Riverside Energy Park

Environmental Permit Appendices

APPENDIX:

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AIR QUALITY ASSESSMENT

GREENHOUSE GAS ASSESSMENT

December 2018 | Revision 0 |

CORY
RIVERSIDE ENERGY

Contents

1 Introduction

1.1.1 Cory Environmental Holdings Limited (trading as Cory Riverside Energy) (Cory or the Applicant) is applying to the Environment Agency (EA) under The Environmental Permitting (England and Wales) Regulations 2016 (Environmental Permitting Regulations) for an Environmental Permit (EP) to operate an integrated Energy Park, to be known as Riverside Energy Park (REP or the Proposed Development). REP would comprise waste treatment facilities together with an associated Electrical Connection.

1.2 Project Description

1.2.1 A detailed description of REP is presented in Sections 1.4 to 1.6 of the Supporting Information. REP would be constructed on land immediately adjacent to Cory's existing Riverside Resource Recovery Facility (RRRF), within the London Borough of Bexley and would complement the operation of the existing facility.

1.2.2 The main elements of REP would be as follows:

- Energy Recovery Facility (ERF): to provide thermal treatment of Commercial and Industrial (C&I) residual (non-recyclable) waste with the potential for treatment of (non-recyclable) Municipal Solid Waste (MSW);
- Anaerobic Digestion facility: to process food and green waste. Outputs from the Anaerobic Digestion facility would be transferred off-site for use in the agricultural sector as fertiliser or as an alternative, where appropriate, used as a fuel in the ERF to generate electricity;
- Solar Photovoltaic Installation: to generate electricity. Installed across a wide extent of the roof of the Main REP Building;
- Battery Storage: to store and supply additional power to the local distribution network at times of peak electrical demand. This facility would be integrated into the Main REP building; and
- On Site Combined Heat and Power (CHP) Infrastructure: to provide an opportunity for local district heating for nearby residential developments and businesses. REP would be CHP Enabled with necessary on site infrastructure included within the REP site.

1.3 The Objective

1.3.1 The objective of this report is to assess the impact of greenhouse gas emissions from REP. The approach adopted within this assessment has been previously requested by the EA for similar power generating activities and is in accordance with UK government guidance titled '*Assess the impact of air emissions on global warming*'[1].

1.3.2 In this report, an assessment of the amount of greenhouse gas released through processing of waste has been undertaken. This assessment reports the predicted carbon dioxide emissions (and their equivalents) from the combustion of the waste; emissions from electricity which is imported into REP from the National Grid; and emissions associated with auxiliary firing. The assessment calculates the quantity of emissions of carbon dioxide from REP and also other greenhouse gases released (for example nitrous oxide) as a carbon dioxide equivalent.

[1] https://www.gov.uk/guidance/assess-the-impact-of-air-emissions-on-global-warming

1.3.3 Power generated through energy recovery from the processing of waste displaces electricity that would have otherwise been sourced from conventional power stations. Therefore, the net change in carbon dioxide emissions has been calculated, as a result of processing waste to generate electricity, rather than generating it by conventional means (based on a Combined Cycle Gas Turbine (CCGT) power station).

1.3.4 For the purpose of this assessment, the power (measured in MWe) generated from low carbon sources has been assumed to displace the same power as that generated by conventional means.

1.3.5 This report does not consider the release or avoidance of indirect carbon dioxide emissions associated with the operation of REP, as the EA does not consider indirect carbon emissions within the determination of an EP application.

1.3.6 In addition, as REP will include the installation of solar panels, these will be considered within this assessment.

1.3.7 Whilst REP will include a battery storage facility, this has not been considered within this assessment as it does not generate power.

2 Assumptions

2.1 ERF

2.1.1 The ERF will use a moving grate as the combustion technology. The ERF will be a two stream design, with a nominal design capacity of approximately 41 tonnes per hour per line of Commercial and Industrial (C&I) waste, and potentially municipal solid waste (MSW) per hour, with an average net calorific value (NCV) of approximately 9 MJ/kg. This equates to a nominal design capacity of 655,000 tonnes per annum.

