REPORT

Boston Alternative Energy Facility

Combined Heat and Power Assessment

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1 Introduction

1.1 Background

1.1.1 This Combined Heat and Power (CHP) Assessment is for the Boston Alternative Energy Facility (the Facility). This report is on behalf of the applicant, Alternative Use Boston Projects Limited (AUBP) to support the application for a Development Consent Order (DCO) (the DCO application) that has been made to the Planning Inspectorate under Section 37 of the Planning Act 2008 (the Act).

1.1.2 The Facility is a proposed Energy from Waste (EfW) plant that would generate approximately 102 megawatts electric (MWe) (gross) of renewable energy and would deliver approximately 80 MWe (net) to the National Grid. The energy recovery plant would be a thermal treatment facility using refuse derived fuel (RDF) as the feedstock to generate energy. The Facility is proposed to be located at Riverside Industrial Estate, Boston, Lincolnshire. The Riverside Industrial Estate is adjacent to the tidal River Witham (known as The Haven) and down-river from the Port of Boston. The central National Grid Reference (NGR) for the site is TF 33950 42241.

1.1.3 The Facility constitutes a Nationally Significant Infrastructure Project (NSIP) under the Act by virtue of the Facility requiring the building, commissioning and operating of a generating station with an energy generating capacity greater than 50 MWe. As the Facility is a NSIP, AUBP is required to make an application for a DCO to the Planning Inspectorate, which will be decided by the Secretary of State.

1.1.4 The DCO, if granted, would be known as ‘The Boston Alternative Energy Facility Order’.

The Applicant

1.1.5 AUBP is the Applicant undertaking the development and securing funding for the Facility. AUBP is a privately-owned company with core business in Energy from Waste, specifically renewable electricity projects producing “Green Energy”.

1.1.6 The company team has been involved in industrial development at Riverside Industrial Estate, Boston, Lincolnshire since 2004. In March 2005, planning consent was obtained for a Special & Clinical Waste Processing Plant, with conditions discharged and commencement of construction.

1.1.7 In 2010, consent was obtained for a 12 MWe Gasification Power Station that would process waste wood (known as Biomass UK No. 3 Ltd) with enabling works

carried out during 2013. This facility was sold to Aviva Investors in November 2015, along with the right to develop the facility, and in September 2016 it was transferred to Biomass UK No. 3 Ltd. The Biomass UK No. 3 Ltd facility is entirely separate to the proposed Facility.

The Application Site

1.1.8 The Application Site is neighboured to the west by the Riverside Industrial Estate and to the east by The Haven, a tidal waterway of the River Witham between The Wash and the town of Boston. The A16 public highway is approximately 1.3 km to the west. The Application Site is entirely within the administrative area of Boston Borough Council.

1.1.9 The Application Site comprises undeveloped and previously developed land enclosed by a network of drainage ditches and forms part of a wider emerging industrial/commercial area.

1.1.10 A detailed description of the Application Site location and surroundings is provided in **Chapter 5 Project Description** of the Environmental Statement (ES) (document reference 6.2.5).

The Proposed Development

1.1.11 The Facility would deliver approximately 80 MWe of renewable energy to the National Grid using RDF as a feedstock into a Thermal Treatment facility generating power via steam turbine generators.

1.1.12 The Facility would comprise the following main elements:

- a wharf and associated infrastructure (including re-baling facility, workshop, transformer pen and welfare facilities);
- a RDF bale contingency storage area, including sealed drainage, with automated crane system for transferring bales;
- conveyor system running in parallel to the wharf between the RDF storage area and the RDF bale shredding plant. Part of the conveyor system is open and part of which is under cover (including thermal cameras);
- bale shredding plant;
- RDF bunker building;
- thermal treatment plant comprising three nominal 34 MWe combustion lines (circa 120 megawatts thermal (MWth)) and associated ductwork and piping, transformer pens, diesel generators, three stacks, ash silos and ash transfer network; and air pollution control residues (APCr) silo and transfer network;
- turbine plant comprising three steam turbine generators, make-up water facility and associated piping and ductwork;

- air-cooled condenser structure, transformer pen and associated piping and ductwork;
- Lightweight Aggregate (LWA) manufacturing plant comprising four kiln lines, two filter banks with stacks, storage silos for incoming ash, APCr, and binder material (clay and silt), a dedicated berthing point at the wharf, silt storage and drainage facility, clay storage and drainage facility, LWA workshop, interceptor tank, LWA control room, aggregate storage facility and plant for loading aggregate / offloading clay or silt;
- electrical export infrastructure;
- two carbon dioxide (CO_2) recovery plants and associated infrastructure, including chiller units;
- associated site infrastructure, including site roads, pedestrian routes, car parking, site workshop and storage, security gate, control room with visitor centre and site weighbridge; and
- habitat mitigation works for redshank and other bird species comprising of improvements to the existing habitat through the creation of small features such as pools/scrapes and introduction of small boulders (Habitat Mitigation Works) within the Habitat Mitigation Area.

