recent). It is anticipated that many sectors, including shipping and road transport, will decarbonise in response to regulations and improvements in technology, thus future emission factors are anticipated to be less carbon intensive. For the purposes of the

assessment, emission factors were assumed to remain at present day values to present conservative scenarios, particularly for the operational phase of the Facility where emissions are likely to be an overestimation.

Climate Change Resilience (CCR) Assessment

21.4.45 An assessment of the resilience and vulnerability of the design and infrastructure to the projected effects of climate change was undertaken over the operational lifespan of the Facility. This assessment identifies the likelihood of climate hazards occurring within the study area, and the consequences of the impact will be highlighted.

Approach

21.4.46 A four-step methodology was applied for the CCR assessment. The initial stages of the assessment aim to identify the climate variables to which the Facility could be vulnerable to during its lifetime. A more detailed risk assessment was then undertaken following the identified of influencing climate variables, to assess the level of risk associated with the hazards posed by the predicted changes in climate variables.

21.4.47 The approach carried out for each step of the CCR assessment is provided below.

Step 1: Identifying climate variables

21.4.48 The first step of the CCR assessment was to identify the receptors which may potentially be impacted by climate change hazards. Those receptors identified should include both known receptors (such as receptors reported / known to have already experienced a climate-related event (i.e. flooding)) and unknown receptors which are yet to be impacted according to available data and literature.

Step 2: Climate vulnerability assessment

21.4.49 Stage 2 consisted of a qualitative assessment (informed by professional judgement and supporting literature) of the Facility to changes in the climate variables. Vulnerability is considered to be a function of:

- The sensitivity of the Facility and any associated infrastructure to climate variables; and
- The exposure (both spatially and temporally) of the Facility and its associated infrastructure to climate variables.

21.4.50 Both the sensitivity and the exposure of the Facility and its associated infrastructure to climate variables were considered in the vulnerability assessment. This approach attributes either a high, moderate or low sensitivity / exposure categorisation to each vulnerability.

21.4.51 Overall vulnerability is determined by considering the interrelationship between the exposure and the receptor sensitivity, as set out in **Table 21-13**.

Table 21-13 Sensitivity / Exposure Matrix for Determining Vulnerability Rating

Sensitivity	Exposure		
	Low	Moderate	High
Low	Low vulnerability	Low vulnerability	Low vulnerability
Moderate	Low vulnerability	Medium vulnerability	Medium vulnerability
High	Low vulnerability	Medium vulnerability	High vulnerability

21.4.52 Climate change projection data was obtained from the UKCP18 database, which was used to identify the climate variables within the study area for three representative concentration pathways (RCP) (RCP 2.6, RCP 6.0 and RCP 8.5). Data were obtained for the 10th, 50th and 90th percentiles for each RCP, in accordance with the requirements of the NPS.

21.4.53 Further information related to the vulnerability of the Facility to the projected effects of climate change were obtained from the other topic chapters such as **Chapter 13 Surface Water, Flood Risk and Drainage Strategy** and **Appendix 13.2 Flood Risk Assessment**.

21.4.54 For those vulnerabilities categorised as medium or high, the risk of climate change to the design and infrastructure of the Facility, and consequently to its operation was then determined through Steps 3-4 of the assessment process.

Stage 3: Risk assessment

21.4.55 For those vulnerabilities categorised as medium or high, climate-related hazards were identified through professional judgement. The risks of the Facility and its associated infrastructure to the occurrence of a hazard event were qualitatively identified through a hazard likelihood and consequence matrix, as detailed in **Table 21-14**.

Table 21-14 Likelihood / Consequence Matrix for Determining Risk Rating

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	Medium	High	Extreme
Moderate	Low	Low	Medium	High	Extreme
Unlikely	Low	Low	Medium	Medium	High
Very unlikely	Low	Low	Low	Medium	Medium

Stage 4: Mitigation

21.4.56 For climate risks to the Facility or its associated infrastructure identified as 'medium' or higher, further mitigation measures were identified by professional judgement. With the proposed mitigation measures taken into consideration, a residual risk rating was assessed.

21.4.57 For each hazard, a resilience rating is identified as one of the following:

- **High** – strong degree of climate resilience. Remedial action or adaptation may be required but is not a priority.
- **Moderate** – a moderate degree of climate resilience. Remedial action or adaptation is recommended.
- **Low** – a low level of climate resilience. Remedial action or adaptation is required as a priority.

Impact Significance

GHG Assessment

21.4.58 There is no single preferred method to evaluate the significance of GHG emissions arising from a 'project'. IEMA guidance advises that all releases of GHGs might be considered to be significant, but professional judgement should be used to contextualise a project's GHG budget (IEMA, 2017). The rationale for this approach is that any additional GHG emissions could compromise the UK's ability to meet its future Carbon Budgets and reduction targets as part of the Climate Change Act 2008.

21.4.59 The approach adopted to contextualise GHG emissions arising from operation of the Facility compared predicted emissions to the two 'Do Nothing' scenarios. In addition, 'net' CO_2eq emissions, which includes the provision of electricity from the Facility to the grid were evaluated.

21.4.60 Furthermore, in the absence of any sector-based or local emissions budgets, the UK Carbon Budgets were used to contextualise GHG emissions from construction and operation of the Facility.

21.4.61 Construction of the Facility will primarily take place within the period of the 4th UK Carbon Budget (2023 – 2027), where the current budget is 1,950 $MtCO_2e$. In addition, predicted GHG emissions during construction were compared to existing levels within the BBC administrative region to provide further context.

21.4.62 The 6th Carbon Budget, published in December 2020, was the first Carbon Budget to be released following the adoption of the 2050 Net Zero target by the UK Government, which sets a limit on GHG emissions released in the period 2033 - 2037. Approximately 20% of emissions are projected to arise from industrial sources, and 10% from grid electricity. It is anticipated that the Facility will operate during this five year period, therefore annual GHGs arising from activities associated with the Facility were compared to the emission limit set out in the 6th Carbon Budget.

21.4.63 To provide context for emissions from the Facility within the 4th and 6th Carbon Budget, emissions from construction and operational activities were considered to be significant if they contributed more than 1% of the UK Carbon Budget in which they arise. This 1% threshold figure was derived from the PAS 2050 Specification (British Standards Institution, 2011), which advises that minor emission sources can be excluded from emission inventories if they contribute to less than 1% of the total inventory.

21.4.64 Therefore, for the purpose of this assessment, emissions arising from the Proposed Development were considered to have a significant effect on the climate where GHGs are equal to or more than 1% of the respective UK Carbon Budget.

CCR Assessment

21.4.65 The significance of the CCR assessment was determined through consideration of the residual risk and resilience rating applied to each hazard identified. **Table 21-15** presents the matrix used to identify the overall significance of climate change resilience.

