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South Humber Bank Energy Centre Project

Planning Inspectorate Reference: EN010107

South Marsh Road, Stallingborough, DN41 8BZ

The South Humber Bank Energy Centre Order

Document Ref: 6.4 Environmental Statement – Volume III Appendix 19A: Greenhouse Gas Emissions Assessment

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) - Regulations 2009 - Regulation 5(2)(a)

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GLOSSARY OF ABBREVIATIONS AND DEFINITIONS

Abbreviation	Description
BEIS	Department for Business, Energy and Industrial Strategy
CH_4	Methane
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
DCO	Development Consent Order
Defra	Department for the Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment – a term used for the assessment of environmental consequences (positive or negative) of a plan, policy, program or project prior to the decision to move forward with the proposed action.
ES	Environmental Statement - A report in which the process and results of an Environment Impact Assessment are documented.
EU	European Union
FGT	Flue gas treatment
GHG	Greenhouse gas
GHGs	Greenhouse gas emissions
HFCs	Hydrofluorocarbons
HGV	Heavy Goods Vehicle
ICE	Inventory of Carbon & Energy
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt hours
MJ	Megajoule
Mt	Megatonnes
MW	Megawatt
NF_3	Nitrogen trifluoride
N_2O	Nitrous oxide
PFCs	Perfluorocarbons
PAS	Publicly Available Specification
RDF	Refuse Derived Fuel
SF_6	Sulphur hexafluoride
t	Tonnes
UK	United Kingdom

WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
wt	Weight

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TABLES

1.0 INTRODUCTION

1.1 Overview and Approach

1.1.1 This document presents an assessment of the impacts of the Proposed Development on the climate through greenhouse gas emissions (GHGs) during construction, operational life (including maintenance) and decommissioning. It defines the study area; the methodology used for developing the baseline and impact assessment; provides a description of the baseline environment in relation to climate; and presents the findings of the impact assessment.

1.1.2 To meet the requirements of Regulation 14(2) of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, and to align with guidance from the Institute of Environmental Management and Assessment (IEMA) for climate change mitigation (IEMA, 2017), and address the Environmental Impact Assessment (EIA) Scoping Opinion (see ES Volume III, Appendix 1B, Document Ref. 6.4) this report provides a GHG impact assessment. The assessment considers impacts on the climate from GHGs arising from the Proposed Development, including how the Proposed Development would affect the ability of the UK government to meet its carbon reduction plan targets.

1.1.3 Other aspects concerning the climate change resilience of the Proposed Development are covered in Environmental Statement (ES) Volume I, Chapter 19: Sustainability and Climate Change (Document Ref. 6.2).

2.0 LEGISLATION, POLICY AND GUIDANCE

2.1.1 This Section identifies and briefly describes the legislation, policy, and guidance of relevance to the assessment of potential climate impacts associated with the construction, operation and eventual decommissioning of the Proposed Development.

2.1.2 Legislation, policy and other relevant guidance has been considered on an international, national and local level. The following is relevant to the GHG assessment as it has either influenced the sensitivity of receptors and requirements for mitigation or the scope and/ or methodology of the assessment.

2.2 International Legislation, Policy and Guidance

2.2.1 The Environmental Impact Assessment Directive 2014/52/EU (hereafter referred to as the EIA Directive) states that as of May 2017, an EIA (where relevant) must include an assessment of the impact of a project on climate change.

2.2.2 At the Conference of the Parties 21 in 2016, the Paris Agreement under the United Nations framework convention on climate change came into force. This Agreement requires all signatories to strengthen their climate change mitigation efforts to keep global warming to below 2°C this century.

2.2.3 This assessment to identify the significance of GHGs from the Proposed Development has been undertaken in line with Guidance published by IEMA in 2017. This provides a framework for the consideration of GHGs in the EIA process, in line with the 2014 EU Directive. The guidance sets out how to:

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

2.2.4 The World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol (2004) provides overarching guidance on developing GHG inventories.

2.2.5 Publicly Available Specification (PAS) 2080 (2016): Carbon Management in Infrastructure Verification provides specific guidance on measuring and managing GHGs from infrastructure.

2.2.6 Intergovernmental Panel on Climate Change (IPCC) Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003) and the current IPCC Emission Factor Database (2019) also provide relevant guidance for the assessment.

2.2.7 Guidance for the Calculation of Land Carbon Stocks (European Commission, 2010) provides a methodology for calculating carbon stocks from land use.

2.3 National Legislation, Policy and Guidance

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

2.3.2 The Act was amended in 2019 to revise the existing 80% reduction target and legislate for a net zero emissions by 2050 (2050 Target Amendment, Order 2019) (UK Government, 2019).

2.3.3 The systems set up by the Climate Change Act 2008 remain, including a system of binding five-year 'carbon budgets' as well as an independent body to monitor progress, the Committee on Climate Change.

2.3.4 The Carbon Budgets Orders set five-yearly carbon budgets until currently 2032. The UK carbon budgets restrict the amount of GHGs the UK can legally emit in a defined five-year period. The UK has declared its 5th carbon budget up until 2032. As a result of the amended 2050 carbon reduction target to net zero carbon, the Committee on Climate Change announced it will review the current carbon budgets. The 6th carbon budget will be published later in 2020.