1.1.13 The construction period for the whole development, including commissioning, is anticipated to be between 46 to 48 months.

1.1.14 The Facility would be designed to operate for an expected period of at least 25 years, after which ongoing operation will be reviewed and if it is not appropriate to continue operation the plant will be decommissioned. The wharf structure would replace a section of the current primary flood defence bank (without impacting on the integrity of the bank) and would form a permanent structure that is not anticipated to be decommissioned.

1.1.15 A detailed description of the Facility is provided within **Chapter 5 Project Description** of the ES (document reference 6.2.5).

1.2 Purpose and Structure of this Report

1.2.1 This CHP Assessment has been prepared in order to comply with Section 4.6 of the 'Overarching National Policy Statement for Energy (EN-1) (Ref. 1-2) and paragraphs 2.5.26 - 27 of the 'National Policy Statement on Renewable Energy (EN-3), which require developers advancing thermal generating stations to consider the opportunities for CHP.

1.2.2 CHP is the simultaneous generation of electrical power and usable heat in a single process, and is also known as co-generation. A CHP station may either supply steam direct to customers or capture heat from low-pressure steam after it has

been used to drive electricity generating turbines, for hot water or space heating purposes or, in the case of the facility, for use in the CO_2 capture facility located on the same site. The process consists of two discrete lines, each of which requires nominally 6.5 MWth, with a total of 13 MWth. Medium pressure steam is extracted from the steam turbine and transferred to the facility. Condensate will be returned to the EfW plant for reintroduction into the steam cycle.

1.2.3 CHP is considered advantageous as generating electrical power and heat together is more efficient than generating them separately. Therefore, it can deliver a reduction in both primary energy usage and carbon emissions.

1.2.4 A further revision of this CHP assessment will take place as part of the Environmental Permit application for the Facility, following completion of the detailed design of the Facility, prior to its construction. The revised assessment will be based on potential heat loads agreed with the Environment Agency (EA) and the specific design of the plant.

2 Legislation, Policy and Guidance

2.1 National Policy Statements for Energy

2.1.1 The policy framework for examining and determining applications for Nationally Significant Infrastructure Projects (NSIPs) is provided by National Policy Statements (NPSs). In July 2011, the Secretary of State for the Department of Energy and Climate Change ('DECC' who's functions were replaced by the Department for Business, Energy and Industrial Strategy (BEIS)) designated several NPSs relating to nationally significant energy infrastructure.

2.1.2 The CHP assessment has been made with specific reference to the relevant NPS. These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIP). Those relevant to the Facility are:

- Overarching NPS for Energy (**EN-1**) (DECC 2011a);
- NPS for Renewable Energy Infrastructure (**EN-3**) (DECC 2011b).

2.1.3 Section 4.6 of EN-1 details the consideration of CHP.

2.1.4 Paragraph 4.6.2 states that:

"CHP is technically feasible for all types of thermal generating stations, including nuclear, energy from waste and biomass"

2.1.5 Paragraph 4.6.5 gives an indication of how a CHP can be economically viable:

"To be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand. For industrial purposes, customers are likely to be intensive heat users such as chemical plants, refineries or paper mills. CHP can also be used to provide lower grade heat for light industrial users such as commercial greenhouses, or more commonly for hot water and space heating, including supply through district heating networks."

2.1.6 Paragraph 4.6.6 states that:

"Under guidelines issued by DECC (then DTI) in 2006, any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must either include CHP or contain evidence that the possibilities for CHP have been fully explored to inform the IPC's consideration of the application. This should be through an audit trail of dialogue between the applicant and prospective customers. The same principle applies to any thermal power station which is the subject of an application for development consent under the Planning Act 2008. The IPC should have regard to DECC's guidance, or any successor to it, when considering the CHP aspects of applications for thermal generating stations."

2.1.7 Paragraph 4.6.7 states that:

"In developing proposals for new thermal generating stations, developers should consider the opportunities for CHP from the very earliest point and it should be adopted as a criterion when considering locations for a project. Given how important liaison with potential customers for heat is, applicants should not only consult those potential customers they have identified themselves but also bodies such as the Homes and Communities Agency (HCA), Local Enterprise Partnerships (LEPs) and Local Authorities and obtain their advice on opportunities for CHP. Further advice is contained in the 2006 DECC guidelines and applicants should also consider relevant information in regional and local energy and heat demand mapping."

2.1.8 Paragraph 4.6.8 states that if a proposal is for thermal generation without CHP the Applicant should:

- explain why CHP is not economically or practically feasible;
- provide details of any future heat requirements in the area that the station could meet; and
- detail the provisions for ensuring any potential heat demand in the future can be exploited.