Table 21-15 Significance Criteria

Risk Rating	Resilience Rating		
	High	Moderate	Low
Extreme	Significant	Significant	Significant
High	Not significant	Significant	Significant
Medium	Not significant	Not significant	Significant
Low	Not significant	Not significant	Not significant

Embedded Mitigation

21.4.66 As part of the project design, several embedded mitigation measures are proposed to reduce potential impacts on climate change. These measures are considered standard industry practice for this type of development.

GHG Assessment

21.4.67 The Facility will include the connection of two thermal treatment lines to CO_2 recovery plants, producing CO_2 to be beneficially re-used in various industries, including part of the on-site fire prevention measures. Full details of the CO_2 recovery system are provided in **Chapter 5 Project Description**. Other measures include the use of heat exchangers, heat re-use within the plant and the positioning of the proposed Facility to enable material transport by river.

CCR Assessment

21.4.68 As described in **Appendix 13.2 Flood Risk Assessment**, there are ongoing improvements to the flood defences near the Application Site. Embedded mitigation for the Facility includes both primary and secondary flood defence lines. The primary flood defence line would be formed by the wharf and would replace the existing Environment Agency flood defence and increase the height of the flood defence line at the Application Site.

21.4.69 Improvements to the tidal defences around the Application Site are being carried out through the Boston Combined Strategy (BCS), which will provide Boston town with a 1 in 300 year standard of protection against tidal flooding. The BCS is being implemented over five phases. In addition, the Boston Tidal Barrier is still programmed for completion by the end of 2020, as the project was identified by the Government as critical infrastructure with works continuing throughout 2020 (EA, 2020). The Boston Tidal Barrier is to be constructed with a crest height of 7.55 m AOD which includes a freeboard allowance for wave action due to wash from vessels.

21.4.70 The Application Site is located within the area that will be subject to improvement

and upgrade works as part of the Haven Banks Project, which forms Phase 5 of the BCS. This is an adaptive defence scheme that will implemented to enable the Haven Banks to address increasing risk associated with climate change. The Haven Banks Project is programmed for construction between June 2019 and December 2020. This phase of Haven Banks Project works will comprise a minimum crest height of 6.5 m AOD, suitable to provide protection for projected flood levels associated with 50 years of climate change.

21.4.71 The proposed primary defence line for the Facility has been determined following discussion with the Environment Agency and takes account of the future ambitions of the BCS. The proposed flood defence line for the proposed wharf is 7.2 m AOD.

21.4.72 A flood action plan for the Facility will be implemented, which will include procedures to receive and react to flood warnings, and closure or evacuation of the Facility with sufficient time before a flood event.

21.4.73 There will be an increase in impermeable areas and associated surface water run-off during the construction and operational phases of the Facility. A surface water drainage system would be built as part of the enabling works to manage the increase in surface water run-off.

21.4.74 The surface water drainage requirements will be finalised post-DCO submission and prior to construction. The Surface and Foul Water Drainage Strategy will be designed to meet the requirements of the NPPF, NPS EN-1 and the CIRA Sustainable Drainage System (SuDS) Manual C753 with runoff limited where feasible, through the use of infiltration and /or attenuation which can be accommodated within the area of the development.

21.4.75 Embedded mitigation related to surface water drainage matters is also detailed in **Chapter 13 Surface Water, Flood Risk and Drainage Strategy**.

Assumptions and Limitations

21.4.76 The GHG assessment is scenario-based, since RDF feedstock supply is not identified as originating from a specific source. There is uncertainty regarding GHG emissions from the different scenarios considered in the assessment, which is driven by different carbon intensities of waste streams.

21.4.77 The assessment also considered the effect of avoided emissions elsewhere in the system in a net CO_2 emission calculation. This accounted for the fact that development of the Facility would avoid emissions associated with fossil fuelled power production (through contributing to renewable energy generation), and

transport of feedstocks overseas and/or landfilling of waste (depending on the baseline scenario considered), as well as avoiding emissions associated with primary aggregate extraction (through development of the LWA facility).

21.4.78 When estimating GHG reductions, it was assumed that electricity produced by combined cycle gas turbine (CCGT) is displaced (0.371 kg/kWh), as CCGT is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2020c).

21.4.79 Although not considered as part of the assessment, embodied GHG emissions within construction materials will be minimised as far as practicable. This will be achieved by reducing quantities of materials required during construction though efficient design and use of materials with a lower embodied GHG intensity where possible.

21.4.80 A key assumption of the climate change projection data from the UKCP18 is that the model is strongly dependent on future global GHG emissions. The RCP scenarios cover a recent set of assumptions based upon future population dynamics, economic development and account for international targets on reducing GHG emissions. Each RCP scenario has a different climate outcome, given they are based upon different set of assumptions. The three RCP scenarios presented within this chapter (RCP 2.6, RCP 6.0 and RCP 8.5) are considered the most likely to occur over the lifespan of the Facility. However, the UKCP18 guidance cautions that the scientific community cannot reliably place probabilities on which scenario of GHG emissions is most likely.

21.4.81 Due to the intrinsic uncertainty within climate projections, the UKCP18 data is based upon probabilistic projections generating a normally-distributed model per output. The projections give values for the 10th, 50th and 90th percentiles, which covers the range of uncertainty.

21.5 Existing Environment

Regional GHG Emissions

21.5.1 The BEIS '*Emissions of carbon dioxide for Local Authority areas'* online database discloses the UK's CO_2 net emissions, which in 2018 were estimated at 344,824 kt CO_2 (BEIS, 2020b). CO_2 emissions from the BBC region were 312.5 kt, which contributed less than 0.1% towards the UK's total. **Table 21-16** presents annual CO_2 emissions in the BBC region from 2005 to 2018.

Table 21-16 Boston Region CO_2 Emission Estimates 2005-2018 (kt CO_2) (BEIS, 2020b)

Year	Industry and Commercial	Domestic	Transport	Total
Annual kt CO_2				
2005	185.9	157.1	120.1	465.8
2006	183.9	157.9	120.5	464.9
2007	178.4	154.7	121.0	455.6
2008	179.4	153.0	114.4	448.7
2009	162.0	139.6	110.5	414.8
2010	167.6	150.6	110.9	431.1
2011	144.7	131.4	109.7	387.4
2012	161.5	140.0	107.7	410.6
2013	151.1	135.4	107.4	394.9
2014	137.3	113.7	109.1	360.4
2015	123.0	109.5	112.1	344.8
2016	105.0	105.3	114.2	324.7
2017	97.6	97.9	116.8	312.4
2018	93.7	97.3	116.4	308.7

21.5.2 Transport was the largest contributing sector to GHG emissions within the Boston region in 2018, responsible for emissions estimated at 116.4 kt CO_2.The industry and commercial, and domestic sectors contributed 93.7 kt and 97.3 kt of CO_2 respectively during 2016.

