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5.4 Combined Heat and Power Assessment (Clean)

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1 Management Summary

1.1.1.1 Fichtner Consulting Engineers Limited (Fichtner) has been appointed by NLGEPL to provide a Combined Heat and Power (CHP) assessment report in support of the planning application for a residual waste fired power plant to be located in Flixborough, North Lincolnshire. The facility will be a Nationally Significant Infrastructure Project, consented under a development consent order (DCO). The energy recovery facility (ERF) is to be the central component of the wider North Lincolnshire Green Energy Park (NLGEP, the Project), comprising of a variety of low carbon energy systems including: battery storage; hydrogen production and storage; carbon capture; ash reprocessing; concrete block manufacturing; electric vehicle recharging; and plastics recycling. The focus of this report is the Energy Recovery Facility (ERF, the Facility).

1.1.1.2 Assuming a design NCV of 14.0 MJ/kg, the Facility will process approximately 633,309 tonnes per annum (at the design capacity of 81.2 tph, assuming 7,796 hours availability, which is the plant lifetime average).

1.1.1.3 Allowing for the full range of NCV wastes that the Facility can process (10-18 MJ/kg), the Facility will have a maximum capacity of up to approximately 758,400 tonnes per annum (assuming first year availability of 8,000 hours).

1.1.1.4 The Facility has been designed to export power to the National Grid. The Facility will generate approximately 95.1 MW_e of electricity in full condensing mode and with average ambient temperature. The Facility will have a parasitic load of approximately 9.5 MW_e. Therefore, the export capacity of the Facility, with average ambient temperature, is approximately 85.6 MW_e.

1.1.1.5 The Environment Agency (EA) Combined Heat and Power (CHP) Ready Guidance requires Best Available Techniques (BAT) to be demonstrated by maximising energy efficiency. Following screening of potential heat consumers and development of a network heat demand profile, it has been established that technically and financially feasible opportunities exist to export an annual average heat load of up to 24.15 MW_{th}, and, when accounting for consumer diversity and heat losses, a peak load of 70.12 MW_{th}.

1.1.1.6 The Facility will be technically and financially capable of meeting these heat loads, subject to detailed economic feasibility. The maximum heat capacity of the Facility will be 90.00 MW_{th}, which will be confirmed during detailed design and will be set as a minimum to meet the requirements of the heat consumers identified.

1.1.1.7 While the quantity of heat demand identified is sufficient to achieve Primary Energy Savings (PES) in excess of the 10 % technical feasibility threshold, it is not sufficient to be deemed 'Good Quality' in accordance with the CHP Quality Assurance (CHPQA) scheme. At the proposed heat network load, PES was calculated to be 16.96 % and the CHPQA Quality Index (QI) score was 57.6. A QI score of 105 is required at the design stage to be deemed 'Good Quality'. The highly onerous new efficiency criteria set out in the latest CHPQA guidance means that it is unlikely that any energy recovery facility will now reach 'Good Quality' status.

1.1.1.8 In accordance with Article 14 of the Energy Efficiency Directive, a cost-benefit assessment (CBA) of opportunities for CHP is required when applying for an Environmental Permit (EP). An assessment of the costs and revenues associated with the construction and operation of the proposed heating network has been undertaken. This has been inputted into a CBA in accordance with the draft Article 14 guidance document issued by the EA. The results of the CBA indicate that the nominal project internal rate of return and net present value (before financing and tax) over 30 years are 19.9 % and £9.16 million respectively. The NPV is positive indicating the project would be profitable. Therefore, it is considered that the proposed heat network yields an economically viable scheme in its current configuration. The full economic feasibility of the scheme will be reassessed in the future when there is further certainty regarding heat loads. This future assessment will also account for any subsidies that might become available in the future to support the export of heat.

1.1.1.9 An access road between the Facility and B1216 will be constructed in Phase 1 of the project, before the Facility is constructed. District heating pipework will be installed in this new access road prior to the Facility construction. A controlled steam extraction valve will be included in the steam turbine to provide steam for the district heating system. Therefore, the Facility will be constructed as CHP enabled from outset and configured as a CHP plant and not just optimised for electricity only operation.

1.1.1.10 Based on these findings, it is considered that construction as CHP-Ready will demonstrate BAT for the Facility. A CHP Ready Assessment form has been completed and is provided in Appendix D of this report.