2.1.9 Paragraph 4.6.9 discusses the space requirements which may conflict with making the Facility Carbon Capture Ready:

"CHP may require additional space than for a non-CHP generating station. It is possible that this might conflict with space required for a generating station to be Carbon Capture Ready, as set out in Section 4.7. The material provided by applicants should therefore explain how the development can both be ready to provide CHP in the future and also be Carbon Capture Ready or set out any constraints (for example space restrictions) which would prevent this."

2.1.10 Paragraph 4.6.10 states that if the IPC is not satisfied with the evidence that has been provided, it may wish to investigate this with one or more of the bodies such as the HCA, LEPs and Local Authorities. Then paragraph 4.6.11 goes on to say that if the IPC identifies a potential heat customer that is not explored in the application it should request that the Applicant pursues this. Should the Applicant not be able to reach an agreement with a potential customer, it should provide evidence demonstrating why it was not possible.

2.1.11 NPS EN-3 reiterates the requirement of EN-1 to either include CHP or present evidence in the application that the possibilities for CHP have been fully explored (2.5.26 - 27).

2.2 DECC CHP Guidance

2.2.1 DECC (then DTI) Guidance on Background Information to Accompany Notifications Under Section 14(1) of the Energy Act 1976 and Applications under Section 36 of the Electricity Act 1989 sets out the information that developers must submit to show that they have fully considered the opportunities to use CHP when developing their proposals.

2.2.2 Information for developers is included from paragraph 8 onwards. Many of the key requirements are covered above as part of EN-1. Paragraph 8 states that expects developers to explore opportunities to use CHP fully, including community heating, when developing proposals for new power stations (see paragraphs 23 to 25). However, it does recognise that in some cases CHP will not always be an economic option.

2.3 CHP-Ready Guidance

2.3.1 In February 2013, the EA produced a guidance note titled 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants'. This guidance applies to the following facilities, which will be regulated under the Environmental Permitting (England and Wales) Regulations 2016 (as amended):

- new combustion power plants (referred to as power plants) with a gross rated thermal input of 50 MW or more; and
- new energy from waste (EfW) plants with a throughput of more than 3 tonnes per hour of non-hazardous waste or 10 tonnes per day of hazardous waste.

2.3.2 The CHP-Ready (CHP-R) guidance requires developers to demonstrate Best Available Techniques (BAT) for several criteria, including energy efficiency. One of the principal ways of improving energy efficiency is through the use of CHP, for which three BAT tests exist.

- The first involves considering and identifying opportunities for the immediate use of heat off-site.
- Where this is not technically or economically possible, the second test involves ensuring that the plant is built to be CHP–R.
- The third test involves carrying out periodic reviews to determine whether the situation has changed and if there are opportunities for heat use off site.

2.3.3 The EA CHP-R Guidance sets out a methodology for assessing the technical and economic viability of CHP for a proposed development to facilitate all new generating station developments being designed as CHP-R.

2.3.4 A further detailed CHP-R Guidance assessment of the Facility will be carried out as part of the environmental permit application. The detailed assessment will cover the following steps:

- Step 1: Assess design concept for development and fully explore and establish whether CHP and CHP-R is relevant for the proposal.
- Step 2: Establish if there are any opportunities for the supply of heat.
- Step 3: Review opportunities for supply of heat and identify the most appropriate heat load.
- Step 4: Generate a CHP envelope and review if the requirements of the heat load can be met.
- Step 5: Establish the effect of the selected heat load on the proposed development.
- Step 6: Based on the work completed in steps 3 – 5, identify provisions and space requirements for CHP / CHP-R.
- Step 7: Where appropriate identify the costs associated with the provision of CHP / CHP-R

- Step 8: Justify the degree to which the proposed development will be CHP-R.

2.3.5 An overview of this process, comprising Steps 1-3 has been carried out as part of this document.

2.3.6 The developer will be required (we propose pursuant to a requirement of the Development Consent Order) to carry out periodic reviews of opportunities for the supply of heat as per the CHP-R Guidance.

2.4 Local Planning Policy

South-East Lincolnshire Local Plan

2.4.1 The South-East Lincolnshire Local Plan (SELLP) was adopted in March 2019 (South-East Lincolnshire Joint Strategic Planning Committee, 2019). It was produced jointly by Boston Borough Council (BBC), Lincolnshire County Council (LCC) and South Holland District Council (SHDC).

2.4.2 The SELLP guides development in South East Lincolnshire over the next twenty years and will identify opportunities for growth and will set out clear guidance on what planning applications will be permitted.

2.4.3 The SELLP deals with all land use and development issues affecting South East Lincolnshire, except for minerals and waste development – these are covered in the Lincolnshire Minerals and Waste Local Plan (see below).

2.4.4 However, the SELLP refers to principles that the Development Consent Order (DCO) application for the Facility can take into account. Policy 3: Design of New Development, seeks to ensure that development would not be wasteful in its use of energy or in its depletion of natural resources.

Lincolnshire Minerals and Waste Local Plan (2016)

2.4.5 The Lincolnshire Minerals and Waste Local Plan (LMWLP) (LCC, 2016) is made up of two documents – the Core Strategy and Development Management Policies (2016) and Site Locations (2017) documents.

