Appendix 18A: Carbon Assessment

APPENDIX 18A: CARBON ASSESSMENT

18A.1 Introduction

18A.1.1 The purpose of this carbon assessment is to benchmark the potential carbon emissions from the operation of the Proposed Development against emissions from the current UK electricity generating mix and also an equivalent currently operational combined cycle gas fired power station in the UK.

18A.1.2 This appendix covers the assessment methodology and data used, the estimated carbon footprint, and a comparison to other power stations.

18A.2 Methodology

18A.2.1 National planning policy (National Policy Statements (NPS) EN-1 (DECC, 2016a) and EN-2 (DECC, 2016b)), places value on the importance of a diverse mix of energy generating technologies. The National Planning Policy Framework also encourages the move to a low carbon future, and planning new development to reduce greenhouse gas emissions. This section details the methodology used to calculate greenhouse gas emissions associated with the operation of the power station and how it compares with the other power stations in the UK.

18A.2.2 The Greenhouse Gas Protocol (WRI & WBCSD, 2005) has been used to calculate the Proposed Development's carbon footprint. A widely used standard for emissions reporting, the Protocol has become the basis for many other reporting standards around the world. It provides a methodology for calculating the carbon footprint of a project or a business entity and was developed by the World Resources Institute and the World Business Council for Sustainable Development.

18A.2.3 Where possible design values for the Proposed Development have been used within this assessment; however, some assumptions have been made where data is not yet available or where exact values are not known at this stage. The assumptions made are set out in this assessment including a justification for their selection.

18A.3 Greenhouse Gas Emission "Scopes"

18A.3.1 For reporting purposes the Greenhouse Gas Protocol categorises different direct and indirect sources of greenhouse gas (GHG) emissions into a series of "scopes". These definitions have been used in this assessment to determine the scope and sources of emissions to be considered for the carbon footprint of the Proposed Development, as shown in Table 18A.1.

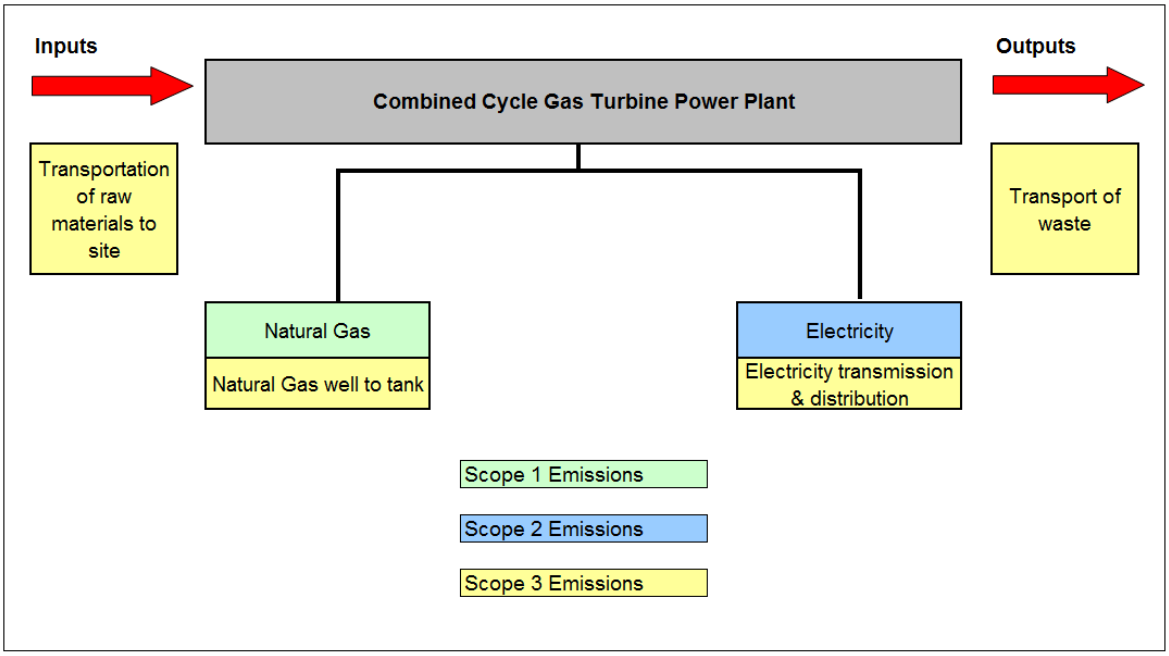
Table 18A.1: Greenhouse Gas Emission "Scopes"