1.1.1.11 CHP-Ready means that the Facility will be able to export heat in the future with minimum modification. This will be achieved by virtue of having steam capacity designed into the turbine bleed and safeguarded space in an area adjacent to the turbine hall, to house CHP equipment. In addition some initial district heating pipework will be installed with the construction of the new access road, thereby making it easier to export heat in the future. This demonstrates commitment beyond the minimum requirements to meet the CHP-Ready BAT test.

1.1.1.12 There will be a carbon capture process, which will be located within the Facility boundary, close to the flue gas treatment hall. A steam pipe will transport the steam to the carbon capture process, and a condensate pipe will return the condensed steam from the carbon capture process to the Facility. The carbon capture system would reduce the gross output from 95.1 MW_e to 93.5 MW_e, and increase the parasitic load from 9.5 MW_e to 10.8 MW_e.

List of abbreviations and units

Abbreviation	Definition
ACC	Air Cooled Condenser
BAT	Best Available Technique
BEIS	The Department for Business, Energy and Industrial Strategy
C	Celsius
CBA	Cost Benefit Analysis
CCR	Carbon Capture Ready
CCS	Carbon Capture and Storage
CfD	Contracts for Difference
CHP	Combined Heat and Power
CHP-R	CHP-Ready
CHPQA	CHP Quality Assurance
CIBSE	Chartered Institution of Building Services Engineers
DCO	Development Consent Order
DH	District Heating
DN250	250mm diameter pipework
DNO	Distribution Network Operator
EA	Environment Agency
EN	Energy (policy)
EP	Environmental Permit
ERF	Energy Recovery Facility
ESCo	Energy Services Company
EU	European Union
GHNF	Green Heat Network Fund
HNDU	Heat Networks Delivery Unit
HNIP	Heat Network Investment Project
IRR	Internal Rate of Return
LHV	Lower Heating Value
MJ	Megajoules
MW	Megawatts
NCV	Net Calorific Value
NPPF	National Planning Policy Framework
NPPW	National Planning Policy for Waste

NPS	National Planning Statement
NPV	Net Present Value
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Impact Report
PES	Primary Energy Savings
PINS	Planning Inspectorate
QI	Quality Index
RHI	Renewable Heat Incentive
RO	Renewables Obligation
SoS	Secretary of State
SPV	Special Purpose Vehicle
UK	United Kingdom

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2 Introduction

2.1.1.1 The North Lincolnshire Green Energy Park (NLGEP) ('the Project'), located at Flixborough, North Lincolnshire, is a Nationally Significant Infrastructure Project (NSIP) with an Energy Recovery Facility (ERF) capable of converting up to 760,000 tonnes of non-recyclable waste into 95 MW of electricity at its heart and a carbon capture, utilisation and storage (CCUS) facility which will treat the excess gasses released from the ERF to remove and store carbon dioxide (CO2) prior to emission into the atmosphere.

2.1.1.2 The NSIP incorporates a switch yard, to ensure that the power created can be exported to the National Grid or to local businesses, and a water treatment facility, to take water from the mains supply or recycled process water to remove impurities and make it suitable for use in the boilers, the CCUS facility, concrete block manufacture, hydrogen production and the maintenance of the water levels in the wetland area.

2.1.1.3 The Project will include the following Associated Development to support the operation of the NSIP:

- a bottom ash and flue gas residue handling and treatment facility (RHTF);
- a concrete block manufacturing facility (CBMF);
- a plastic recycling facility (PRF);
- a hydrogen production and storage facility;
- an electric vehicle (EV) and hydrogen (H2) re-fuelling station;
- battery storage;
- a hydrogen and natural gas above ground installation (AGI);
- a new access road and parking;
- a gate house and visitor centre with elevated walkway;
- new railway works including, sidings at Dragonby, re-instatement and safety improvements to the 6km private railway spur, and the construction of a new railhead with sidings south of Flixborough Wharf;
- a north and south district heating and private wire network (DHPWN);
- Biodiversity Net Gain (BNG) and ecological mitigation, including green infrastructure and 65 acre wetland area;
- new public rights of way and cycle ways;
- Sustainable Drainage Systems (SuDs) and flood defence; and
- an electrical grid connection, lighting and utilities.