21.5.3 The data in **Table 21-16** shows that annual CO_2 emissions within the Boston region have decreased by 34% from 2005 to 2018, with reductions in industrial and domestic emissions largely driving this change.

Existing Climate

21.5.4 The Facility is located on the east coast of England, and currently experiences a 'maritime' climate which is typical of the UK. As it is located on the east coast of England, Boston is situated in a 'rain shadow' and has a drier climate than the UK average.

21.5.5 Existing climate data for the period 1981 to 2010 were obtained from the Coningsby meteorological station, which is the most representative station to the Application Site. Climate data for Coningsby and the UK average are provided in **Table 21-17**.

Table 21-17 Existing Climate at the Coningsby Meteorological Station for the Period 1981 – 2010 (Met Office, 2019)

Climate Variable	Units	Coningsby Annual Average	UK Average
Maximum Temperature (average over 12 months)	^{0}C	14.0	12.4
Minimum Temperature (average over 12 months)	^{0}C	6.0	5.3
Days of Air Frost	Days	48.1	54.6
Rainfall	mm	590.3	1154.0
Days of Rainfall ≥ 1 mm	Days	112	156
Mean Wind Speed at 10 m	Knots	8.6	N/A

21.5.6 **Table 21-17** displays the influence of the maritime setting of the Application Site, compared to the average climate in the UK. Maximum and minimum temperatures are both higher than the UK average, and there are fewer days of air frost. In addition, annual precipitation is 49% less than the UK average.

Projected Climate Change

21.5.7 Climate change projections were used to identify future risk to existing climatic variability within the study area. It is anticipated that the Facility will have a lifespan of at least 25 years. This is the expected operational period and is considered typical of a development of its kind. On reaching 25 years of operation, its ongoing use would be reviewed and if not deemed appropriate to continue then the Facility will be decommissioned. As such, climate forecasts and impacts to the baseline conditions arising from the construction and operation of the Facility have been based on a 25-year lifespan.

21.5.8 Climate change projections for 2050 (average weather from 2040 to 2069) in the 25 km^2 grid square where the Application Site is located were obtained from the UKCP18 database (Met Office, 2018). Data were obtained for three RCPs scenarios, which are defined in

21.5.9 **Table 21-18**. For each of these RCPs, three probabilities were considered, 10% (unlikely), 50% (central estimate of projections) and 90% (projections unlikely to be less than).

Table 21-18 Summary of the RCP Emission Scenarios

RCP	Atmospheric CO_2eq (parts per million) in 2100	Parameters
2.6	421	GHG emissions stay at present levels until 2020, and then start to decline

RCP	Atmospheric CO_2eq (parts per million) in 2100	Parameters
6.0	670	Decline of global GHG emissions begins around 2080
8.5	936	Increasing global GHG emissions throughout 21st century

21.5.10 Data from the RCP emission scenarios presented within

21.5.11 **Table 21-18** were based obtained from the 537500, 337500 25 km land-based grid square which encompasses the Application Site. Changes in climate variables were compared to a baseline period of 1981 to 2000 and are displayed in **Table 21-19**.

Table 21-19 Projected Climate Change within the study area in 2050 (from the 1981-2000 baseline), at the 10th, 50th and 90th Percentile for Three Climate Scenarios (Met Office, 2018)

Climate Variable	Climate Scenario								
	RCP 2.6			RCP 6.0			RCP 8.5		
	10%	50%	90%	10%	50%	90%	10%	50%	90%
Change in precipitation (%)	-10.2	-2.2	6.6	-10.1	-2.1	6.6	-10.2	-1.9	6.5
Change in mean daily maximum temperature (ºC)	0.4	1.4	2.4	0.4	1.3	2.4	0.8	1.9	3.0
Change in mean daily minimum temperature (ºC)	0.3	1.2	2.1	0.3	1.2	2.1	0.7	1.7	2.8
Change in mean temperature (ºC)	0.5	1.3	2.1	0.5	1.2	2.0	0.9	1.8	2.7

21.5.12 The data contained within **Table 21-19** demonstrate that, under all scenarios, the maximum, minimum and mean daily temperatures are projected to increase within the study area. Mean daily maximum temperatures are anticipated to rise between 0.1 ºC to 3.4 ºC at the Application Site over the lifespan of the project, dependent on the RCP and probability scenario. Changes in precipitation are predicted to be the same for each RCP but vary according to each probability scenario showing the potential for increased or decreased annual precipitation levels. Changes in precipitation patterns may result in an increase of surface water flooding or drought at the Application Site.

21.5.13 It is anticipated that climate change will result in an increase in intensive preciptation events in the UK. Environment Agency guidance (2017) suggests a 10% and 20% allowance should be applied to the development of the surface water drainage design for the Facility, as shown in **Table 21-20** (see **Appendix 13.2 Flood Risk Assessment**).

Table 21-20 Peak Rainfall Intensity Allowance in Small and Urban Catchments (1961-90 Baseline)

Applies across all of England	Total Potential Change Anticipated for the '2020s' (2015-2039)	Total Potential Change Anticipated for the '2050s' (2040-2069)	Total Potential Change Anticipated for the '2070s' (2070-2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

21.5.14 **Plate 21-1** and **Plate 21-2** below display the annual average precipitation rate anomaly (%) and the annual average mean air temperature anomaly at 1.5 m (°C) for 2040 to 2059 in all administrative regions, using baseline 1981 to 2000. Climate scenarios RCP 2.6, 6.0 and 8.5 are provided at the 10th, 50th and 90th percentiles across the UK.