2.3.5 The National Policy Statement for Renewable Energy Infrastructure (EN-3) (Department of Energy and Climate Change, 2011a) and the Overarching National Policy Statement for Energy (EN-1) (Department of Energy and Climate Change, 2011b) sets out the UKs policy for energy infrastructure in relation to climate impacts and adaptation; adverse effects and benefits; in relation to EU Directive and ES requirements; in relation to adaptation measures in response to climate projections; in relation to climate projections, flood risk and the importance of relevant mitigation.

EN-3 describes the positive effects of renewable energy infrastructure on medium and long-term climate change objectives. Any associated negative impacts should take into account "*the positive role that large-scale renewable projects play in the mitigation of climate change, the delivery of energy security and the urgency of meeting the national targets for renewable energy supply and emissions reductions"*.

2.3.6 The National Planning Policy Framework (Ministry of Housing, Communities and Local Government, 2019a) sets out the Government's planning policies for England and how these are expected to be applied. Policies of particular relevance to climate change and sustainability assessment as presented include those achieving sustainable development and meeting the challenge of climate change, flooding and coastal change.

2.3.7 In alignment with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017, Regulation 14(2)(f), as set out in Schedule 4, paragraph 5(f), the EIA requires a description of *"the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions)".*

2.3.8 The National Planning Policy Guidance on Climate Change published by the Ministry of Housing, Communities and Local Government (2019b) describes how to identify suitable mitigation and climate adaptation measures to incorporate into

the planning process. It states, "*effective spatial planning is an important part of a successful response to climate change as it can influence the emission of greenhouse gases… Planning can also help increase resilience to climate change impact through the location, mix and design of development*."

2.3.9 The Department for the Environment, Food and Rural Affairs (Defra) published Our Waste, Our Resources: A Strategy for England (Defra, 2018a), which describes the national strategic ambition to reduce waste. This Strategy specifically describes the role that energy from waste will play in diverting waste from landfill.

2.3.10 The Department for Business, Energy and Industrial Strategy (BEIS) (2019) and the Defra (2014) UK Government GHG Conversion Factors for Company Reporting provides GHG conversion factors for a range of fuel consumption types.

2.3.11 The Inventory of Carbon & Energy (ICE) Database (University of Bath, 2019), provides GHG conversion factors to calculate embedded emissions in materials.

2.4 Local Policy

2.4.1 The 2013 to 2032 Local Plan for North East Lincolnshire (North East Lincolnshire Council, 2018) includes Policy 32 'Energy and Low Carbon Living', which states:

> "*Where appropriate, the principles of the energy hierarchy should be followed in order to achieve energy efficient and low carbon development*."

2.4.2 'Level 3' of this hierarchy states development could provide onsite decentralised or renewable energy.

3.0 CONSULTATION

3.1.1 An EIA Scoping Report was prepared by AECOM and submitted to the Planning Inspectorate in August 2019. The EIA Scoping Report sets out the proposed approach to the ES and is intended to facilitate discussions regarding the scope of the ES.

3.1.2 In response to the EIA Scoping Report, the Planning Inspectorate prepared a Scoping Opinion document (included in ES Volume III, Appendix 1B, Document Ref. 6.4). Specific comments raised by the Planning Inspectorate in relation to climate change are listed in Table 3.1.

Table 3.1: Comments raised by The Planning Inspectorate in the Scoping Opinion Report (2019)

PINS ID	SUBJECT	INSPECTORATE COMMENTS	ADDRESSED IN ES SECTION
4.12.5	Sustainability and climate change	The Scoping Report states that sustainability and climate change matters will be reported in the appropriate chapters in the ES, with the main considerations being increased flood risk linked to climate change, carbon dioxide emissions and the generation of renewable energy. The Inspectorate agrees with this approach but advises that the ES should clearly signpost the sections of the relevant chapters which are dealing with climate and climate change. The Applicant is referred to the advice given in section 3 and Table 4.1 of this Opinion.	ES Chapter 19: Sustainability and Climate Change provides signposting of the sections elsewhere in the ES relevant to sustainably and climate change matters. In addition, this GHGs Assessment report details climate change impacts associated with the construction and operation of the Proposed Development (refer to Section 7.0 of this report).

4.0 GHG ASSESSMENT METHODOLOGY

4.1 Determination of Assessment Scenarios

The GHGs assessment of the Proposed Development includes an assessment of two scenarios, the baseline and the project scenario. The baseline scenario is a 'Do Nothing' scenario where the Proposed Development is not progressed. The baseline comprises existing carbon stock and sources of GHGs within the boundary of the existing Site. Carbon stocks are defined as stored carbon within soils and living and dead biomass. It also considers the current waste management and emissions intensity from current electricity generating sources.

4.1.1 The alternative scenario is a 'Do Something' scenario associated with the delivery of the Proposed Development, which includes construction and operation as described in Chapter 4: The Proposed Development (ES Volume I, Document Ref. 6.2).

4.2 Study Area

4.2.1 The GHG study area includes all GHGs from within the Main Development Area arising during all stages of the construction, operation and decommissioning of the Proposed Development. It also includes emissions arising from offsite activities which are directly related to the onsite activities associated with the Proposed Development, such as transport, treatment of materials and waste disposal.

4.3 Sensitive Receptors

4.3.1 The identified receptor for GHGs is the global climate. As the effects of GHGs are not geographically constrained all development has the potential to result in a cumulative effect on GHGs. Therefore, for the purpose of the GHGs impact assessment, the global climate is used as the receptor. To assess the impact of the Proposed Development on this receptor, UK carbon budgets have been used as a proxy for the global climate.