2.4.6 The Core Strategy and Development Management Policies (CSDMP) document was adopted in June 2016 and replaced the Lincolnshire Minerals Local Plan (1991) and the Lincolnshire Waste Local Plan (2006) (with the exceptions of Policies WLP2, WLP6 and WLP12). The CSDMP document outlines the future of waste management in the Lincolnshire up to 2031, as well as a guide to future winning and working of materials. The criteria against which waste planning

applications are considered are also set out in the CSDMP document.

2.4.7 With relation to CHP, paragraph 7.26 states:

"The objective of reducing greenhouse gas emissions will be achieved by encouraging:

- *waste treatment processes that reduce the amount of waste going to landfill (with all waste management facilities being required to provide evidence of how much waste will be diverted from landfill);*
- *decentralised, low-carbon/renewable energy generation and carbon reduction measures at new mineral working sites and waste management developments (including landfill gas collection);*
- *low carbon energy recovery facilities, such as combined heat and power (CHP), where possible, to be suitably sited in close proximity to suitable potential heat customers to enable the utilisation of the heat produced as an energy source;*
- *increased energy efficiency measures in plant, buildings and operations; and*
- *good practice in transport related matters to reduce vehicle miles."*

3 Local Heat Loading

3.1.1 A high level overview of the heat load was made using the UK CHP Development online heat map tool (BEIS) and it has not identified any potential heat demand.

3.1.2 The wider Boston area (within 10 km of the Application Site) heat load is provided in **Plate 3-1** below, which shows the heat loading indicates medium heat demand per annum (up to 100,000 MWh/km^2) mainly comprising long-established small industrial and residential users, which comprise three-quarters of total heat demand.

3.1.3 Section 4.6.5 of the Overarching National Policy Statement for Energy (EN-1) does not recommend using existing housing to be part of new CHP Schemes:

"*the provision of CHP is most likely to be cost-effective and practical where it is included as part of the initial design and is part of a mixed-use development. For example, retrofitting a district heating network to an existing housing estate may not be efficient.*"

3.1.4 For this reason, using existing domestic housing, or housing developments that are likely to be started prior to the operation of the Facility; or established small industrial users, is unlikely to be technically feasible.

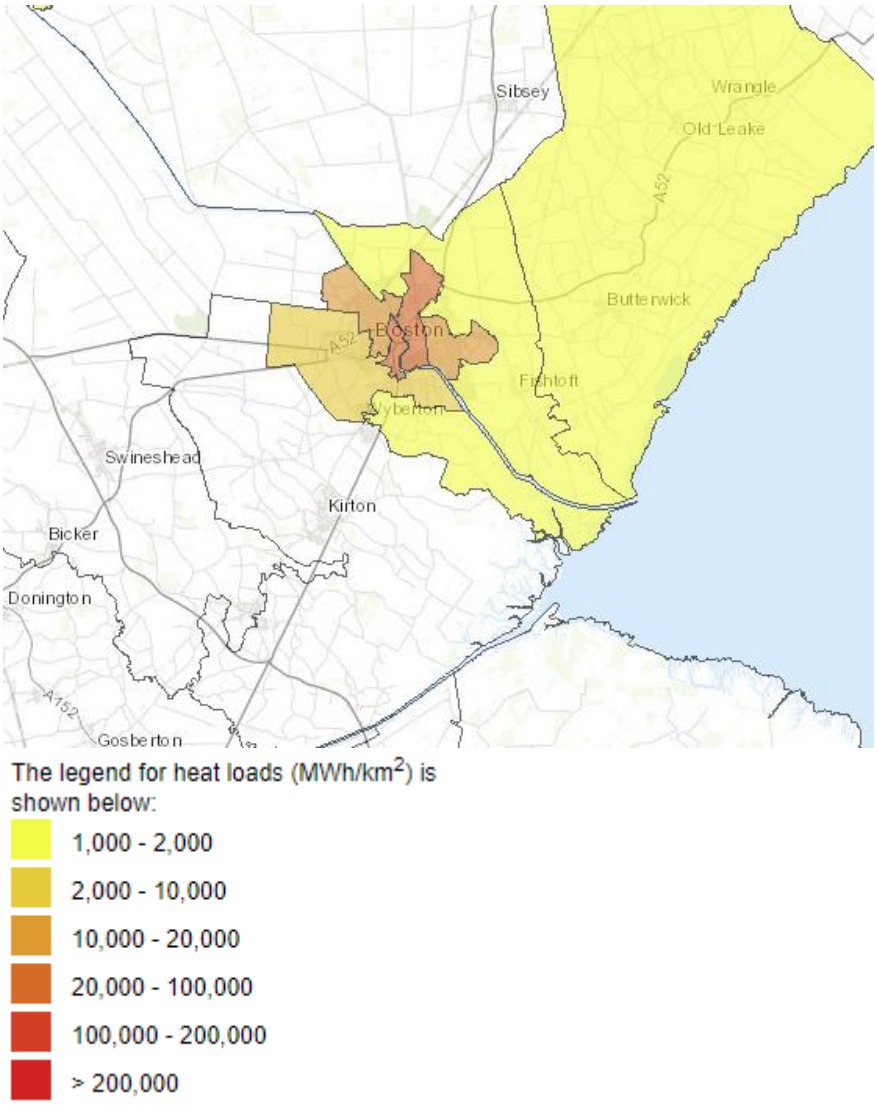

Plate 3-1 Boston Heat Load [Source: UK CHP Development Map[1]]