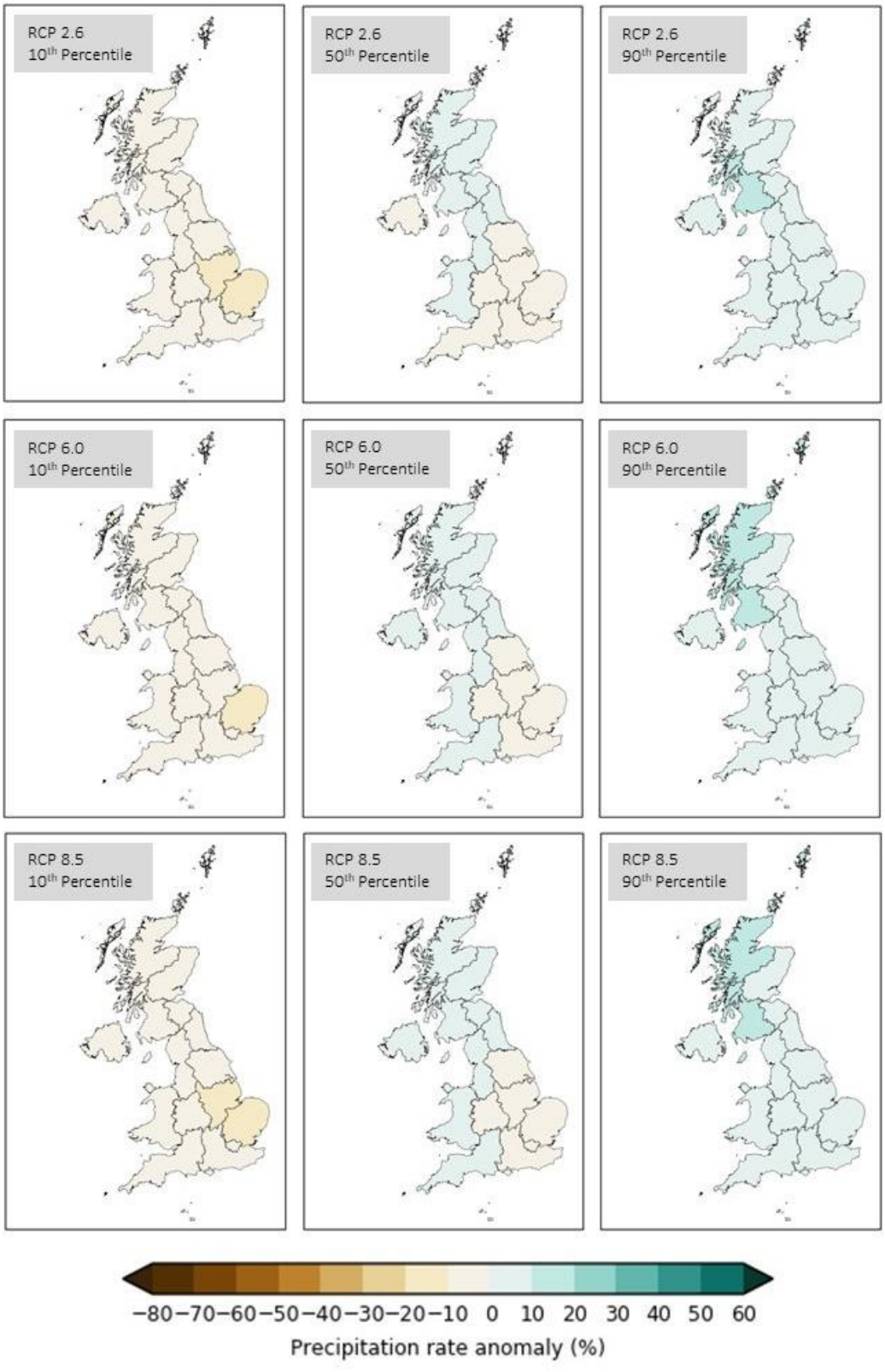

Plate 21-1 Annual Average Precipitation Rate Anomaly (%) for 2040 to 2059 in all Administrative Regions using Baseline 1981-2000, and Scenarios RCP 2.6, 6.0 and 8.5 (Met Office, 2018)

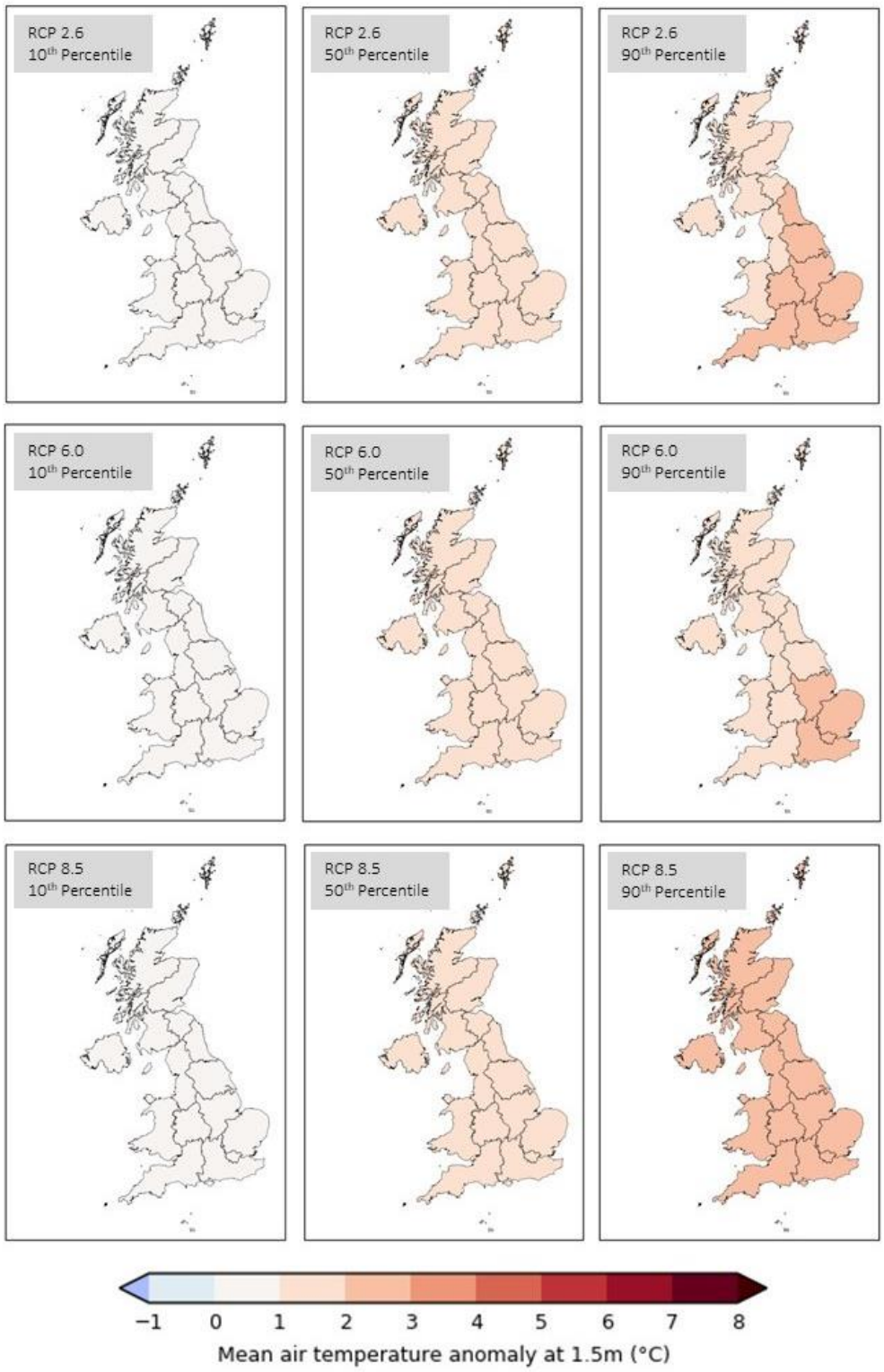

Plate 21-2 Annual Average Mean Air Temperature Anomaly at 1.5 m (ºC) for 2040 to 2059 in all Administrative Regions, using Baseline 1981-2000, and Scenarios RCP 2.6, 6.0 and 8.5 (Met Office, 2018)

Flood Risk

21.5.15 The baseline flood risk information is detailed in **Appendix 13.2 Flood Risk Assessment** and is summarised below.