4.4 GHG Calculation Methodology

4.4.1 Currently there is no standard method for assessing the significance of a Proposed Developments impact on climate for EIA. Each project is evaluated according to its individual characteristics.

4.4.2 A lifecycle approach to calculating the GHGs has been used. This approach considers specific timescales and emissions from different lifecycle stages of the Proposed Development: product stage, construction process stage, operational stage and decommissioning.

4.4.3 Where specific activity data has been available, expected GHGs arising from the construction and operational activities, and embodied carbon in materials of the Proposed Development, have been quantified using a calculation-based methodology as per the following equation below as stated in the Defra emissions factors guidance (Defra, 2019):

Activity data x GHG emissions factor = GHG emissions value

4.4.4 Emission factors and calculation methods have been sourced from publicly available sources, such as Defra, IPCC, and the Bath University ICE (2019). Additional emissions factors where required have been taken from Simapro lifecycle assessment software, which is based on the EcoInvent LCA database.

4.4.5 The potential impacts of the Proposed Development on the climate through GHGs during construction are calculated in line with the GHG Protocol (WRI & WBCSD, 2004) and the GHG 'hot spots' (i.e. sources and activities likely to generate the largest amount of GHGs) are identified, as listed in Table 4.1. This has enabled priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA guidance.

4.4.6 In line with the GHG Protocol (WRI & WBCSD, 2004), when defining potential impacts, the seven Kyoto Protocol GHGs have been considered, specifically:

- carbon dioxide (CO_2);
- methane (CH_4);
- nitrous oxide (N_2O);
- sulphur hexafluoride (SF_6);
- hydrofluorocarbons (HFCs);
- perfluorocarbons (PFCs); and
- nitrogen trifluoride (NF_3).

4.4.7 These gases are broadly referred to in this report under an encompassing definition of 'GHGs', with the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (mega tonnes of CO_2 equivalent).

4.4.8 Where data has not been available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance (2017). As details of the activities required for decommissioning are not available at this stage of the Proposed Development, the GHGs associated with this phase of the Proposed Development are qualitatively assessed.

4.4.9 RDF contains both biogenic and non-biogenic forms of carbon. According to the GHG Protocol (WRI & WBCSD, 2011) CO_2 emissions associated from biogenic sources (emission from combusting from biomass) should not be included in the inventory but reported separately. To aid transparency, both forms of emissions will be displayed but only non-biogenic carbon emissions from the RDF will be used in the final assessment calculation.

4.4.10 There are no current activities within the Main Development Area that are sources of GHGs, other than carbon stocks from biomass and soils.

4.4.11

4.4.12 Table 4.1 summarises the GHG activity sources that are potentially relevant to the baseline (Do Nothing) scenario. These sources are considered for their presence and materiality in the baseline environment assessment (Section 6.0).

4.4.13

4.4.14 Table 4.2 summarises the GHG activity sources that are potentially relevant to the project (Do Something) scenario of this Proposed Development. These sources are considered for their presence and materiality in the project scenario assessment (Section 7.0).

Table 4.1: Potential Sources of GHGs Relevant to the Baseline

STAGE	ACTIVITY	PRIMARY EMISSIONS SOURCES
Baseline	Existing land use	Carbon stocks and emissions from above- and below-ground biomass

Table 4.2: Potential Sources of GHGs Relevant to the Proposed Development

STAGE	ACTIVITY	PRIMARY EMISSIONS SOURCES
Product Manufacture, Site Enabling and Construction	Pre-construction activity within Main Development Area	Fuel consumption from construction plant and vehicles, generators, and construction worker commuting.
	Disposal and transportation of earthworks/ waste	Transportation and disposal of earthworks/ construction waste.
	Site clearance works	Loss of carbon stocks.
	Raw material extraction and manufacturing	Embodied GHGs in the materials used for construction of the Proposed Development as a result of the excavation, processing and transportation.
	Transport to Site	Fuel used for transportation of construction materials to Site.
	Construction activity within Main Development Area	Energy (electricity, fuel, etc.) consumption from plant, vehicles and generators.
	Transport of construction workers	Fuel consumption for transportation of construction workers to/ from Site.
Operation	Operation of the Proposed Development	Operational energy use in buildings (e.g. any liquid fuels, gases and purchased electricity). Combustion

STAGE	ACTIVITY	PRIMARY EMISSIONS SOURCES
		of fuel (Refuse Derived Fuel (RDF)) to produce energy.
	Transportation of fuel	Transporting RDF to Site.
	Transport of operations workers	Fuel consumption for transportation of workers.
	Disposal and transportation of operational waste	Disposal of process by-products/ municipal waste (liquid and solid wastes) (assuming as a worst case that it is not recycled). Fuel consumption for transportation of operational waste.
	Provision and treatment of water	Supply of potable water, and the disposal and treatment of wastewater.
	Building/ infrastructure maintenance	Maintenance of buildings and infrastructure/ assets in operation stage.
	Avoided emissions	Avoided emissions through waste combustion and energy generation over current waste disposal practices.
Decommissioning	Activities within the Main Development Area	Fuel consumption from the use of plant and vehicles.
	Waste transport	Transporting decommissioning waste to licenced facilities.
	Waste treatment and disposal	Treatment and disposal of solid and liquid waste.
	Transport of workers	Fuel consumption for transportation of construction workers.