SCOPE	ASSESSMENT DETAILS
Scope 1: Direct Emissions	Fossil Fuel combustion on site: combustion of natural gas.
Scope 2: Electricity Indirect Emissions	Electricity is imported from the grid during start-up of the plant.
Scope 3: Other Indirect Emissions	For the purpose of this assessment, Scope 3 emissions focus on those elements over which the Applicant has significant control and

SCOPE	ASSESSMENT DETAILS
	influence during the operation of the power station and that are anticipated to differ from any equivalent power plant, primarily the transport of major raw materials to site. Emissions associated with the transfer of operational waste materials from the site are assumed to be negligible as there will be limited solid or liquid waste arisings from the plant, however a conservative estimate has been included for the purposes of this assessment. The electricity used on site during normal operation of the plant (the parasitic load) will be sourced from the electricity generated on site, and therefore is included in the Scope 1 calculation.

18A.3.2 A breakdown of emissions sources for the Proposed Development is displayed diagrammatically in Figure 1 below.

Figure 18A.1: Emissions Sources for the Proposed Development



18A.4 Assumptions

18A.4.1 Several broad assumptions have been developed to enable the current assessment:

- the Proposed Development gas-fired CCGT is assumed to operate for 7,884 hours per annum (assuming 90% operating time), the net generation capacity is assumed to be 2,201 MWe from the CCGT, recognising that the gross power station capacity is up to 2,500MWe;
- the peaking plant is gas-fired and assumed to operate for 500 hours per year with net generation capacity of 299 MWe and an assumed electrical efficiency of 38%;

- the electrical efficiency of CCGT generation is expected to be between 60.5% and 62% based on H Class technology; the estimated carbon footprint is presented as a range using these efficiencies. Other technologies are also under consideration but for the purposes of this assessment, H Class technology has been assumed; and
- the 2 MW auxiliary boiler is assumed to be required for an hour each day and is powered by grid electricity.

18A.5 Emission Conversion Factors

18A.5.1 The emission conversion factors used in the assessment for the Proposed Development were derived from factors published annually by Defra (2016) and are summarised here:

- natural gas: 0.2044 $kgCO_2e$ per kWh (Net CV) gas for scope 1, plus the scope 3 well to tank factor for natural gas 0.0278 $kgCO_2e$ per kWh (Net CV) for scope 3;
- grid electricity: 0.4121 $kgCO_2e$ per kWh for scope 2, plus the scope 3 transmission and distribution factor for electricity 0.0373 $kgCO_2e$ per kWh; and
- transport by heavy goods vehicle (HGV (all diesel), average laden (57%), per tonne.km plus well to tank factor): 0.1380 $kgCO_2e$ per tonne-kilometre.

18A.6 Data Inputs

18A.6.1 Tables 18A.2 – 18A.4 below detail all other assumptions and data required for the carbon footprint calculation.

Table 18A.2: Data Inputs

SCOPE	ASSESSMENT DETAILS	ANNUAL QUANTITY CONSUMED
Scope 1 (& scope 3)	Annual quantity of natural gas used on site in normal operation.	29,076 GWh
Scope 2 (& scope 3)	Annual quantity of electricity used on site by the auxiliary boiler	1.8 GWh
Scope 2	Electricity used on site during normal operation of the plant (the parasitic load).	The parasitic load electricity is currently, and will continue to be, sourced from the electricity generated on site, and therefore is included in the Scope 1 calculation.

18A.6.2 Predicted annual quantities of major raw materials consumed and waste streams generated during the operation of the Proposed Development are presented below in Table 18A.3.