21.5.16 Flood risk mapping from the Environment Agency confirms that the Application Site is in a Flood Zone 3. This is associated with tidal flood risk rather than fluvial flood risk, and therefore it would be affected by tidal flooding during the 1 in 200 year event, without the presence of any flood defences. There was a tidal flood event on the 5th December 2013, which affected the southern boundary of the Application Site. The maximum tidal water level during the tidal flood was recorded as 5.2 m AOD.

21.5.17 Surface water flood risk on the Application Site is primarily very low, with small areas of increased surface water flood risk across the site associated with existing drains / watercourses and localised low-lying points.

21.5.18 The Application Site would be at high risk of tidal flooding if it did not benefit from existing tidal flood defences, through earth embankments which provide a 1 in 150 year standard of protection. Effective crest levels for the defences are understood to be 6.1 m AOD. The Site also benefits from a secondary flood defence, known as Sea Bank (or 'Roman Bank'), which has a crest level approximately 5.2 m AOD.

21.5.19 The flood defences near the Application Site are currently being improved by a series of schemes, as described in **Section 21.6**.

21.5.20 The projected Sea Level Anomaly (SLA) data, defined as the difference between actual and average sea levels, off the Boston Coastline were obtained from the UKCP18 database (compared to a 1981 to 2000 baseline), and displayed in **Table 21-21** (Met Office, 2018).

Table 21-21 UKCP18 Sea Level Anomaly Data at the Application Site for 2050

RCP	Sea Level Anomaly (m)		
	5% Probability Scenario	50% Probability Scenario	95% Probability Scenario
2.6	-0.843	-0.135	0.591
6.0	-0.885	-0.139	0.589
8.5	-0.867	-0.151	0.596

21.5.21 The data in **Table 21-21** highlights that the SLA off the Boston coastline would increase by 0.161 – 0.392 m, depending on the RCP and probability scenario.

21.6 Potential Impacts

Potential Impacts during Construction

Impact 1: GHG Assessment

21.6.1 Construction phase GHG emissions from the activities considered in the assessment are provided in **Table 21-22**.

Table 21-22 Predicted Annual GHGs During Construction

Scenario	GHG Emission Source	Annual CO_2eq Emissions (Tonnes)
Construction	Road Traffic Movements	1,113
	Construction Plant and Equipment	1,855
	Diesel Generators	1,900
Total for Per Year		**4,198**
Total During Construction (Four Years)		**16,792**

21.6.2 There was estimated to be 4,198 tonnes of CO_2eq released per year from the activities considered in the construction phase GHG assessment. The largest source of emissions was predicted to be road traffic movements, and the use of the diesel generators to provide power to the Application Site.

21.6.3 Estimated GHG emissions per year were approximately 1.4% of the total emissions within the BBC region. It is acknowledged that some emissions sources considered in the assessment will take place outside of the BBC administrative region, particularly from road transport.

21.6.4 Emissions from construction of the Facility contribute approximately 0.001% of the limit set out in the UK 4th Carbon Budget (2023 – 2027). Whilst it is acknowledged that embodied emissions in construction materials were not included as part of the assessment, it is unlikely that the inclusion of this source would significantly affect the outcomes of the assessment.

21.6.5 As GHG emissions released from these sources will only be temporary for the duration of the construction phase and form a relatively small component of existing regional emissions and within the 4th UK Carbon Budget, the release of GHGs during construction is considered to be **not significant**.

CCR Assessment

21.6.6 **Section 21.5** identified that the main climate hazards with the potential to impact

upon the Facility are likely to be an increase in temperature, flood risk and drought conditions at the Application Site. The construction phase is anticipated to be 48 months, commencing in 2022. Given the timescales over which the climate changes, there is not anticipated to be any significant effects of projected climate change to construction activities.

21.6.7 Following implementation of the surface water drainage scheme in the enabling works, there is anticipated to be a **negligible** effect on the risk of surface water flooding during construction, as detailed in **Appendix 13.2 Flood Risk Assessment**.

21.6.8 Given that climate impacts upon the Facility are not considered to occur during the construction phase, these climate hazards have not been considered further within the subsequent steps forming the CCR assessment (i.e. climate vulnerability, risk assessment and mitigation / resilience tests).

Potential Impacts during Operation

Impact 1: GHG Assessment

21.6.9 Predicted (gross) GHG emissions from each assessment scenario, in accordance with the methodology in **Section 21.4** are provided in **Table 21-23**.

Table 21-23 Predicted Annual Gross GHG from Each Scenario

Scenario	GHG Emission Source	Annual CO_2eq Emissions (Tonnes)
Scenario 1	Landfilled Waste in UK	533,834
Total for Scenario 1		**533,834**
Scenario 2	Landfilled Waste in UK	266,917
	Marine Vessel Movements	5,718
	European EfW Facility	150,000 – 360,000 (as CO_2)[1]
Total for Scenario 2		**422,635 – 632,635**
Scenario 3	Marine Vessel Movements	9,397
	Road Traffic Movements	493
	On-Site Plant	4,458
	Thermal Treatment Process	609,649 (as CO_2)

Scenario	GHG Emission Source	Annual CO_2eq Emissions (Tonnes)
Total for Scenario 3		**623,996**

[1] – Based on the range of the carbon intensity of the EfW process identified in **Table 21-12**.

21.6.10 GHG emissions from Scenario 1 (i.e. landfilling the waste) were predicted to be 533,834 tonnes of CO_2eq per year. Due to the range of carbon intensity of EfW processing in European facilities, GHG emissions from Scenario 2 ranged from 422,769 to 632,769 tonnes of CO_2eq per year. Gross GHG emissions arising in Scenario 3 were predicted to be 623,996 tonnes of CO_2eq per year. The methodology for determining GHG emissions from the thermal treatment process in Scenario 3 was considered to be conservative, as it assumed that all three lines would operate at full capacity for the full operating hours in the year (8,000 hours).

21.6.11 The Facility will provide 80 MWe to the National Grid, and it is expected that it would displace energy generated from fossil fuel sources within the UK. When estimating GHG reductions, it was assumed that electricity produced by CCGT is displaced (0.371 kg/kWh), as this is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2020c).

21.6.12 Considering the displaced CO_2eq emissions associated with energy from fossil fuel sources, the GHG 'contribution' of the Facility is provided in **Table 21-24**.