4.4.15 The aggregated operational GHGs for the Proposed Development take into account direct emissions from the combustion of waste, together with the emissions avoided as a result of diverting waste from landfill. This approach is consistent with the Defra Energy Recovery for Residual Waste (2014) modelling approach.

4.5 GHG Significance Criteria

4.5.1 The global climate has been identified as the receptor for the purposes of the GHGs assessment. The sensitivity of the climate to GHGs is considered to be high.

4.5.2 As per IEMA (2017) guidance, all GHGs are classed as significant as all emissions contribute to climate change. The rationale for classification is as follows:

- any additional GHG impacts could compromise the UK's ability to reduce its GHGs and therefore the ability to meet its future carbon budgets;
- the extreme importance of limiting global warming to below 2°C this century, as broadly asserted within the Paris Agreement, national legislation and community support. Additionally, a recent report by the IPCC highlighted the importance of limiting global warming below 1.5°C (IPCC, 2018); and
- a disruption to global climate is already having diverse and wide-ranging impacts to the environment, society, economic and natural resources. Known effects of climate change include increased frequency and duration of extreme weather events, temperature changes, rainfall and flooding, and sea level rise and ocean acidification. These effects are largely accepted to be negative, profound, global, likely, long-term to permanent, and are transboundary and cumulative from many global actions.

4.5.3 Further IEMA (2017) guidance states that there are currently no agreed methods to evaluate levels of significance and that professional judgment is required to contextualise a project's GHGs impacts.

4.5.4 In GHG accounting, it is considered good practice to contextualise emissions against pre-determined carbon budgets (IEMA, 2017). In the absence of sector-based or local emissions budgets, the UK Carbon Budgets can be used to contextualise the level of significance.

4.5.5 The Carbon Budgets set a legally binding five-year limit for UK-wide GHGs (UK Government 2009, 2011 and 2016).

4.5.6 The 5th Carbon Budget (UK Government, 2016) that extends from 2028 to 2032 has a published limit of 1,725 $MtCO_2e$. This is broken down to include approximately 27% projected contributions from industrial sources, 11% projected contributions from grid electricity and 5% projected contributions from waste and fluorinated greenhouse gases (F-gases) (Committee on Climate Change, 2016).

4.5.7 In developing GHG emission inventories, both the Department of Energy and Climate Change (2013) and the PAS 2050 Specification (British Standards Institution, 2011) allow minor emission sources to be excluded if they contribute to less than 1% of the total inventory. For the purpose of this assessment the Proposed Development is therefore considered to have a significant impact on the climate where GHGs are equal to or more than 1% of the UK carbon budget in which they arise and would prevent the UK from meeting its carbon reduction targets.

4.5.8 No industry guidance is available to determine annual GHG thresholds for a development therefore GHG reporting rules used by the International Finance Corporation (IFC) have also been applied as an indicator of the extent of the Proposed Development's annual GHGs impact.

4.5.9 Under IFC lending criteria, where a project funded by the IFC annually exceeds GHGs 25,000 tCO_2e, the emissions impact is deemed sufficiently substantial so as to require a project operator to report annual emissions performance.

4.5.10 Although the Proposed Development is not funded by the IFC, the 25,000 tCO_2e per year threshold has been used to put the estimated annual construction and operational GHG impacts of the Proposed Development into further context.

4.5.11 This secondary, more conservative (IFC) threshold is being used for the following reasons:

- the design life of this Proposed Development goes slightly beyond the published UK Carbon Budgets; and
- the UK has now legislated for net zero emissions by 2050 (see Section 0), meaning UK Carbon Budgets will need to heavily reduce during the life of the Proposed Development and emissions will become increasingly significant.

4.5.12 The threshold for determining the magnitude of the GHG emission volumes has been incorporated and summarised in Table 4.3. Only the categories of 'Low' and 'High' have been used to describe magnitude as the sensitivity of the receptor (global climate) to increases in GHGs is considered always 'High'.

Table 4.3. Magnitude Criteria for GHGs Impacts

MAGNITUDE OF CHANGE	CRITERIA DESCRIPTION
Low	GHGs represent less than 1% of total emissions of the relevant 5-year National Carbon Budget in which they arise
High	GHGs represent, equal to or more than 1% of total emissions of the relevant 5-year National Carbon Budget in which they arise

4.5.13 The level of significance of project-related emissions has been determined using the matrix in Table 4.4.

Table 4.4. Significance of Effects for GHGs Impact Assessment

		SENSITIVITY OF RECEPTOR
		High
MAGNITUDE OF CHANGE	**Low**	Minor adverse
	High	Major adverse

4.5.14 The UK carbon budgets are in place to limit the amount of GHGs the UK can legally emit in a five-year period (Committee on Climate Change, 2017). The UK is currently in the 3rd carbon budget period, which runs from 2018 to 2022.

4.5.15 The appropriate UK national carbon budgets that span the construction programme of the Proposed Development, which are considered to be a worst case of 2026 to 2029, are the 4th and 5th carbon budgets (2023-2027 and 2028-2032, respectively).

4.5.16 The operational phase of the Proposed Development (fully operational and occupied by 2029 at the latest) has been compared to all the appropriate and available carbon budgets within the design life of the Proposed Development: the 5th carbon budgets (2028-2032). Although the Proposed Development will be operational beyond this time, the budgets have only been calculated to 2032. The current carbon budgets reflect the previous 80% reduction target by 2050, rather than the current target of net zero emissions by 2050.