2.1.1.4 The Project will also include development in connection with the above works such as security gates, fencing, boundary treatment, hard and soft landscaping, surface and foul water treatment and drainage systems and CCTV.

2.1.1.5 The Project also includes temporary facilities required during the course of construction, including site establishment and preparation works, temporary construction laydown areas, contractor facilities, materials and plant storage, generators, concrete batching facilities, vehicle and cycle parking facilities, offices, staff welfare facilities, security fencing and gates, external lighting, roadways and haul routes, wheel wash facilities, and signage.

2.1.1.6 The overarching aim of the Project is to support the UK's transition to a low carbon economy as outlined in the Sixth Carbon Budget (December 2020), the national Ten Point Plan for a Green Industrial Revolution (November 2020) and the North Lincolnshire prospectus for a Green

Future. It will do this by enabling circular resource strategies and low-carbon infrastructure to be deployed as an integral part of the design (for example by re-processing ash, wastewater and carbon dioxide to manufacture concrete blocks and capturing and utilising waste-heat to supply local homes and businesses with heat via a district heating network)

2.2 Objective

2.2.1.1 The principal objectives of this study are as follows.

Prepare a Heat Plan in line with the Environment Agency (EA) guidance on cost-benefit assessment (CBA) for combustion installations, which will support an Environmental Permit (EP) application.

Provide a technical description of the proposed Facility and heat export infrastructure.

Calculate heat demands based on identified heat consumers and assess the feasibility of connecting identified heat consumers to the network.

Based on the heat loads anticipated for the outline solution identified, calculate relevant energy efficiency measures to demonstrate legislative compliance.

Produce provisional pipe routing drawing from the Facility to the likely heat consumers.

Conduct an economic assessment feeding into the CBA as required under Article 14 of the Energy Efficiency Directive.

Produce a CHP-Ready Assessment as required under the EA CHP-Ready guidance, including a clear statement on best available techniques (BAT), combined heat and power (CHP) envelope and the CHP-Ready Assessment form.

2.3 The Location

2.3.1.1 The site on which The Project will be located is on land adjacent to the existing Flixborough Industrial Estate, situated at Stather Road, Flixborough, Scunthorpe.

2.3.1.2 A site location plan is presented in Document Reference 4.1.

3 Conclusions

3.1 Policy

3.1.1.1 The main policy drivers in determining the DCO are the National Policy Statements (NPS's). Specifically relating to CHP guidance, Part 4 of NPS EN-1 sets out the assessment principles which should be taken into consideration for energy NSIPs.

3.1.1.2 Although the National Planning Policy Framework (NPPF) does not contain specific policies relating to CHP, they do highlight the overall need to adopt principles of sustainability and maximum efficiency from new developments. The NPPF is underpinned by the principles of sustainable development, towards which CHP can substantially contribute.

3.1.1.3 CHP will also contribute to the UK achieving net zero carbon by 2050, as required under the Climate Change Act 2008 (2050 Target Amendment) Order 2019, by providing low-carbon and resource-efficient heating technology that is applicable across most demand sectors.

3.2 Technical Solution

3.2.1.1 The Facility will have a gross electrical output of 95.1 MWe, (design when operating in fully condensing mode), with a parasitic load of 9.5 MW_e with the balance exported to the National Grid. Therefore, the Facility will export approximately 85.6 MW_e in fully condensing mode. The Facility will be designed with the capability to export up to 90 MW_{th} of heat to local consumers. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during the detailed design stage. Based on the heat network identified within this Heat Plan, the average heat load is expected to be 24.15 MW_{th}, resulting in an average gross electrical generation of approximately 91.5 MW_e.

3.2.1.2 Several options for heat recovery and export from the Facility are available. Given the requirements of the heat consumers (discussed subsequently), flexibility in terms of export temperatures and capacity, and the associated environmental benefits, steam extraction from the turbine is considered the most favourable solution. It is proposed that heat will be transferred to a closed hot water circuit via a series of condensing heat exchangers and supplied to consumers through a pre-insulated buried hot water pipeline, before being returned to the Facility for reheating. This technology is well proven and highly efficient.