Table 21-24 Annual CO_2eq Emissions Contribution of the Facility

Scenario	Annual CO_2eq Emissions (Tonnes)		
	Gross Emissions	Emissions Saving from 80 MW Renewable Energy	Emissions Contribution of the Facility
Scenario 3	623,996	237,440	386,556

21.6.13 Annual net CO_2eq emissions from the Facility, when compared to the two 'Do Nothing' waste treatment scenarios are detailed in **Table 21-25**.

Table 21-25 Net Annual CO_2e Emissions Compared to Scenario 1 and Scenario 2

Scenario	Annual CO_2eq Emissions (Tonnes)		
	Gross Emissions	Scenario 3 Emissions Contribution	Net Emissions
Scenario 1	533,834	386,556	-147,278
Scenario 2 (Lower Range)	422,635		- 36,079

Scenario 2 (Upper Range)	632,635		- 246,079

21.6.14 The results in **Table 21-25** show that the scenarios considered in this assessment indicate a decrease in GHG emissions in Scenario 3, once the net effect of providing electricity to the grid is accounted for.

21.6.15 In Scenario 2, there is no net climate gain in the UK from electricity contribution to the grid from the EfW process, but it is acknowledged that there would be a gain in other European countries where the waste would be processed.

21.6.16 As the composition and source of the RDF is unknown at this time, UK average emission factors for landfilled waste were used in this assessment. Therefore, the results presented are indicative only, but can be used to provide context for GHG emissions arising from the Facility. However, it is recognised that the BEIS emission factors for landfilled waste are much higher when compared to the values provided for 'combustion' of waste with energy recovery (BEIS, 2020a).

21.6.17 A study carried out by Zero Waste Scotland identified that there are many uncertainties in attributing GHG emissions associated with different waste disposal options. The composition of RDF is variable and is changing, and emissions from both waste treatment options are highly sensitive to the composition of fossil and biogenic waste (Zero Waste Scotland, 2020). However, it is considered likely that GHG emissions associated with provision of the Facility would be lower or similar when compared to landfilled waste streams.

21.6.18 Gross GHG emissions arising from operation of the Facility are predicted to contribute approximately 0.06% per year to the 6th UK Carbon Budget (or 0.3% over the five year period). As such, the Facility is not considered to have a significant effect on the UK meeting its Carbon Budgets that are implemented up to 2032.

21.6.19 The implementation of the Facility was not predicted to increase GHG emissions compared to the other current indicative waste management options considered in the assessment, and the GHG contribution from the operation of the Facility is not likely to be a significant increase in terms of national emissions. The effect of operational GHG emissions from the Facility was therefore determined to be **not significant**.

Impact 2: CCR Assessment

Step 1 Identifying climate variables

21.6.20 This section provides a summary of projected climate change variables and the

associated hazards anticipated to interact with the Facility during its operational phase.

21.6.21 A review of UKCP18 data in **Section 21.5** identified that the main climate hazards over the operational lifespan of the Facility are likely to be:

- An increase in temperature at the Application Site;
- An increase in drought conditions; and
- An increase in flood risk through a higher risk of hazardous precipitation events causing surface water flooding events and storm surges resulting in tidal flooding.

21.6.22 The vulnerability, and by extension the resilience, of the Facility to these climate parameters was therefore consider at Step 2 of the CCR assessment.

Step 2 Climate vulnerability assessment

Temperature

21.6.23 The Facility is considered to have a high exposure to ambient temperature increases, although a **low** sensitivity to any such climatic change, as the components of the Facility are not inherently sensitive to changes in temperature. Overall the Facility is assessed to have a **low** vulnerability to air temperature changes over its lifetime in accordance with the criteria detailed in **Table 21-13**.

21.6.24 Given the vulnerability rating of the Facility is **low**, an assessment of the predicted effects and associated risks of an increase in temperatures at the Facility (Step 3) was not carried out.

Drought Conditions

21.6.25 RDF will be delivered to the Application Site via cargo vessels to the new wharf which will be constructed as part of the Facility. As The Haven is tidal, there are not anticipated to be any significant effects associated with an increase in drought conditions disrupting the supply of RDF to the Facility. As such, the exposure to drought conditions of the Facility is considered to be **low**, and the sensitivity **moderate.** It was therefore determined that the Facility has a **low** vulnerability to drought conditions in accordance with the criteria detailed in **Table 21-13**.

21.6.26 An assessment of the impacts and associated risks of an increase in drought conditions (Step 3) was not carried out, since the vulnerability rating was identified as **low**. As such, drought conditions was not considered further in the assessment.

Flood Risk

21.6.27 Climate change may exacerbate the risk of flooding in the Application Site by an increase in tidal water levels, and an increase in the duration and intensity of rainfall events likely to affect surface or tidal water flooding.

21.6.28 As discussed in **Appendix 13.2 Flood Risk Assessment** and **Section 21.5**, the most likely source of flooding to the Application Site is tidal flooding from The Haven. The Application Site is located along part of the frontage included within the Haven Banks flood defence improvement works and the BCS, which will provide Boston town with a 1 in 300-year standard of protection. Currently, the Application Site benefits from protection against 1 in 150-year flood events in the form of earth embankment tidal defences classified as 'good' by the Environment Agency. Improvement works associated with the Haven Banks project will be constructed along the frontage in front of the Application Site prior to the commencement of operations at the Facility, affording the Facility additional protection against flooding. The flood defence line will also be increased by the Facility itself, by raising the level at the wharf to 7.2 m AOD.

21.6.29 **Appendix 13.2 Flood Risk Assessment** details the potential risk from tidal flooding, which includes consideration of the Environment Agency's tidal climate change allowances to uplift the 1 in 200-year and 1 in 1,000-year still water levels to the present day scenario (i.e. 2020). The overall risk of tidal flooding is considered to be low, as the Facility is protected by the presence of defences.

21.6.30 It is considered that the exposure of the Facility to increased flood risk from tidal sources is **low** and has a sensitivity of **moderate** to increasing tidal flood risk. The overall vulnerability rating for the Facility in terms of tidal flood risk is therefore considered to be **low**.

21.6.31 The Facility will result in permanent chances to land use and the drainage system from existing greenfield agricultural land, the majority of which is permeable, to an impermeable area. This has the potential to create a permanent increase in surface water flood risk, however, as stated in **Chapter 13 Surface Water, Flood Risk and Drainage Strategy**, this is considered to have a low magnitude of effect.

21.6.32 Therefore, the exposure of the Facility to increased flood risk from pluvial sources is assessed to be **low** and has a sensitivity of **moderate** to increasing pluvial flood risk. As such, the overall vulnerability rating for the Facility in terms of pluvial flood risk is considered to be **low** in accordance with the criteria detailed in **Table 21-13**.