Table 18A.3: Annual Raw Material Consumption and Waste Generation

SCOPE	ASPECT OF FOOTPRINT	ANNUAL QUANTITY (ROUNDED TO THE NEAREST TONNE)
Scope 3	Raw materials transported: Diesel	3
Scope 3	Raw materials transported: Hydrogen	3
Scope 3	Raw materials transported: Carbon Dioxide	10
Scope 3	Raw materials transported: Scale Inhibitor	725
Scope 3	Raw materials transported: Sulphuric Acid	72
Scope 3	Raw materials transported: Caustic Soda	72
Scope 3	Raw materials transported: Corrosion Inhibitor	1
Scope 3	Raw materials transported: Antibacterial	720
Scope 3	Raw materials transported: Ammonia	6
Scope 3	Raw materials transported: Oxygen Scavenger	1
Scope 3	Raw materials transported: Tri Sodium Phosphate	2
Scope 3	Waste material: General domestic waste	4
Scope 3	Waste material: General industrial waste	14

18A.6.3 Table 18A.4 summarises the distances assumed for fuel, raw material and waste transportation, for the purposes of this assessment. The actual distances will depend on the selected supplier and award of contracts.

Table 18A.4: Distances and Assumptions for Resource and Waste Transportation

MATERIAL TRANSPORTED	APPROX. DISTANCE TRANSPORTED BY HGV (km)	ASSUMPTIONS
Diesel	40	Average assumption provided by EPL. Sensitivity testing has been conducted for the transport distances and their impact on the total emissions from the Proposed Development. The overall contribution of transport emissions to the total footprint is low, from 0.0003% to 0.0005% with increased transport distances.
Hydrogen	80	
Carbon Dioxide	80	
Scale Inhibitor	80	
Sulphuric Acid	80	
Caustic Soda	80	
Corrosion Inhibitor	80	
Antibacterial	80	
Ammonia	80	
Oxygen Scavenger	80	
Tri Sodium Phosphate	80	
General domestic waste	32	
General industrial waste	80	

18A.7 Carbon Footprint of the Proposed Development

18A.7.1 Carbon footprints have been calculated for the operational phase of the Proposed Development. A breakdown is shown in Table 18A.5 below.

Table 18A.5: Carbon Footprint of the Proposed Development

EMISSIONS SOURCE	ANNUAL CARBON EMISSIONS BY SCOPE (tCO_2e)	
	60.5% EFFICIENCY	62% EFFICIENCY
Scope 1		
Emissions from fossil fuel (natural gas) combustion (including the peaking plant)	5,944,231	5,802,364
Scope 2		
Electricity imported from the National Grid	752	752
Scope 3		
Transport of raw materials (see table 2.3 for materials)	18	18
Transport of waste materials (see table 2.3)	0.18	0.18
Gas Combusted (scope 3 well to tank emissions)	807,137	787,874
Electricity from Grid (scope 3 transmission & distribution)	68	68
Total annual carbon emissions (tCO_2e)	**6,752,206**	**6,591,076**
Carbon Intensity of generated electricity all scopes (tCO_2e/GWh)	**386**	**377**

18A.7.2 Using the data described above, the total annual carbon footprint of the Proposed Development is between 6,591 kilotonnes and 6,752 kilotonnes CO_2e (rounded to the nearest thousand tonnes). Assuming the Proposed Development exports 17,502 GWh per year (based on 7,884 operating hours with net output of 2,201 MWe, plus peaking plant for 299 MWe for 500 hours) this is equivalent to between 377 and 386 tonnes CO_2e per GWh electricity generation (intensity is for all GHG scopes).

18A.8 Comparison of Proposed Development Carbon Footprint

18A.8.1 Table 18A.6 presents the carbon intensity of the Proposed Development along with national averages for 2014 for other UK power stations sourced from the *Digest of United Kingdom Energy Statistics* (DECC, 2016). It should be noted that the intensity figures stated below comprise carbon intensity associated with the combustion of the primary fuel source (e.g. coal, natural gas, refuse derived fuel) *i.e.* Scope 1 emissions only, and do not include other elements of the carbon footprint such as transport of primary fuel electricity use on site. Therefore results are presented compared to the Scope 1 CCGT intensity of the Proposed Development only (excluding the peaking plant).