3.3 Potential Heat Consumers

3.3.1.1 A review of the potential heat demand within a 15 km radius of the Facility has been undertaken in accordance with the requirements set out in Section 2 of the EA's draft Article 14 guidance. Physical constraints imposed by local infrastructure has a significant impact on which consumers can viably be connected. Both river and rail crossings exist in the area surrounding the Facility and may present obstructions to connect some consumers. Engineering a bridge crossing will likely require detailed structural assessments and the consent of the bridge owner. Trenching in road crossings will require traffic management and permission from the highway authority. Following screening of potential heat consumers, the identification of potential heat demands has centred on nearby industrial and commercial users, as the benefits of providing heat to large nearby premises is generally more financially viable than supply to multiple smaller consumers at further distances.

3.3.1.2 The identified heat users include the following:

1. proposed new Lincolnshire Lake housing development and business enterprise park;

2. Glanford business park, Scunthorpe;
3. new and existing hospitals;
4. a new commercial glasshouse;
5. new vertical farm, glasshouses;
6. the Facility visitor's centre;
7. a new plastic processing plant,
8. a concrete manufacturing plant;
9. hydrogen electrolysis plant;
10. battery energy storage; and
11. existing Scunthorpe Council buildings.

3.3.1.3 A large heat consumer (point heat demands greater than 5 MW_{th} as defined by the UK CHP Development Map) has been identified. The large consumer was more than 16 km from the Facility and would require a prohibitively costly pipe network to connect to. Therefore, the large heat user has been discounted.

3.4 Heat Network Profile

3.4.1.1 The heat demand of the preferred heat consumers has been estimated based on generic heat demand profiles. The average and diversified peak heat demand of the proposed heat network has been estimated to be 24.15 MW_{th} and 70.12 MW_{th} respectively, with an annual heat demand of 211,592 MWh/annum.

3.4.1.2 A heat demand profile has been developed to assess diurnal and seasonal variation in heat demand for the proposed heat network. The heat demand profile indicates that base and peak loads can be met by the Facility independently. Detailed techno-economic modelling will be undertaken when there is a better understanding of consumer heat demands.

3.5 Economic Assessment

3.5.1.1 The costs and revenues associated with the construction and operation of the proposed district heating network has been undertaken. This has been inputted into the EA's CBA template. The CBA takes account of heat supply system capital and operating costs, heat sales revenue and lost electrical revenue as a result of diverting energy to the heat network.

3.5.1.2 The results of the CBA indicate that the estimated £58.9 million capital investment will be offset by heat sales revenue. The nominal project internal rate of return (before financing and tax) over 30 years is projected as 19.9 %, with a net present value of £9.16 million. The NPV is positive indicating the project would be profitable. Therefore, it is considered that the proposed heat network yields an economically viable scheme in its current configuration.

3.5.1.3 The detailed economic feasibility of the scheme will be assessed in the future when the heat demands are confirmed.

3.5.1.4 As construction of a district heating network is currently economically feasible, the Facility will be built to be CHP-Ready. As such, the Facility will meet the requirements of BAT tests outlined in the EA CHP Ready Guidance. Additional steps beyond the minimum required to satisfy the BAT test will be instigated such as the installation of district heating pipework in the new access road to the Facility site.

3.6 Energy Efficiency Measures

3.6.1.1 To qualify as technically feasible under the draft Article 14 guidance, the heat demand must be sufficient to achieve high efficiency cogeneration, equivalent to at least 10 % savings in primary energy usage compared to the separate generation of heat and power. When operating in fully condensing mode (i.e. without heat export) the Facility will achieve a primary energy saving (PES) of 16.96 %, which is in excess of the technical feasibility threshold defined in the draft Article 14 guidance. Adding the proposed heat network will result in PES of 20.84 % which is in excess of the technical feasibility threshold and would therefore be technically feasible to supply.

3.6.1.2 To be considered 'Good Quality' CHP under the CHPQA scheme, the quantity of heat exported to a heat network must be sufficient to achieve a Quality Index (QI) of at least 105 at the design stage (reducing to 100 at the operational stage). Changes to CHPQA guidance in December 2018 mean that the maximum QI score which could be achieved by the proposed heat network would be 63.4. On this basis, any heat network would not qualify as Good Quality CHP. The efficiency criteria set out in the latest CHPQA guidance means that it is unlikely that any energy recovery facility will now achieve 'Good Quality' status.