3.1.5 **Table 3-1** below identifies the heat demand using the UK CHP Heat map within the 10 km search radius.

Table 3-1 Heat demand within 10 km of Application Site

Sector	Share	Total MWh/annum
Communications and Transport	0.04%	237.18
Commercial Offices	0.63%	3869.85
Domestic	75.05%	461911.72
Education	1.61%	9925.52
Government Buildings	0.06%	357.86

[1] https://chptools.decc.gov.uk/developmentmap

Sector	Share	Total MWh/annum
Hotels	0.22%	1326.66
Large Industrial	4.94%	30432.61
Health	4%	24610.73
Other	0.13%	826.74
Small Industrial	12.16%	74859.51
Prisons	0%	0.00
Retail	0.48%	2969.80
Sport and Leisure	0.10%	603.93
Warehouses	0.58%	3554.82
District Heating	0%	0.00
Total heat load in area		615486.95

3.1.6 The greatest single point demand in Boston is Pilgrim Hospital, which is Boston's only "large" heat demand source and considerably skews the heat load for the town (Total Heat Load per annum: 24077 MWh, partly served by CHP = 894 MWh).

3.1.7 Pilgrim Hospital is over 3 km (in a straight line) from the Application Site and is separated by the historic town centre, the main A16 highway, which runs through town and the River Witham. Therefore, it is unlikely to represent a viable destination of heat from the Facility due to the technical constraints and considerable financial investment required to connect to it through the town centre and across the river. However, the future detailed heat user assessment will evaluate the potential connection further.

3.1.8 There are no district heating schemes identified on the heat demand list.

3.1.9 The potential heat loads at a local level immediately adjacent to the proposed Facility are shown in **Plate 3-2** and identified the area associated with the Riverside Industrial Estate as a medium heat demand per annum (10,000 - 20,000 MWh/km^2).

3.1.10 EN-1 states (at paragraph 4.6.5) that "*To be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand*." Only one large heat demand source (Pilgrim Hospital) exists within a 10km radius and this is considered to be

technically and economically unfeasible to connect given the distance and intervening constraints.