4.5.17 Table 4.5 shows the current and future UK carbon budgets up to 2032, which highlights a reduction in the amount of GHG the UK can legally emit in the future. This means that any source of emissions contributing to the UK's carbon inventory will have a greater impact on the UK carbon budgets in the future.

Table 4.5: Proposed Development timeline with the UK Carbon Budgets (UK Government, 2009, 2011 and 2016)

PROJECT PHASE	CARBON BUDGET	TOTAL UK BUDGET ($MTCO_2E$)
Construction	4th (2023 – 2027)	1,950
Operation	5th (2028 – 2032)	1,725

5.0 LIMITATIONS AND ASSUMPTIONS

5.1 Limitations

5.1.1 Some aspects of the design have not been finalised at this stage as the detailed design has not been completed. Maximum parameters ('the Rochdale envelope') have been adopted where relevant, as a worst case. As a result, some data is not available to provide a fully quantified assessment of the GHGs from the construction and operation of the Proposed Development. Accordingly, some industry estimates have been used.

5.2 Assumptions, Inclusions and Exclusions

5.2.1 General assumptions relating to this assessment are listed below. Specific scenario assumptions are listed in Sections 6.0 and 7.0.

- the baseline scenario calculations are based upon the activities within the Main Development Area as outlined in Chapter 3: Description of the Proposed Development Site (ES Volume I, Document Ref. 6.2);
- the construction and operations scenario are based upon the activities detailed in Chapter 4: The Proposed Development and Chapter 5: Construction Programme and Management (ES Volume I, Document Ref. 6.2);
- construction of the Proposed Development is assumed to take three years;
- the operational design life of the Proposed Development is assumed to be 30 years; and
- decommissioning activities are described qualitatively only due to the absence of information regarding these activities at this stage of the design.

6.0 BASELINE ENVIRONMENT

6.1.1 As discussed in paragraph 0, the baseline scenario was determined to be the activities within the Main Development Area boundary that will lead to carbon emissions or carbon sinks if the Proposed Development does not go ahead.

6.1.2 The Main Development Area is currently an empty plot within the wider boundary of the South Humber Power Bank Station (SHBPS). A number of services are located on the plot, such as an internal road, underground services and cooling water pipes; all associated with the existing SHBPS.

6.1.3 The GHGs that would be associated with the baseline scenario have been calculated using the methodology described in Section 4.0, and the results are based upon the assumptions listed below:

- the Main Development Area is currently an empty plot with no associated activities; and
- the Main Development Area covers approximately 7.3 hectares of which are broken down into the following land use categories –
  - 6.03 ha 'semi-improved neutral grassland',
  - 0.64 ha bare ground,
  - 0.54 ha hardstanding,
  - 0.01 ha ditches with standing water,
  - 0.04 ha amenity grassland, and
  - 0.05 ha scrub;
- the soil type has been categorised as 'high activity clay soils'; and
- the climatic region has been classed as 'cool temperate, moist'.

6.1.4 As there are no activities within the Main Development Area during the baseline scenario, total emissions are concluded as being zero. The associated vegetative cover of the Main Development Area provides a net sink of emissions.

6.1.5 Emissions intensities from existing UK grid electricity generation sources are detailed in Table 6.1 for reference. The table details the carbon intensity associated with the combustion of the primary fuel source (e.g. natural gas).

Table 6.1. Carbon intensities of UK electricity grid generation sources in 2018 (BEIS, 2019)

GENERATION SOURCE BY FUEL TYPE	EMISSIONS (TONNES OF CO_2 PER GWH OF ELECTRICITY SUPPLIED)
Gas	349
All fossil fuels	450
All fuels, grid average (including nuclear and renewables)	173

7.0 CONSTRUCTION IMPACTS AND EFFECTS

7.1 Construction Impacts and Effects

7.1.1 In order to assess the magnitude of the climate change impacts through GHGs associated with construction of the Proposed Development, the emissions that would be associated with the project activities have been calculated and listed in Table 7.1 based on the assumptions listed below:

- Construction activities will take three years with approximately 782 working days. This figure is based on construction activities being undertaken from Monday to Saturday;
- Construction phase working hours are assumed to be 12 hours per day, Monday to Saturday;
- Construction workers and vehicle numbers are as per the Transport Assessment (see Table 11.1 of ES Volume II, Appendix 9A, Document Ref. 6.4) and all commutes (assumed to be from an average of 35 km away) include a return trip;
- The materials and consumables required during construction have been assumed to be sourced from an average of 50 km from Site;
- Uses of grid electricity are likely to include lighting and worker facilities. Usage has conservatively been based on continuous use during this period on an average estimate of 50 kWh per day;
- Fuel usage onsite is entirely through diesel-powered plant and vehicles including construction vehicles and generators conservatively active for 12 hours each day. The usage is conservatively based upon 50 units of plant and vehicles with an average power of 200 kW;
- Waste volumes are based upon current project estimates and their disposal is based on a combination of landfill, re-use/ recycling, composting and sewage treatment. Any additional wastewater generated through construction has been excluded but is expected to be minor;
- An average of 92 daily HGV trips to and from Site are expected of which 80% (74 trips) is assumed to be incoming materials, and the remainder (18 trips) is assumed to be outgoing waste;
- Emissions from the supply of mains water is based upon the total use of 96,000 m^3 over the full construction period; and
- Volumes of materials required for construction were not currently available, so embodied carbon estimates have been calculated using Designing out Waste Tool for Buildings.