3.7 CHP-Ready Assessment

3.7.1.1 A CHP-Ready Assessment has been carried out as part of this Heat Plan and the completed CHP Ready Assessment form is provided in Appendix D. The economic case for the proposed heat network is economically viable at this stage, constructing the Facility as CHP Ready is considered to represent BAT. This would enable the Facility to export heat when there are formal agreements in place with the potential heat users.

3.7.1.2 As CHP-Ready, the Facility will be designed to be ready, with minimum modification, to supply heat in the future. The electrical efficiency on fully condensing mode of a CHP-Ready facility (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-Ready facility. The Facility will include steam capacity designed into the turbine bleeds to facilitate heat export in the future, and safeguarded space in the area adjacent to the turbine hall to house CHP equipment.

3.7.1.3 In addition, an access road between the Facility and B1216 will be constructed in Phase 1 of the project before the Facility is constructed. DH heat pipework will be installed in this new access road prior to the Facility construction. A controlled steam extraction valve will be included in the steam turbine to provide steam for the district heating system. Therefore, the Facility will be constructed as CHP enabled from outset and configured as a CHP plant and not just optimised for electricity only operation.

3.7.1.4 To satisfy the third BAT test on an ongoing basis, NLGEPL is committed to carrying out periodic reviews of opportunities for the supply of heat to realise CHP.

4 Policy

4.1 Introduction

4.1.1.1 This section demonstrates how the Facility meets the clear preference for plant that provides CHP which is emphasised in relevant national and local policy requirements relating to the provision of CHP.

4.2 National planning policy and guidance

4.2.1 National Planning Statements

4.2.1.1 National Policy Statement (NPS) EN-1 sets out the national policy for the delivery of energy infrastructure and, along with other NPS's is the primary policy framework for examining and determining Development Consent Order applications in England and Wales.

4.2.1.2 Section 4.6 of NPS EN-1 refers directly to the consideration of Combined Heat and Power within the list of assessment principles against which DCO applications relating to energy infrastructure will be considered.

4.2.1.3 Paragraph 4.6.2 recognises that in conventional thermal generating stations, the heat that is raised to drive electricity generation is subsequently emitted to the environment as waste, however, supplying steam direct to industrial customers (or using lower grade heat, such as in district heating networks), can reduce the amount of fuel otherwise needed to generate the same amount of heat and power separately.

4.2.1.4 Paragraph 4.6.3 goes on to state that 'using less fuel to generate the same amount of heat and power reduces emissions, particularly CO2. The Government has therefore committed to promoting Good Quality CHP, which denotes CHP that has been certified as highly efficient under the CHP Quality Assurance programme.'

4.2.1.5 Paragraph 4.6.6 of EN-1[1] explains that Guidance issued by the then Department for Trade and Industry (DTI) in 2006[2] will apply to any application to develop a thermal generating station under the Planning Act 2008. It goes on to confirm that applications for thermal stations must either include CHP proposals or contain evidence that the possibilities for CHP have been fully explored to inform the Secretary of State's consideration of the application. This should be through an audit trail of dialogue between the applicant and prospective customers. The Secretary of State should have regard to the 2006 guidance, or any successor to it, when considering the CHP aspects of applications for thermal generating stations.

4.2.1.6 At paragraph 4.6.7 it is stated that in developing proposals for new thermal generating stations, applicants 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[3]. Given how important liaison with

1.1.1.1

[1] Paragraph 4.7.6 of the revised NPS EN-1 out for consultation at the time of writing this statement refers to the same guidance.

[2] 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.

[3] In terms of economic viability, paragraph 4.6.5 of EN-1 recognises that a generating station needs to be located close to industrial or domestic customers with heat demands, although the exact distance will vary according to the size of the generating station and the nature of the heat demand

potential customers for heat is, the same paragraph goes on to state that applicants should not only consult those potential customers they have identified themselves but also bodies such as Local Enterprise Partnerships (LEPs) and Local Authorities and obtain their advice on opportunities for CHP. Further advice is contained in the 2006 DTI guidance and applicants should also consider relevant information in regional and local energy and heat demand mapping.

4.2.1.7 Paragraph 4.6.8 explains that in order to encourage proper consideration of CHP within applications, substantial additional positive weight should therefore be given by the Secretary of State to applications incorporating CHP. If the proposal is for thermal generation without CHP, the applicant should[4]:

4.2.1.8 explain why CHP is not economically or practically feasible for example if there is a more energy efficient means of satisfying a nearby domestic heat demand;

1. provide details of any potential future heat requirements in the area that the station could meet; and
2. detail the provisions in the proposed scheme for ensuring any potential heat demand in the future can be exploited.