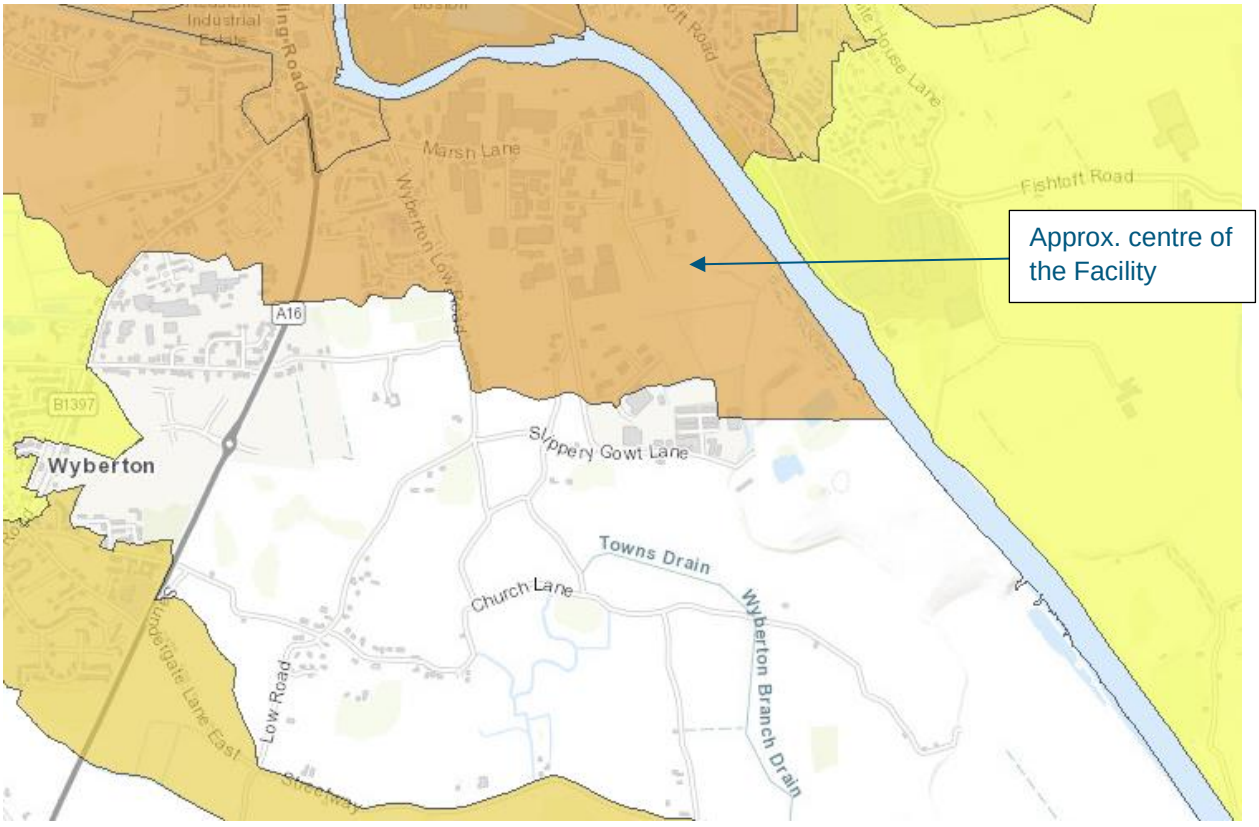

Plate 3-2 Current heat load at the Application site [Source: UK CHP Development Map[2]]

3.1.11 It is therefore considered based on the low heat demand in the surrounding area and taking into account the distance and sparse nature of heat users resulting in technical and commercial challenges for proposed routes, the Facility will be designed as CHP-R and will not be developed as a CHP scheme until such loads become available that running with CHP is considered economically feasible.

3.1.12 The list of proposed cumulative schemes (**Appendix 6.1 List of Cumulative**

[2] https://chptools.decc.gov.uk/developmentmap

Schemes of the ES (document reference 6.4.2)) provided by Boston Borough Council was used to identify potential sources of future heat use. Discussions with Boston Borough Council have not identified any significant local demand for heat from the Facility in developments that are likely to align with the completion of the Facility. Accordingly, limited consultation has taken place with relevant stakeholders regarding heat. Given the uncertainty of future heat loads, the lack of currently available suitable heat loads, and the undefined operating scheme of the Proposed Scheme, the Proposed Scheme will not be CHP for external distribution of heat from the first operation of the Facility.

4 Provision of Heat

4.1.1 Section 3 (above) provides an explanation as to why, based upon current findings, CHP is not economically or practically feasible from the first operation of the Facility. However, demonstration is provided below that the Facility can be CHP-R through provisions during the construction of the plant.

4.1.2 Consent is sought for the development of technology to the extent of the CHP envelope, which is defined by Work No. 1A (ii), (v) and (vii); and Work 1A(viii) and Work 1C for the export of heat to the carbon capture facility (see below) (refer to DCO Schedule 1, (document reference 2.1) and the Works Plans (document reference 4.3).

4.1.3 The Indicative Generating Station Plan (refer to 'Item list' - Sheet 9 of 9, document reference 4.9) refers to 'site items' with reference numbers. The relevant site items covered by the CHP envelope, linked to their respective Work package numbers are:

- C1 EfW Plant 3 Lines Work No. 1A(ii).
- D1 Turbine Generator Hall Work No. 1A(v).
- E1 Air Cooler Condenser Work No. 1A(vii).
- F1 ASCO Plant - Carbon Capture Work No. 1C.
- F3 6.5 MW Chiller Work No. 1C.

4.2 Internal use of heat

Thermal treatment process

4.2.1 This section explains how the Facility is set up to be 'CHP ready' (CHP-R) and identifies connection points for CHP if future users are found that could connect to the Facility if CHP export is, in the future engaged.

4.2.2 The plant consists of a combustion unit fired on RDF coupled to a waste heat recovery boiler. The combustion unit has three lines with a capacity of 120 MW thermal input each (that is the energy in the fuel based on net Calorific Value). Regardless of any variations in the calorific value of the fuel, this capacity stays the same and it is the feed rate of the fuel that varies (lower CV = higher feed rate and a higher CV = a lower feed rate).

4.2.3 In terms of the quantum of heat available, the plant is 3 x 120 MW thermal input and about 90% of that is recovered by the boiler. Therefore, 320 MW of heat is available and with 8,000 operating hours a year that's nearly 2.9 million MWh per year of recovered energy. This can then be used for electricity generation or heat export or a combination of the two.

4.2.4 The waste heat recovery boilers absorb heat from the combustion flue gasses and generate steam. Each boiler produces steam at about 60 bar and 400°C and this steam is passed through a steam turbine that turns a generator to make electricity. The output of this generator is connected to the electrical distribution network for export with about 20 MWe being used for the 'parasitic' load (e.g. for the pumps, fans, drive motors etc that make the plant work).

4.2.5 The exported power will go to the public grid via the Western Power Distribution network (Electricity Grid Connection Statement, document reference 5.6).