7.1.2 The total GHGs from constructing the Proposed Development are estimated to be 367,855 tCO_2e with the majority of emissions (93%) associated with the embodied carbon of materials used to construct the buildings and infrastructure (Table 7.1), as would be expected for a nationally significant infrastructure project. Average annual construction phase emissions are therefore expected to be approximately 122,618 tCO_2e.

Table 7.1: Construction GHG emissions

LIFECYCLE STAGE	PROJECT ACTIVITY/ EMISSIONS SOURCE	EMISSIONS (TCO_2E)	% OF PROJECT PHASE EMISSIONS
Product Stage	Embodied carbon of materials and products	314,477	92.8
	Materials and product transport	3,177	0.9
Construction Stage	Electricity usage	14,394	3.9
	Fuel usage onsite	6,632	1.8
	Waste disposal	1,769	0.5
	Worker commute	307	0.1
	Materials	99	0.0
TOTAL		**367,855**	
ANNUAL		**122,618**	

7.1.3 As stated in Section 4.5, all emissions are considered significant. To contextualise the level of significance, emissions are compared to UK carbon budgets (Table 4.3). Emissions from the construction of the Proposed Development contribute considerably less than 1% of the total UK carbon budget emissions during any five-year carbon period under which they arise. The magnitude of impact during construction is therefore considered low. As per Table 4.4, the significance of effects is considered as 'minor adverse'. As such, the construction of the Proposed Development will not have a significant impact on the UK meeting the current carbon budgets.

7.1.4 Under the IFC reporting guidelines, the construction-related emissions from the Proposed Development would be considered to be a large project and would be required to report annual emissions performance.

7.1.5 These emissions do reflect the unavoidable emissions that are required to construct the Proposed Development. However, the construction period is relatively short duration (three years) and represents peak emissions in the full design life of the Proposed Development.

8.0 OPERATIONAL IMPACTS AND EFFECTS

8.1 GHG Avoidance Due to Operation of the Proposed Development

8.1.1 The Proposed Development will not only generate electricity but will also divert waste that might otherwise be disposed of in landfill.

8.1.2 National policy (Defra, 2011; Department of Energy and Climate Change, 2011a; Defra, 2018b; Ministry of Housing, Communities and Local Government, 2019a) supports efficient energy recovery from residual municipal waste to deliver environmental benefits and reduce carbon impacts, as well as reducing the amount of waste sent to landfill in support of targets set by the EU. When biomass materials such as wood and paper are allowed to decay naturally in a landfill, methane is released into the atmosphere. When biomass is burned efficiently and in a controlled manner (such as within the Proposed Development) the complete combustion results in the emission of CO_2 rather than methane. Due to the lower global warming potential of CO_2 as compared to methane, energy recovery can lead to lower carbon equivalent emissions.

8.1.3 The total operational emissions associated with burning the RDF (see Section 8.2 below) are potentially reduced by the avoidance of the RDF entering standard disposal methods. In England, the standard waste disposal methods are approximately (Defra, 2018b; Defra, 2019):

- 45% recycling;
- 2% anaerobic digestion;
- 5% incineration; and
- 48% landfill.

8.1.4 Using Defra emission factors (BEIS, 2019), the Defra Energy Recovery for Residual Waste (2014) modelling approach, and the average English waste disposal proportions, the emissions associated with disposing of the 753,500 tonnes per annum of RDF (waste) (the theoretical maximum throughput assumed for the purposes of assessment) without the Proposed Development are detailed in Table 8.1. Over the operational life of the Proposed Development, the plant will displace 956,197 tCO_2e if the RDF (waste) is used at the Proposed Development rather than disposed of using typical methods.

Table 8.1. Emissions from typical disposal of 753,500 tonnes of RDF (waste) to be displaced by the Proposed Development

WASTE DISPOSAL METHOD	EMISSIONS PER YEAR (TCO_2E)	EMISSIONS OVER 30 YEARS (TCO_2E)
Recycling	7,241	217,216
Anaerobic digestion	154	4,613
Incineration	805	24,135
Landfill	23,674	710,232
TOTAL	**31,873**	**956,197**

8.1.5 Approximately 179,000 tonnes per annum of bottom ash will be produced as a result of the RDF combustion process. Bottom ash is a source of valuable metals that can be recovered. To calculate GHGs displaced as a result of waste metal recovery and recycling, a conservative estimate has been used based on professional judgment that assumes 5% of the bottom ash weight is ferrous metals and 1% is non-ferrous metals. These metals can then be recycled and used instead of the processing and use of virgin metal resulting in a carbon reduction. Using the metal recycling factors detailed in the England Carbon Metric Report, the displaced emissions from using this source of metals totals 32,690 tCO_2e per year as detailed in Table 8.2.