2.1.2 For the purposes of this assessment the following assumptions have been applied:

i. The ERF has a nominal design capacity of approximately 655,000 tonnes per annum and a maximum design throughput of 805,920 tonnes per annum. However, for the purposes of this assessment and to be consistent with the BAT assessment, the nominal design throughput has been applied.

ii. The ERF will have an availability of approximately 8,000 hours operation per annum.

iii. The boilers within the ERF will have an aggregated thermal capacity (based on NCV) of 204.44 MWth.

iv. The ERF will generate up to approximately 67.6 MWe with an estimated parasitic load of 6.1 MWe.

v. It is understood that whilst REP would be expected to process commercial and industrial waste rather than MSW, the carbon composition of the waste has been assumed to be the same as the waste processed in RRRF. Cory have published a report, titled 'Cory Riverside Energy: A Carbon Case', dated March 2017. Within the report, the carbon content of the waste processed in RRRF is reported as follows:

- The incoming waste contains 27% carbon by weight; and
- 54.1% of the carbon content of the incoming waste qualifies as renewable, i.e. it is classified as biogenic carbon.

vi. Nitrous oxide is emitted at a rate of 0.046 kg nitrous oxide per tonne of waste, in accordance with IPCC Guidelines for Greenhouse Gas Inventories, Vol 2, table 2.2 Default Emissions Factors for Stationary Combustion in the Energy Industries, Municipal Wastes (non-biomass) and Other Primary Solid Biomass.

vii. The ERF will have 6 periods of start-up and shutdown per annum per stream. The ERF will be shutdown for two periods of planned maintenance per annum. However, to be conservative, there will be up to 4 periods of unplanned maintenance per annum per stream. Each sequence of start-up and shutdown will take a total of 18 hours. Therefore, each stream of the ERF will be in start-up and shutdown for approximately 100 hours per annum.

viii. During periods when the ERF is not operational, it is estimated that the electrical load required by the ERF will be 20% of the operational parasitic load. Therefore, the ERF will have an electrical load of approximately 1.2 MWe during periods of non-availability (660 hours per annum). During periods of start-up and shutdown, power will be imported from the national electricity network. As stated in UK Government guidance titled '*Assess the impact of air emissions on global warming*' the import of electricity from public supply should be assumed to have emissions of 0.166 t CO2/MWh.

ix. The auxiliary burners, which will be fired on fuel oil, will operate at 70% of the maximum continuous rating of the thermal capacity of the facility. Therefore, the burner capacity for each line will be approximately 71.6 MW.

x. The export of heat to nearby heat users will result in additional savings in the displacement of greenhouse gas emissions from conventional sources. It is acknowledged that there is potential to export up to 3 MWth of heat for the operation of the (onsite) anaerobic digestion facility; however, for the purposes of this assessment they have been excluded from the calculations as this will result in a more conservative assessment.

2.2 Anaerobic Digestion facility

2.2.1 The anaerobic digestion facility will process approximately 40,000 tonnes per annum of organic waste in the absence of oxygen to produce a biogas/biomethane, (referred to as biogas).

2.2.2 The biogas generated by the anaerobic digestion plant will be upgraded to a CNG and/or upgraded for injection into a local gas network. CNG would be the preferred option if feasible and viable. However, if a CNG option is not feasible or viable then REP will incorporate a "CHP engine" which would use the biogas to generate electricity and heat, which could be used to support the anaerobic digestion process or added to energy available for export from REP. As the combustion of biogas in a biogas engine will result in greenhouse gas emissions, to ensure that this assessment is conservative the emissions from a biogas engine have been considered within this greenhouse gas assessment

2.2.3 For the purposes of this assessment, the following assumptions have been assumed with regards the combustion of biogas within a biogas engine:

i. The biogas engine will have a gross electrical output of up to 1 MWe.

ii. The anaerobic digestion facility will have a parasitic load of up to 300 kWe.

iii. The biogas engine will have an availability of 8,400 hours operation per annum. Therefore, the gas engines will not be available for 360 hours per annum. During periods when the anaerobic digestion facility is not available to generate power it will operate at approximately 5 % of the parasitic load to maintain operation of the safety critical equipment.

iv. UK Government guidance (1 February 2016) titled '*Assess the impact of air emissions on global warming*', states that "*emissions that come from renewable energy sources as having an impact of '0'* [zero] *on global warming*". The guidance note explains that renewable energy sources include "*from waste or from biomass* - '*biodegradable waste*".

v. The ERF has the potential to export heat to the anaerobic digestion facility which would otherwise be generated from the combustion of natural gas in a conventional gas fired boiler. However, the export of heat from the ERF has been excluded from this assessment as this will ensure that this assessment is conservative.