4.2.1.9 With regards to Carbon-Capture NPS-EN-1 states, at paragraph 4.6.9, that CHP may require additional space than for a non-CHP generating station and it is possible that this might conflict with space required for a generating station to be Carbon Capture Ready. It details that 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.

4.2.1.10 Finally, with reference to potential future developments, paragraph 4.6.12 explains that the Secretary of State may be aware of potential developments (for example from the applicant or a third party) which could utilise heat from the plant in the future, for example planned housing, and which is due to be built within a timeframe that would make the supply of heat cost-effective.

4.2.2 NPS EN-3 (Renewable Energy Supply from Waste)

4.2.2.1 NPS EN-3[5] (Renewable Energy Supply from Waste) applies to nationally significant energy from biomass/waste infrastructure in England and Wales with at least 50 MW electrical generating capacity. NPS EN-3 states that new developments should consider CHP as part of its application or demonstrate that CHP has been considered and that PINS can seek further information should this not be provided. Section 2.5 of NPS EN-3 states that biomass/EfW generating stations can be configured to produce CHP.

4.2.3 National Planning Policy for Waste

4.2.3.1 The National Planning Policy for Waste (NPPW) was published in October 2014 and sets out the Government's ambition to develop a more sustainable and efficient approach to resource use and management. The NPPW recognises that planning can help to deliver the national waste strategy

1.1.1.1

[4] In addition to the points listed, the revised version of NPS EN-1 out for consultation at the time of writing this statement details at paragraph 4.7.8 that '*given the importance which government attaches to CHP, if an application does not demonstrate that CHP has been considered the Secretary of State should seek further information from the applicant. The Secretary of State should not give development consent unless satisfied that the applicant has provided appropriate evidence that CHP is included or that the opportunities for CHP have been fully explored. For non-CHP stations, where there is reason to believe that opportunities to supply heat through CHP may arise in the future, the Secretary of State may also require that developers ensure that their stations are 'CHP ready' and are designed in order to allow heat supply at a later date*'

[5] National Policy Statement for Renewable Energy Infrastructure (EN-3) (DECC, 2011b)

by helping to secure the re-use, recovery or disposal of waste without endangering human health and without harming the environment. One of the key objectives within the NPPW is the delivery of sustainable development and resource efficiency, including the provision of modern infrastructure, local employment opportunities and wider climate change benefits by driving waste management up the waste hierarchy.

4.2.3.2 Section 4 of the NPPW states that local authorities should identify sites for waste management facilities in local plans and that waste planning authorities should consider the suitable siting of energy recovery facilities to enable the utilisation of the heat produced as an energy source in close proximity to suitable potential heat customers.

4.2.4 National Planning Policy Framework

4.2.4.1 The National Planning Policy Framework (NPPF) was last updated on 20 July 2021. Paragraphs 149-154 of the NPPF explain that planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, and in supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development. In particular, paragraph 151 c) stipulates that plans should "identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers".

4.2.4.2 Local planning authorities are advised to adopt proactive strategies to mitigate and adapt to climate change. When determining planning applications, local planning authorities should:

1. not require applicants for energy development to demonstrate the overall need for renewable or low carbon energy, recognising that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
2. approve the application if its impacts are (or can be made) acceptable (page 45).

4.2.5 Net zero carbon policy

4.2.5.1 On 27 June 2019, the Climate Change Act 2008 (2050 Target Amendment) Order 2019 came into force in the UK. This introduced a target of at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050. This legally binding target supersedes the previous target of an 80% reduction by 2050 and is expected to intensify the national focus within the relevant NPS's (see Section 4.2.1).

4.3 Local Policy Context – North Lincolnshire

4.3.1.1 In local policy terms, the Facility lies entirely within the administrative district of North Lincolnshire Council (North Lincolnshire), which is a unitary authority. Full details of the key adopted, and emerging local planning policy and guidance documents considered relevant to the Facility are outlined in Chapter 2 of the ES as well as the Planning Statement.