4.2.6 When the plant is configured in CHP mode, some of the steam is bled from the turbine casing through tapings at intermediate pressures. These pressures can be chosen at the design stage to match the requirements of the heat export and there can be more than one tapping.

4.2.7 The use of pass out steam from tappings on the turbine casing allows continuous variation between the amount of steam supplied and the amount of electricity. There is no fixed ratio. The CHP plant can react automatically to changes of demand from the heat users. These tapping points are within the proposed Facility as part of Work No. 1A(v) (site item D1) (see 4.1.3 above) and would allow external connection to the Facility for future heat users, if any suitable users are found

4.2.8 The EfW plant operates at 100% output all the time. Where there is excess energy recovered, over and above that needed for heat export, this is converted to electrical energy for export to the public grid.

4.2.9 When the turbine is operated in fully condensing mode (that is when there is no steam being supplied for heat export), the generator output is at its maximum. When steam is supplied to provide export heat the electrical output reduces by a

ratio of approximately 5 to 1 depending on the exact pressure ratios (for example that would mean for a 5 MW supply of steam for heating the electrical output would reduce by 1 MW electricity), however, this could be improved for lower grade heat input to a district heating system if one was available.

4.2.10 Typical industrial processes may want steam at 10 bar pressure while typical space heating and hot water demand would need only 2 bar. The steam can be tapped off the turbine at both these pressures to satisfy different heat demands. The steam is piped to a shell and tube heat exchanger where it condenses through the tubes which in turn heats up water in a separate loop. Alternatively steam can be export directly to the user, with condensate return via a closed loop. As previously identified, the tappings point is part of the proposed Work No. 1A (v).

4.2.11 Some of the bleed steam (i.e. steam which is extracted from the turbine in a regulated manner to prevent decrease in overall efficiency of the cycle), typically at a medium pressure, is taken and used in the EfW plant. The amount is relatively small and is used for the following purposes:

- Heating up mains water to top up the boiler circuit;
- Re-heating the condensate returning from the Air Cooled Condenser;
- Pre-heating the combustion air; and
- Deaerating the boiler feed water.

4.2.12 So, although the Facility is proposed without an existing external heat demand (based upon current availability of appropriate heat users outside of the Order limits), the plant is built “CHP ready”. Alternative potential sources of heat, i.e. condensing economiser, live steam via auxiliary steam (high pressure to low pressure letdown station), low grade heat from airblast coolers could then be used if a heat export network to a wider area has been made available.

4.2.13 The pre-application work on heat has focussed on the ability of the Facility to be self-sufficient in heat use, with limited potential for external heat demand because it is economically and commercial not feasible.

Lightweight Aggregates Plant

4.2.14 The lightweight aggregates plant is not generating energy from the treatment of the residues from the thermal treatment of RDF and therefore isn’t part of the CHP generating system.

4.3 External distribution of heat

4.3.1 CHP is generally more attractive in cases when the heat load is large and constant throughout the year. This is typically the case with facilities that rely on continuous processes and use large amounts of heat (usually supplied as steam) for example chemical plants, refineries and factories.

4.3.2 CHP for domestic heating purposes is less attractive in cases where the heat load is seasonal or intermittent and this is typical for the UK given the shorter winter season compared to northern European countries. There is a general absence of significant district heating schemes in the UK and where they are developed, district heating schemes have generally been associated with new-build publicly funded and often high-rise housing where the heat loads can be readily combined and the heat distribution piping is compact. Furthermore, it is recognised that there are limited (and not economically viable) opportunities to provide CHP to domestic users other than part of district heating schemes.

4.3.3 CHP is unattractive where demand is for high-temperature heat. This is because generating stations can supply their waste heat (low temperature) with minimal impact to the power output or efficiency. This is compared with generating stations supplying heat from within the power cycle (high temperature) which has a greater impact to power output and efficiency.

4.3.4 The Proposed Scheme will provide heat in the form of medium pressure steam from the Facility to the CO_2 Capture Facility. Medium pressure steam is extracted partway down the turbine, having imparted some energy to the rotor. Extracted steam flows to the CO_2 Capture Facility where it is condensed in a heat exchanger, and energy transferred to a closed loop heating circuit. Condensate is collected and pumped back to the steam circuit of the EfW plant for reintroduction to the boiler.

4.3.5 The Facility will not be developed to export heat outside of the Order limits from the outset. The Facility will be developed as "CHP Ready" (CHP-R). The term “CHP-R” in this context represents a plant which is initially configured to generate electrical power only (apart from heat supply to the CO_2 Capture facility) but is designed to be ready, with minimum modification, to supply heat in the future.

5 Conclusions

5.1 Summary of CHP-R BAT test

5.1.1 The CHP guidance requires developers to demonstrate BAT for several criteria, including energy efficiency. Three BAT tests exist for CHP.