2.3 Solar Panels

2.3.1 There will be up to 1 MWe of solar panel capacity installed at REP.

2.3.2 The 'PV Fit calculator' developed by the Energy Saving Trust[2], states that a solar panel with minimal shading and installed at an optimal orientation will typically generate up to 907 MWh/MW of the installed capacity.

[2] http://www.pvfitcalculator.energysavingtrust.org.uk/

3 Displaced Heat and Power

3.1.1 The DEFRA document 'Energy from Waste – A guide to the debate 2014' provides support for the use of CCGT as a comparator for electricity generated from the combustion of waste. Footnote 29 on page 21 states that:

'A gas fired power station (Combined Cycle Gas Turbine - CCGT) is a reasonable comparator as this is the most likely technology if you wanted to build a new power station today.'

3.1.2 The Department for Business, Energy & Industrial Strategy publish fuel mix tables which identify the quantities of carbon dioxide equivalents from the combustion of different fuel types. The Fuel Mix Disclosure data table dated 01 April 2017 to 31 March 2018, which was revised on 24 August 2018, states that carbon dioxide emissions from the combustion of natural gas are 357 g/kWh[3].

3.1.3 Therefore, for the purposes of this assessment it is assumed that power generated by REP will displace power from a CCGT and that the carbon dioxide emissions from a CCGT power station is equivalent to 357 g/kWh.

3.2 ERF

3.2.1 The ERF will generate approximately 560,000 MWh of power per annum. Of this power approximately 511,200 MWh per annum will be available for export. This will displace approximately 182,500 tonnes of carbon dioxide equivalent.

3.2.2 As stated previously, the export of heat from the ERF has been excluded from this assessment as this will ensure that this assessment is conservative.

3.3 Anaerobic Digestion facility

3.3.1 The anaerobic digestion facility will generate approximately 8,400 MWh of power per annum. Of this power approximately 5,880 MWh per annum will be available for export. This will displace approximately 2,100 tonnes of carbon dioxide equivalent.

3.4 Solar Panels

3.4.1 The solar panels will generate up to 910 MWh of power per annum. This will displace approximately 320 tonnes of carbon dioxide equivalent.

3.5 Summary of Displaced Power

3.5.1 To summarise, REP will:

- export up to 517,990 MWh of power per annum from low carbon sources; and
- of the power exported this will displace approximately 185,920 tonnes of carbon dioxide equivalent if the power was generated in a CCGT power station and the heat generated in a conventional gas fired boiler.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/737451/fuel-mix-disclosure-data-2018-revised-2.pdf

4 Carbon Equivalent Emissions from REP

4.1.1 REP will release carbon dioxide from the combustion of waste and potential combustion of biogas and the operation of any ancillary processes. Taking into consideration the assumptions set out in section 2, the emissions of carbon dioxide (and their equivalents) have been calculated for each of the power generating facilities as set out below.

4.2 ERF

Emissions from the Combustion of Incoming Waste

4.2.1 The ERF will export approximately 780 kW of power per tonne of incoming waste.

4.2.2 The carbon dioxide equivalent emissions from the processing of waste within the ERF would be approximately 990 kg per tonne of incoming waste, of which 454 kg per tonne of incoming waste will be from non-biogenic sources.

4.2.3 The total carbon dioxide equivalent emissions from fossil fuels (excluding the combustion of auxiliary fuels for start-up and shutdown and auxiliary firing) will be approximately 297,600 tonnes per year.

Emissions of Nitrous Oxide

4.2.4 The ERF will release approximately 30.1 tonnes of nitrous oxide per annum, based on the assumption of 0.046 kg nitrous oxide per tonne of waste. Nitrous oxide has a GWP of 310 carbon dioxide equivalents.

4.2.5 The total carbon dioxide equivalent emissions from emissions of nitrous oxide will be approximately 9,300 tonnes per year.

Electricity Import

4.2.6 During periods of start-up and shutdown the ERF will have an electrical demand of approximately 620 MWh per annum; and during periods of non-availability the facility will have an electrical demand of approximately 800 MWh per annum. Therefore, the ERF will consume approximately 1,420 MWh of power per annum.