Table 18A.6: Comparison of Carbon Intensities for the Proposed Development with other Existing Power Stations

NATURE OF POWER STATION	CARBON INTENSITY OF ELECTRICITY SUPPLIED (tCO_2e / GWh) SCOPE 1 ONLY
Existing Eggborough power station	944
Average UK power station 2014 - fossil fuels only	652
Average UK power station 2014- all fuel types (including nuclear & renewable)	400
UK Gas power station 2014	388
Proposed Development, Scope 1 CCGT only (60.5% thermal efficiency)	338
Proposed Development, Scope 1 CCGT only (62% thermal efficiency)	330

18A.8.2 The Proposed Development will outperform the existing coal-fired power station, the average UK power station and an equivalent current UK gas power station average carbon intensity.

18A.8.3 Based on the average carbon intensity data provided in Table 18A.6 above, the annual tonnes of CO_2e emitted from an average gas fired UK power station with the same capacity as the Proposed Development would be 6,791 kilotonnes CO_2e (scope 1 only, rounded to the neatest thousand tonnes). The scope 1 annual carbon footprint of the Proposed Development is between 5,802 kilotonnes and 5,944 kilotonnes CO_2e depending on the efficiency of the units installed. This is an annual saving of between 847 kilotonnes and 988 kilotonnes CO_2e.

18A.8.4 The existing coal-fired power station has a higher carbon intensity; if generating the same GWh of electricity, the existing coal-fired power station would generate 16,522 CO_2e (scope 1 only). The results indicate that the generation of electricity by the Proposed Development represents annual scope 1 carbon savings of between 10,578 kilotonnes and 10,720 kilotonnes CO_2e compared to the existing coal-fired power station.

18A.9 Carbon Reduction and Mitigation Measures

18A.9.1 Chapter 18: Sustainability and Climate Change (ES Volume I) discusses further how the Proposed Development has been designed to reduce its environmental impact.

18A.9.2 A Combined Heat and Power (CHP) Readiness Assessment has been undertaken (Application Document Ref No. 5.7). This assessment considers potential heat users within the local area (a 15 km radius) and the technical suitability of connecting these potential users to a district heating system, developing a preferred most feasible option. There are several potential CHP opportunities within a 15 km radius of the Proposed Development, although no viable opportunities have yet been identified. However, the Proposed Development will incorporate features allowing future implementation of CHP if it becomes viable to do so in the future (*i.e.* the Proposed Development is being designed and built to be CHP Ready).

18A.10 Conclusions

18A.10.1 National planning policy (National Policy Statements) places value on the importance of a diverse mix of energy generating technologies. The National Planning Policy Framework also encourages the move to a low carbon future, and planning new development to reduce greenhouse gas emissions. The Proposed Development is effectively replacing the existing coal-fired power station on the site, and this will provide a secure energy supply to the national grid.

18A.10.2 This assessment demonstrates that the carbon emissions from the Proposed Development compare favourably with UK average gas-fired power stations (based on 2014 DECC data, published in 2016), with annual scope 1 carbon savings of between 847 and 988 thousand tonnes CO_2e.

18A.10.3 This assessment confirms that the majority of the emissions will originate from process emissions from the combustion of natural gas rather than the fuel and raw material transportation elements. Given the early stages of design, we have tested a range of transportation distances to confirm that this remains the same even when the transportation distances are hypothetically doubled.

18A.10.4 Emissions have been calculated based on H Class technology plus some additional peaking plant usage; these calculations demonstrate that the carbon intensity of the proposed development is lower than the average UK power station, the benchmark UK Gas fired power station and the current coal fired power station, largely through the proposed use of higher efficiency H Class combined cycle units.

18A.11 References

Department for Energy and Climate Change (2016a) Overarching National Policy Statement (NPS) for Energy (EN-1).

Department for Energy and Climate Change (2016b) National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)

World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) (2005) *Greenhouse Gas Protocol for Project Accounting*

DEFRA (2016b) UK Government GHG Conversion Factors for Company Reporting

Department for Energy and Climate Change (2016) *Digest of United Kingdom energy statistics' (DUKES)*. [Online] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/577712/DUKES_2016_FINAL.pdf (Accessed 02 March 2017)