Summary

21.6.33 The CCR assessment identified the vulnerability and resilience, of the Facility to the main climate hazards likely to occur over its operational lifespan. The assessment determined that the vulnerability rating for each climate hazard would be **low.** Therefore, steps 3 and 4 of the methodology for the CCR assessment are not required, and the effect from climate change variables is assessed as **not significant**.

Additional Mitigation

GHG Assessment

21.6.34 No additional mitigation measures beyond the embedded mitigation set out within the above section are considered necessary, as the Facility is considered not to have a significant net effect upon the UK's climate change emissions or ability to meet currently identified Carbon Budgets.

CCR Assessment

21.6.35 With inclusion of the embedded mitigation measures related to flooding at the Application Site, the effects of projected climate change to the Facility are considered to be **not significant**. **Chapter 13 Surface Water, Flood Risk and Drainage Strategy** provides details of site-specific mitigation relating to flood risk, such as the provision of a (SuDS).

21.7 Cumulative Impacts

21.7.1 The global atmosphere is the receptor for the GHG assessment, therefore there are no common receptors between this assessment and other disciplines considered in the ES. GHG emissions have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. The GHG assessment is therefore considered to be inherently cumulative.

21.7.2 All projects considered for the cumulative impact assessment for the CCR assessment are listed within **Table 21-26**, along with a justification for their consideration.

Table 21-26 Summary of Projects Considered for the CIA in Relation to Climate Change

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
Boston Barrier Flood Defence	Transport and Works Act Order consented	2017 – ongoing (completed August 2021)	Boston Barrier at closest point to the Application Site is 500 m.	ES	Complete / high	Yes	Potential to affect tidal flooding within the Application Site.
Battery Energy Storage Plant (Marsh Lane) B/17/0467	Application approved	2017 - ongoing	Beeston Farm less than 10 m from the Application Site	Detailed application	Incomplete / low	Yes	Potential to affect surface water flooding within the Application Site.
The Quadrant Mixed-use development of 502 dwellings and commercial/ leisure uses B/14/0165	Application approved Construction started	2014 - ongoing	Quadrant 1 1.2 km from the Application Site	Details within ES	Quadrant 1 – Complete/ high Quadrant 2 - Incomplete/ low	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land to the west of Stephenson Close Residential Development of up to 85 dwellings B/17/0515	Application not yet determined	2017 - ongoing	From the most eastern part of the Scheme to the Application Site is 550 m.	Outline only	Incomplete/ low	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Triton Knoll Offshore Wind Farm	DCO consented	2008 - ongoing	Onshore cable corridor and Construction compound at Langrick 9.7 km	ES	Complete/ high	No	Due to the distance from the Application site, cumulative

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
			from the Application Site				effects are not anticipated.
Viking Link Interconnector B/17/0340	Application approved	2014 - 2023	Bicker Fen substation 14.4 km from the Application Site	ES	Incomplete / low	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Sutterton Garage and adjacent land, Station Road, Sutterton, Boston, Lincolnshire PE20 2JH B/15/0084	Application approved	2015 – ongoing	10.3 km south (following A16 and B1397) of the Application Site	Outline only	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land west of Boston Road, Kirton, Boston, Lincolnshire, PE20 1ES B/15/0266	Application approved	2015 – ongoing	4 km south west of the Application Site	Approval of reserved matters	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land adjacent to London Road/Drainside South, Kirton, Boston, Lincolnshire, PE20 1JH	Application approved	2015 – ongoing	6 km south west of the Application Site	Outline only	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
Land south of Endeavour Way, PE20 0JA Erection of 14,655sq.m Class B2 (general industrial) floor space B/15/0506	Application Approved	2015 – ongoing	10 km south west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land off Station Road, PE20 3NX Erection of 63 no. residential dwellings with associated infrastructure B/16/0052	Application approved	2016 – ongoing	8 km west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
The Junction Community Hall, PE20 1QJ Construction of community building B/16/0062	Application approved	2016 – ongoing	4 km south west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Yew Lodge, PE20 2EE Demolition of outbuildings and the construction of 14 no. dwellings	Application approved	2016 – ongoing	8 km south west of the Application Site	Outline application with some matters reserved for later approval	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
B/16/0313							
Land at Station Road, PE20 2JH Erection of 21 dwellings, new vehicular access, private access road and associated works B/16/0409	Application approved	2016 – ongoing	8 km south west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land west of Boston Road, Kirton B/17/0171	Application approved	2017 - ongoing	3 km south west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Woods Nurseries Site, Swineshead, Boston Proposed residential development of 41 market and affordable dwellings B/17/0244	Application approved	2017 – ongoing	9 km west of the Application Site	Outline application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land to the rear of Westminster Terrace, Swineshead, Boston	Application approved	2017 – ongoing	8 km west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
Construction of 18 dwellings B/17/0396							
Land adjacent to Avalon Road, PE20 1QR Construction of 4 no. detached buildings comprising 16 no. industrial units B/18/0057	Application approved	2018 – ongoing	6 km south west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Land to the north and west of Coles Lane, PE20 3NS Change in site boundary of planning permission B/17/0404 B/18/0382	Application approved	2018 – ongoing	8 km west of the Application Site	Detailed application	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Plots C and D, The Quadrant, Land adjacent to A16, Wyberton, Boston For approval of reserved matters (appearance, layout and scale) for the construction of	Application approved	2018 – ongoing	1 km south west of the Application Site	Application for approval of reserved matters	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.

Project	Status	Development Period	Distance from the Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
hotel, public restaurant and drive-thru B/18/0413							
The Quadrant, PE21 7HT Application for approval of reserved matters from application B/14/0165 (roads 6, 7 and 8) B/19/0027	Application approved	2018 – ongoing	1 km south west of the Application Site	Application for approval of reserved matters	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.
Wash Road/ Station Road. Kirton Demolition of dwelling and erection of 30 dwellings. B/15/0503	Application approved at appeal	2015 – ongoing	4 km south west of the Application Site	Application for demolition, outline application for erection of dwellings and matters reserved for later consideration	Complete / high	No	Due to the distance from the Application site, cumulative effects are not anticipated.

21.7.3 The three projects that were identified to have the potential for cumulative affects to the vulnerability and resilience of the Facility to the projected effects of climate change were:

- Boston Barrier flood defence;
- Battery energy storage plant (Marsh Lane) (application reference: B/17/0467); and
- Land to the west of Stephenson Close residential development of up to 85 dwellings (application reference: B/17/0515).

21.7.4 The Boston Barrier flood defence scheme is due for completion in winter 2020, and therefore will be in place before the Facility is in operation. The Application Site is downstream of the Boston Barrier, and will not directly benefit from the barrier's tidal flood protection. However, it is not considered likely that there would be any significant adverse impacts to the Facility associated with the implementation of the Boston Barrier.