4.2.7 Therefore, the ERF is anticipated to release approximately 240 tonnes per year of carbon dioxide equivalent from the import of electricity.

Emissions from Auxiliary Firing

4.2.8 The auxiliary burners will consume approximately 26,700 MWh of gas oil per annum. This will be equivalent to a total of approximately 6,700 tonnes per year of carbon dioxide equivalent from the combustion of gas oil for auxiliary firing.

4.3 Anaerobic Digestion facility

Emissions from the Combustion of Biogas

4.3.1 Emissions from the combustion of biogas is zero rated. Therefore, there will not be any emissions of carbon dioxide from the combustion of biogas.

Emissions of Nitrous Oxide

4.3.2 There will not be any emissions of nitrous oxide from the combustion of biogas generated by the anaerobic digestion facility. Therefore, there will not be any emissions of carbon dioxide from auxiliary firing.

Electricity Import

4.3.3 During periods of non-availability the anaerobic digestion facility will have an electrical demand of approximately 0.015 MWh. Therefore, the anaerobic digestion facility will consume approximately 5 MWh of power per annum.

4.3.4 Therefore, the anaerobic digestion facility is anticipated to release approximately 1 tonne per year of carbon dioxide equivalent from the import of electricity.

Emissions from Auxiliary Firing

4.3.5 There will not be any auxiliary firing associated with the anaerobic digestion facility. Therefore, there will not be any emissions of carbon dioxide from auxiliary firing.

4.4 Solar Panels

4.4.1 There will not be any emissions of carbon dioxide from the power generated by the solar panels.

4.5 Summary of Displaced Power

4.5.1 The operation of REP will lead to the release of approximately:

- 297,600 tonnes per year of carbon dioxide equivalent from the processing of the non-biogenic component of the waste within the ERF;
- 9,300 tonnes per year of carbon dioxide equivalent from nitrous oxide from the process of waste within the ERF;
- 240 tonnes per year of carbon dioxide equivalent from imported electricity for the operation of the REP during periods when the ERF or anaerobic digestion facility is not operational; and
- 6,700 tonnes per year of carbon dioxide equivalent from the combustion of gas oil for auxiliary firing in the ERF.

4.5.2 Therefore, in total it is predicted that approximately 313,840 tonnes per year of carbon dioxide equivalent would be released from the Facility.

5 Conclusions

5.1.1 The information presented within this assessment is summarised in Table 1 below.

Table 1 - Tonnes of carbon dioxide emissions per annum from the operation of the waste processing activities undertaken at REP

	ERF		Anaerobic digestion facility		Solar panels	
Parameter	**Released**	**Off-set**	**Released**	**Off-set**	**Released**	**Off-set**
Energy recovered (electricity)		182,500		2,100		320
Energy recovered (heat)		-		-		-
Total Off-set		**182,500**		**2,100**		**320**
Carbon dioxide emissions from derived from fossil fuels	297,600		-		-	
Nitrous oxide emissions from the process	9,300		-		-	
Indirect carbon dioxide emissions from imported electricity	240		1		-	
Direct carbon dioxide emissions from the combustion of auxiliary fuel	6,700		-		-	
Total Released	**313,840**		**1**		**-**	
Net greenhouse gas emission from REP	**+131,340**		**-2,099**		**-320**	

5.1.2 To conclude, the operation of REP will result in an increase in emissions of carbon dioxide equivalent of 128,920 tonnes per annum from the generation of power from the processing of waste compared to generating the equivalent power in a CCGT power station. However, this does not take into consideration carbon emissions associated with any existing treatment

techniques for the waste – such as landfill – which will more than off-set the stated increase in carbon dioxide emissions from the operation of REP.

5.1.3 In addition, within this assessment it is assumed that there is no recovery of heat from the ERF or the anaerobic digestion facility.

5.1.4 The methodology applied in this assessment has been developed following consultation with the EA on previous EP applications and has been developed to specifically support the requirements of the EP application process. However, it should be noted that REP will deliver significant carbon savings as discussed in the DCO application, refer to Appendix 7.2 – '*The Project and its Benefits Report*', which are not considered in this methodology.