Table 8.2. Displaced emissions from using recycled metals over virgin metal sources

	TONNES RECOVERED FROM BOTTOM ASH PER YEAR	GHG EMISSI0NS DISPLACED FROM USE OF RECYCLED METALS OVER VIRGIN SOURCES (TCO_{2E} PER YEAR)
Ferrous metals	8,950	16,103
Non-ferrous metals	1,790	16,587
	TOTAL	**32,690**

8.2 Operational Emissions

8.2.1 In order to assess the magnitude of the climate change impacts through GHGs associated with operating and maintaining the Proposed Development, the GHGs that would be associated with the project activities have been calculated and listed in Table 8.3 based on the assumptions listed below:

- Operational activities will be undertaken for 30 years equating to approximately 10,950 working days. This figure is based upon operational activities being undertaken every day;
- The Proposed Development will be staffed 24 hours per day;
- 56 permanent staff roles will be created;
- All previously vegetated areas within the Main Development Area will be lost;
- Once yearly the plant will be offline for approximately three weeks for standard maintenance. Once every five years the plant will be taken offline for approximately five weeks for further maintenance (‘major outage’) where additional staff will be required taking with a total of around 200 staff per day;
- Operational workers and vehicle numbers are as per the Transport Assessment (see Section 7 of ES Volume II, Appendix 9A, Document Ref. 6.4);
- Electricity requirements will be taken from the plant, except in times of emergency or downtime where it will be sourced from the grid. This is

expected to be minimal and less than 1,800 MWh per year, a figure based on similar projects;

- Additional fuels used at the Proposed Development include diesel for auxiliary burners or generators and has been estimated to be approximately 270,000 litres per year of operation;
- Operational wastes include incinerator bottom ash, FGT residues, wastewater, municipal waste and sewage;
- Waste volumes are based upon current project estimates and their disposal is based on a combination of landfill, recycling and wastewater treatment per year of operation;
- Suitable landfill and recycling facilities are assumed to be within 200 km of the Site;
- Products requiring manufacturing and production during the operational phase include hydrated lime, ammonium hydroxide, activated carbon, fuels and towns water;
- All materials and consumables required during the operational phase (except the RDF) have been assumed to be available an average of 50 km from Site;
- Replacement of a number of capital parts will be required during the operational life. Embodied carbon data of these parts is not available and has not been included in the calculation;
- The plant will burn an average of 753,500 tonnes of RDF per year (this being the same figure used in the GHG avoidance calculation above), creating an assumed gross electrical output of 76 MW;
- 6% of the bottom ash contains recoverable metals (5% ferrous and 1% non-ferrous) which will be diverted from landfill;
- The composition of the RDF has an assumed average of 34% wt. of carbon of which is further broken down to 18% wt. non-biogenic carbon, and 16% biogenic carbon; and
- The waste used as fuel is supplied an average 120 km radius of the Proposed Development.

8.2.2 As presented in the methodology RDF contains both biogenic and non-biogenic forms of carbon. As detailed in the GHG Protocol (WRI & WBCSD, 2011) it is not necessary to consider CO_2 emissions associated from biogenic sources. For clarity estimated emissions from biogenic and non-biogenic sources are set out in Table 8.3 however only non-biogenic carbon emissions from the RDF have been considered in the GHG assessment calculation.

8.2.3 Annual carbon emissions (non-biogenic) associated with the RDF are estimated to be 132,219 tCO_2 (see Table 8.3 below). When avoided emissions are taken into account (Section 8.1), the net annual emissions associated from burning the RDF is reduced from 132,219 tCO_2e to a net annual emission of 45,297 tCO_2e (Table 8.3).

Table 8.3. Breakdown of GHG displacements

GHG SOURCE	TONNES OF CO_2E
Direct emission of biogenic carbon dioxide from combustion of waste, release of landfill gas and combustion of landfill gas *N.B. biogenic carbon dioxide is reported for transparency, but is excluded from the overall balance in accordance with guidance from IPCC and the GHG Protocol*	258,344
Biogenic carbon stored in landfill	n/a (see paragraph 4.4.9)
Direct emission of fossil carbon dioxide from combustion of waste	132,219
Emissions avoided from recycled metal (Table 8.2)	-32,690
Avoided emissions from landfill, net of offset electricity generation as a result of landfill gas recovery	-55,232
Total net GHG emissions from RDF combustion per year	**45,297**

8.2.4 The net GHGs (including all GHG avoidance deductions) from operating the Proposed Development over its 30-year life are estimated to be 1,786,162 tCO_2e. Annual emissions are expected to be approximately 59,539 tCO_2e (Table 8.4).

Table 8.4: Net operational GHGs

LIFECYCLE STAGE	PROJECT ACTIVITY/ EMISSIONS SOURCE	EMISSIONS (tCO_2E) ANNUAL	EMISSIONS (tCO_2E) 30 YEAR TOTAL	% OF PROJECT EMISSIONS
Operation	Electricity usage	460	13,802	0.8
	Fuel usage onsite: non-biogenic emissions from RDF combustion (Table 8.3)	45,297	1,358,917	76.1
	Fuel usage onsite: other fuels	725	21,764	1.2
	Waste disposal	3,758	112,747	6.3
	Worker commute	91	2,720	0.2
	Materials	43	1,297	0.1
	RDF and other material transport	9,164	274,914	15.4
	TOTAL	**59,539**	**1,786,162**	**100**

8.2.5 The carbon intensity of electricity generated by the Proposed Development, before consideration of avoidance of GHGs from landfill is 174 tCO_2e per GWh. Once GHG displacements are included, this improves the gross intensity from 174 tCO_{2e} per GWh to a net intensity of 72 tCO_{2e} per GWh, compared to the average grid value of 173 tCO_{2e} per GWh (Table 8.5).