1. Considering and identifying opportunities for the immediate use of heat off-site.

2. Where 1. is not technically or economically possible, the second test involves ensuring that the plant is built to be CHP Ready.

3. The third test involves carrying out periodic reviews to determine whether the situation has changed and if there are opportunities for heat use off site.

5.1.2 A detailed CHP-R Guidance assessment of the Facility will be carried out as part of the environmental permit application. The detailed assessment will cover the eight steps identified below.

5.1.3 An initial overview of this process, comprising Steps 1-3 has been carried out as part of this document and is summarised below. These steps and the remaining steps will be re-assessed during the permit application.

Step 1: Assess design concept for development and establish whether CHP and CHP-R is relevant for the proposal.

The Facility will not be operated as a CHP unit from the outset as no viable heat loads beyond the Order limits have been identified for a CHP unit to be commercially and technically feasible.
The plant will therefore need to be designed as CHP ready as per the second BAT test.

Step 2: Establish if there are any opportunities for the supply of heat.

The Facility will generate heat as part of the processes and there is a demand for heat use within the onsite processes, for the thermal treatment plant:

- Heating up mains water to top up the boiler circuit.
- Re-heating the condensate returning from the Air Cooled Condenser.
- Pre-heating the combustion air.
- Deaerating the boiler feed water.

Step 3: Review opportunities for supply of heat and identify the most appropriate heat load.

Within the Order limits, there will be external use of heat in the CO_2 Capture facility in the form of medium pressure steam, which is condensed in a heat exchanger, and energy transferred to a closed loop heating circuit. Condensate is collected and pumped back to the steam circuit of the EfW plant for reintroduction to the boiler.

No immediate opportunities for off-site use of heat have been identified.

The wider Boston area (within 10 km of the Application Site) heat load indicates medium heat demand (up to 100,000 MWh/km^2) mainly comprising long-established small industrial and residential users, which comprise three-quarters of total heat demand.

Using existing domestic housing, or housing developments that are likely to be started prior to the operation of the Facility; or established small industrial users, is unlikely to be technically feasible.

The greatest single point demand in Boston is Pilgrim Hospital, which is Boston's only "large" heat demand source and considerably skews the heat load for the town (Total Heat Load: 24077 MWh, partly served by CHP = 894 MWh).

Pilgrim Hospital is over 3 km (in a straight line) from the Facility and is separated by the historic town centre, the main A16 highway, which runs through town and the River Witham. Therefore, it is unlikely to represent a viable destination of heat for from the Facility due to the technical constraints and considerable financial investment required to connect to it through the town centre and across the river. However, the future detailed CHP assessment (and CHP reviews submitted pursuant to the DCO requirements) will evaluate the potential connection further.

There are no district heating schemes in the list of potentially cumulative schemes provided to the Applicant by Boston Borough Council.

Step 4: Generate a CHP envelope and review if the requirements of the heat load can be met.

Step 5: Establish the effect of the selected heat load on the proposed development.

Step 6: Based on the work completed in steps 3 – 5, identify provisions and space requirements for CHP / CHP-R.

Step 7: Where appropriate identify the costs associated with the provision of CHP / CHP-R

Step 8: Justify the degree to which the proposed development will be CHP-R.

5.1.4 It is therefore considered based on the low heat demand in the surrounding area and taking into account the distance and sparse nature of heat users resulting in

technical and commercial challenges for proposed routes, the Facility will be designed as CHP Ready and will not be developed as a CHP scheme until such loads become available that running with CHP is considered economically feasible.

5.2 Follow-up actions

5.2.1 A detailed heat user assessment will be prepared as part of the environmental permit application.

5.2.2 The Applicant will continue with periodic reviews of potentially available heat users, starting with the detailed heat plan as part of the environmental permit application; and continuing no later than 12 months from full commissioning of the Facility. This CHP review (post DCO consent) is secured by a requirement in the draft DCO submitted as part of the DCO application (document reference 2.1).

5.2.3 The following technical and commercial aspects will be considered during the CHP reviews:

- Economic viability of any proposed CHP Scheme; and
- Review of technical assessment if any viable heat load is identified.

6 References

Department for Energy and Climate Change (DECC) (2011a). The overarching NPS for Energy (EN-1),

Department for Energy and Climate Change (DECC) (2011b). The NPS for Renewable Energy Infrastructure (EN-3).

Lincolnshire County Council (2016). Lincolnshire Minerals and Waste Local Plan Core Strategy and Development Management Policies. Available at: https://www.lincolnshire.gov.uk/directory-record/61697/core-strategy-and-development-management-policies [Accessed: 25/06/2020].

Lincolnshire County Council (2017). Lincolnshire Minerals and Waste Local Plan Site Locations. Available at: https://www.lincolnshire.gov.uk/directory-record/63740/site-locations [Accessed: 25/06/2020].

South East Lincolnshire Joint Strategic Planning Committee (2019). Available at: http://www.southeastlincslocalplan.org/ [Accessed: 25/06/2020].