4.3.1.2 North Lincolnshire Council's adopted and emerging Local Plan policies are generally consistent with the UK government's approach in seeking to tackle climate change, reduce carbon emissions and move towards a more resource efficient future. For the purposes of the CHP Assessment, the following policies are considered of most relevance:

1. Saved Policy DS21 of the North Lincolnshire Local Plan (Renewable Energy), along with emerging policy DQE9p supports proposals for the generation of energy from renewable resources where any detrimental impacts are outweighed by environmental benefits.

2. Core Strategy Policy CS18 (Sustainable Resource Use and Climate Change) together with emerging Policy DQE8p (Climate Change and Low Carbon Living) seek to ensure that all development proposals promote low carbon living through the reduction of carbon emissions. Both policies list a number of measures that developments could incorporate into their proposals in order to achieve this such as: being designed to reduce energy consumption and utilising decentralised, renewable and low carbon energy. The former policy in particular details the support for renewable sources of energy in appropriate locations and development that maximises the use of combined heat and power. The latter policy states that proposals for large-scale schemes that would generate a significant source or demand for heat should be supported by evidence considering the feasibility of serving the development by means of a district heating system.
3. Emerging Policy SS3p (Development Principles). This policy requires development proposals to make a positive contribution to North Lincolnshire and support the delivery of sustainable communities and places. It requires all development proposals to reflect a number of key principles, including: minimising the use of non-renewable and unsustainable resources, including energy, water and materials and aiming to achieve the higher standards of sustainable construction and design through the incorporation of the principles of low carbon development.

5 Legislative Requirements

5.1 CHP-Ready Guidance

5.1.1.1 In February 2013, the EA produced a guidance note titled 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants'[6]. This guidance applies to the following facilities, which will be regulated under the Environmental Permitting (England and Wales) Regulations 2016:

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

5.1.1.2 The Facility will be regulated as a waste incineration facility with a throughput of more than 3 tonnes per hour. Therefore, the requirements of the CHP-Ready guidance will apply.

5.1.1.3 The EA requires developers to demonstrate BAT for a number of 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-Ready. 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.

5.2 Energy Efficiency Directive

5.2.1.1 From 21 March 2015, operators of certain types of combustion installations are required to carry out a CBA of opportunities for CHP when applying for an EP. This is a requirement under Article 14 of the Energy Efficiency Directive and applies to a number of combustion installation types. As a new electricity generation installation with a total aggregated net thermal input of more than 20 MW, the Facility will be classified as an installation type 14.5(a).