Table 8.5. Carbon intensities of different UK power stations in 2018 (BEIS, 2019) and the Proposed Development (including emissions avoided)

TYPE OF POWER STATION BY FUEL TYPE	EMISSIONS (TONNES OF CARBON DIOXIDE PER GWH OF ELECTRICITY SUPPLIED)
Gas	349
All fossil fuels	450
All fuels (grid average) (including nuclear and renewables)	173
Proposed Development (gross - without consideration of emissions avoided)	**174**
Proposed Development (net - with consideration of emissions avoided through typical waste disposal methods and use of recovered metals over virgin sources)	**72**

8.2.6 As stated in Section 4.5, all emissions could be considered significant (IEMA, 2017). Gross and net GHGs from the operation of the Proposed Development will contribute considerably less than 1% of the 5th UK carbon budget. Using the criteria set out in Table 4.3 and Table 4.4, the Proposed Development can be defined as low magnitude of impact and representing a 'minor adverse' effect.

8.2.7 As such, the Proposed Development will not have a significant effect on the UK meeting its current carbon budgets that are set up 2032. Carbon budgets for beyond this timeframe are expected to be published later in 2020 and will detail the next 'stepping stone' towards net zero in 2050.

8.2.8 The gross and net operational GHGs per annum are above the contextual IFC threshold of 25,000 tCO_{2e} per annum.

8.2.9 The national need for additional renewable electricity generation and waste management facilities are detailed in Chapter 6: Need, Alternatives and Design Evolution of the ES (Volume I, Document Ref. 6.2) and is summarised in Section 2.0.

9.0 DECOMMISSIONING IMPACTS AND EFFECTS

9.1.1 Activities associated with the decommissioning phase of this Proposed Development are listed in Table 4.2.

9.1.2 At this stage of the design, details regarding decommissioning activities have not been developed. However, decommissioning is likely to be undertaken in a timeframe and scale that is similar to construction activities, but with higher emissions associated with waste transport and disposal rather than material manufacture and transport. Emission factors for the disposal of wastes are generally lower than the emissions factors for the production of the same materials (the embodied carbon).

9.1.3 Decommissioning will therefore emit GHGs, however the emissions are expected to be less than that calculated for the construction phase and therefore not likely to be significant in terms of the UK meeting its carbon budgets.

10.0 COMPARISON WITH THE CONSENTED DEVELOPMENT

10.1.1 As described in Chapter 1: Introduction and Chapter 4: The Proposed Development of the ES Volume I (Document Ref. 6.2), full planning permission for a 49.9 MW energy from waste development at the Site was granted in April 2019. Aside from the 'Additional Works' described in Section 4.4 of ES Chapter 4 to enable the Proposed Development to generate up to 95 MW electricity, the Consented Development and the Proposed Development are otherwise the same.

10.1.2 Assuming that the GHGs produced by the Consented Development are approximately the same as the GHGs produced by the Proposed Development, the net carbon intensity of the Consented Development would be approximately 93 tCO_{2e} per GWh compared to the Proposed Development's net carbon intensity of 72 tCO_{2e} per GWh. Consequently, the Proposed Development has a lower carbon intensity than the Consented Development as a result of the higher planned operational efficiency.

11.0 MITIGATION AND MONITORING

11.1.1 Focussing on the main source of GHGs from construction (embodied carbon of materials and products, which accounts for 92.8% of construction phase GHGs (see Table 7.1)), the Applicant will ensure that the scale of the overall building is minimised without affecting safety or functionality. The detailed design will be approved in accordance with a DCO requirement

11.1.2 Although construction worker commuting is only estimated to generate 0.1% of construction phase GHGs (see Table 7.1), it is noted that the Construction Worker Travel Plan (see Annex 27 of the Transport Assessment in ES Volume III, Document Ref. 6.4) will require a range of measures to be implemented to reduce the level of construction worker traffic and monitoring of the effectiveness of these measures against defined targets. This will be secured by a DCO requirement.

11.1.3 During operation the main source of GHGs will be the combustion of RDF (76.1% GHGs during operation (see Table 8.4)) and transport of RDF and other materials (15.4% GHGs during operation (see Table 8.4)). As set out in paragraph 6.3.4 of the Transport Assessment in ES Volume III, Appendix 9A, Document Ref. 6.4, rail transport of fuel directly to the Site is not considered to be feasible for the Proposed Development as the Site is not rail connected. In addition, fuel contracts have not yet been agreed and it is not known whether the suppliers will be rail connected. The Site is well connected by road but opportunities to use nearby rail facilities will be considered where appropriate during fuel contract negotiations, and this would reduce GHGs associated with RDF transport.

11.1.4 Although operational staff commuting is only estimated to generate 0.2% of operational GHGs (see Table 8.4), it is noted that the Operational Travel Plan (see Annex 7 of the Transport Assessment in ES Volume III, Appendix 9A, Document Ref. 6.4) will require measures to be implemented to reduce the level of operational staff traffic and monitoring against defined targets. This will be secured by a DCO requirement.

11.1.5 The GHG assessment has been based on a number of conservative, worst case assumptions. These include:

- the RDF volumes and associated transport are based upon a worst-case annual throughput of 753,000 tonnes of RDF, but the RDF throughput is expected to be closer to 616,500 tonnes per annum based upon the design NCV of the fuel. Reduced RDF tonnages would result in lower GHG emissions;
- the grid electricity generated will initially displace fossil fuel power generation during earlier years of the Proposed Development's operation. This displacement of higher carbon intensity power sources has not been included in this assessment; and
- as set out in Chapter 16: Waste Management of the ES (Volume I, Document Ref. 6.2) beneficial use for operational waste materials, such as bottom ash, as secondary aggregates to avoid landfill is being considered by the Applicant.

There would be carbon savings in using recovered and recycled aggregates over the use of virgin aggregate material.

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