21.7.5 The Marsh Lane battery energy storage plant and residential development to the west of Stephenson Close are at a distance close enough to the Application Site which could increase surface water flooding by increasing the impermeable area in the vicinity of the Application Site. However, both developments will have site specific Surface Water Drainage Schemes which will also consider the implications of climate change and therefore will not increase the risk of flooding off-site. Therefore, cumulative effects from the two projects identified with the potential for cumulative effects with respect to the CCR assessment are considered to be **not significant.**

21.8 Inter-Relationships with Other Topics

21.8.1 This chapter has inter-relationships with the following chapters:

- **Chapter 11 Contaminated Land, Land Use and Hydrogeology**
- **Chapter 12 Terrestrial Ecology**;
- **Chapter 13 Surface Water, Flood Risk and Drainage Strategy** (and **Appendix 13.2 Flood Risk Assessment**);
- **Chapter 14 Air Quality**;
- **Chapter 17 Marine and Coastal Ecology**; and
- **Chapter 19 Traffic and Transport**.

21.9 Summary

21.9.1 A GHG assessment was undertaken to consider GHG emissions during the construction and operational phases of the Facility. The construction phase assessment considered emissions from road traffic and on-site plant, included a diesel generator to provide power to the Application Site. The operational phase assessment considered the 'net' effect of the Facility compared with two potential existing waste disposal routes (two alternative baseline scenarios were considered). The results of the assessment highlighted that the operation of the Facility would be likely to result in a decrease in GHG emissions compared to existing waste treatment routes, and the net contribution to regional and national emissions was not considered to be a material impact on the UK's ability to meet its Carbon Budgets or the requirements of the Climate Change Act 2008.

21.9.2 A CCR assessment was carried out to determine the vulnerability of the assessment to projected climate change over the lifespan of the Facility. The assessment determined that with the inclusion of mitigation (see **Appendix 13.2 Flood Risk Assessment**), the vulnerability rating of the Facility to future climate changes would be low.

21.9.3 The impacts of the assessment are summarised in

21.9.5 **Table *21-27*.**

21.9.4 Potential Impact	Receptor	Value / Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
Construction						
Impact 1: GHG emissions during construction	Global atmosphere	The assessment approach does not consider the sensitivity of the receptor, which is the global atmosphere.	N/A	Not likely to represent a significant net CO2 emissions contribution	N/A	Not significant
Operation						
Impact 1: GHG emissions from the Facility	Global atmosphere	The assessment approach does not consider the sensitivity of the receptor, which is the global atmosphere.	N/A	Does not represent a significant net CO2 emissions contribution, therefore does not affect the UK's ability to meet 2050 carbon targets.	N/A	Not significant
Impact 2: Impact of climate change on the Facility	The vulnerability of the Facility and associated infrastructure to increased temperatures, drought and flood risk.	The Facility is considered to have a low sensitivity to increased temperatures, drought and flood risk.	Moderate	Low	Implementation and maintenance of surface water drainage strategy.	Not significant

Table 21-27 Impact Summary

Potential Impact	Receptor	Value / Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
Construction						
Impact 1: GHG emissions during construction	Global atmosphere	The assessment approach does not consider the sensitivity of the receptor, which is the global atmosphere.	N/A	Not likely to represent a significant net CO_2 emissions contribution	N/A	Not significant
Operation						
Impact 1: GHG emissions from the Facility	Global atmosphere	The assessment approach does not consider the sensitivity of the receptor, which is the global atmosphere.	N/A	Does not represent a significant net CO_2 emissions contribution, therefore does not affect the UK's ability to meet 2050 carbon targets.	N/A	Not significant
Impact 2: Impact of climate change on the Facility	The vulnerability of the Facility and associated infrastructure to increased temperatures, drought and flood risk.	The Facility is considered to have a low sensitivity to increased temperatures, drought and flood risk.	Moderate	Low	Implementation and maintenance of surface water drainage strategy.	Not significant

21.10 References

British Standards Institution (2011). PAS 2050:2011. Specification for the assessment of the life cycle greenhouse gas emissions of good and services

Christensen, T. H., Damgaard, A., Astrup, T. F. (2015). Waste to energy the carbon perspective. Waste Management World, (January-February 2015), 24-28.

Committee on Climate Change (CCC) (2018) Reducing UK Emissions – 2018 Progress Report to Parliament

Department for Business, Environment and Industrial Strategy (BEIS), (2016), UK Ratifies the Paris Agreement, available at URL: https://www.gov.uk/government/news/uk-ratifies-the-paris-agreement

Department for Business, Environment and Industrial Strategy (BEIS), (2020a), Greenhouse Gas Reporting, Conversion Factors 2020, available at URL: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2020

Department for Business, Environment and Industrial Strategy (BEIS), (2020b), Emissions of carbon dioxide for local authority areas, available at URL: https://data.gov.uk/dataset/723c243d-2f1a-4d27-8b61-cdb93e5b10ff/emissions-of-carbon-dioxide-for-local-authority-areas

Department for Business, Environment and Industrial Strategy (BEIS), (2020c), Digest of United Kingdom Energy Statistics, 2020, available at URL: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/924591/DUKES_2020_MASTER.pdf

Department of Energy and Climate Change (DECC) (2011a). Overarching National Policy Statement for Energy (EN-1)

Department of Energy and Climate Change (DECC) (2011b). National Policy Statement for Renewable Energy Infrastructure (EN-3)

Department of Transport (2018), Transport Analysis Guidance (TAG) Unit A1.3, Table A 1.3.9 Proportions of Vehicle Kilometres by Fuel Type, May 2018.

Environment Agency (2017) Flood Risk Assessments: Climate Change Allowances. Available at URL: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed 05/06/2019]

Environment Agency (2020). Press release: First boats set to pass through the new Boston Barrier.

GloMEEP & IAPH (2018), GEF-UNDP-IMO GloMEEP Project and IAPH, 2018: Port Emissions Toolkit, Guide No.1, Assessment of port emissions.

Institute of Environmental Management and Assessment (IEMA) (2017). Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available at: https://www.iema.net/policy/ghg-in-eia-2017

IEMA, (2020), EIA Guide to Climate Change Resilience and Adaptation

Met Office (2018). UK Climate Projects Database, User Interface. Available at https://ukclimateprojections-ui.metoffice.gov.uk/ui/home

Met Office (2019). Holbeach climate. Available at https://www.metoffice.gov.uk/public/weather/climate/u12hg1nxt

South-East Lincolnshire Joint Strategic Planning Committee, (2019), South East Lincolnshire Local Plan, 2011 – 2036, Adopted March 2019

World Business Council for Sustainable Development and the World Resources Institute (2015); Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, ISBN 1-56973-568-9.

Zero Waste Scotland (2020), The climate change impacts of burning municipal waste in Scotland, Technical Report, October 2020.