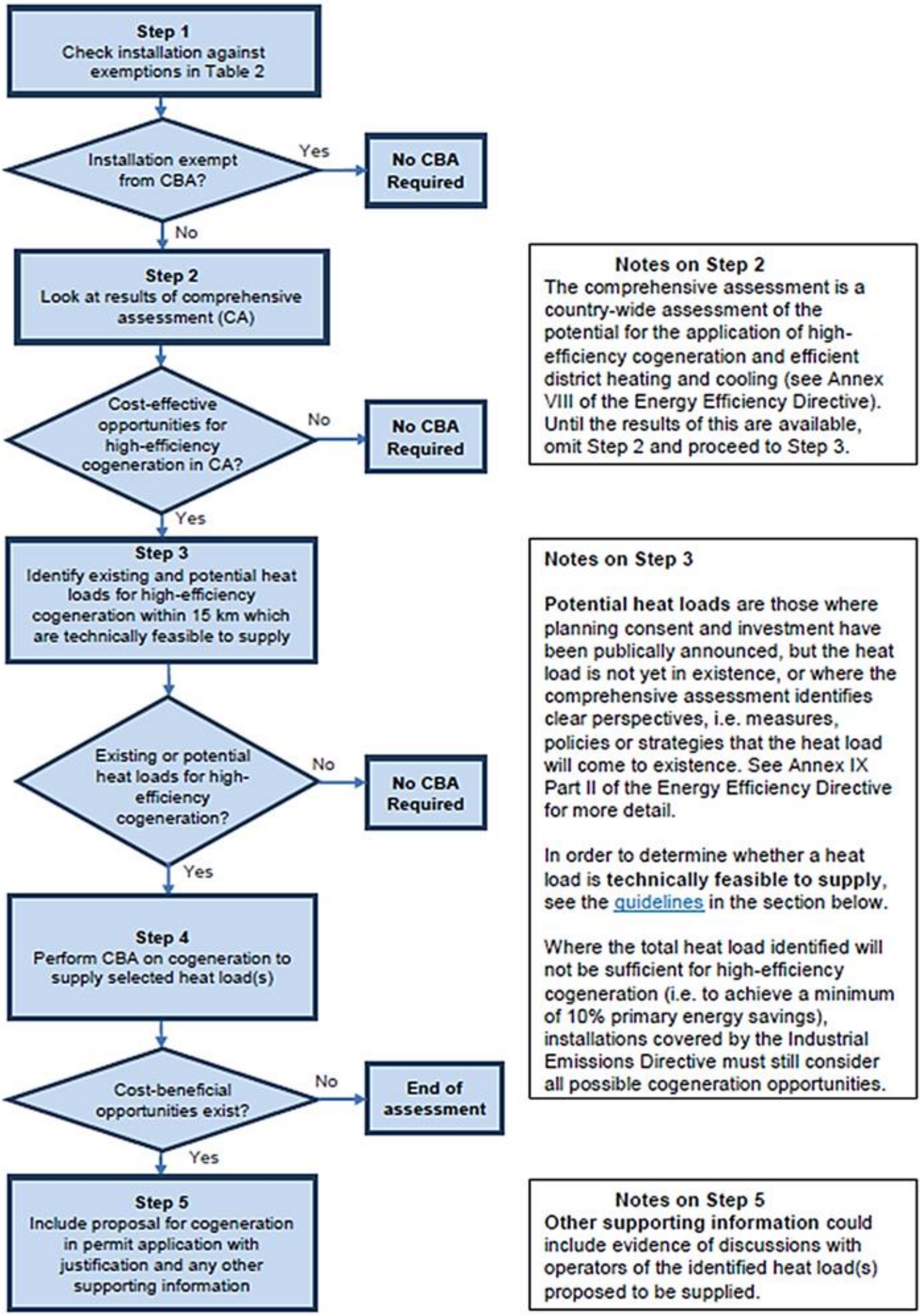
5.2.1.2 In April 2015, the EA issued draft guidance on completing the CBA, entitled '*Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive*'[7]. Figure 1 describes the process that must be followed for type 14.5(a) and 14.5(b) installations.

1.1.1.1

[6] CHP Ready Guidance for Combustion and Energy from Waste Power Plants v1.0, February 2013

[7] Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive, V0.9 April 2015

Figure 1: CBA methodology for type 14.5(a) and 14.5(b) installations



6 Description of the Facility Technology

6.1 The Facility

6.1.1.1 The main activities associated with the Facility will be the combustion of incoming non-hazardous waste to raise steam and the generation of electricity in a steam turbine/generator.

6.1.1.2 The Facility includes three waste incineration lines, a waste reception hall, main thermal treatment process, one turbine hall, on-site facilities for the treatment or storage of residues and wastewater, flue gas treatment, stack, boiler, systems for controlling operation of the waste incineration plant and recording and monitoring conditions.

6.1.1.3 In addition to the main elements described, the Facility will also include weighbridges, water treatment, auxiliary fuel and air supply systems, site fencing and security barriers, external hardstanding areas for vehicle manoeuvring, internal access roads and car parking, transformers, a grid connection compound, firewater storage tanks, offices, workshop, stores and staff welfare facilities.

6.1.1.4 The Facility will have a gross electrical output of 95.1 MW_e, (design when operating in fully condensing mode), with a parasitic load of 9.5 MW_e with the balance exported to the local grid. Therefore, the Facility will export approximately 85.6 MW_e in full condensing mode. The facility is to be designed with the capability to export up to 90 MW_{th} of heat to local consumers. The maximum heat capacity will be confirmed during the detailed design stage and will be set as a minimum to meet the requirements of the heat consumers identified.

6.1.1.5 Based on the heat network identified within this Heat Plan, the average heat load is expected to be 24.15 MW_{th}, resulting in an average electrical export of approximately 82.0 MW_e. The power exported may fluctuate as fuel quality fluctuates, and if heat is exported from the Facility to local heat users in the future.

6.1.1.6 The nominal capacity of the Facility will be approximately 81.2 tonnes per hour of mixed non-hazardous waste, with a nominal net calorific value of 14.0 MJ/kg. The plant will have an estimated lifetime average availability of around 7,796 hours. Therefore, the plant will have a nominal capacity of approximately 633,309 tonnes per annum.

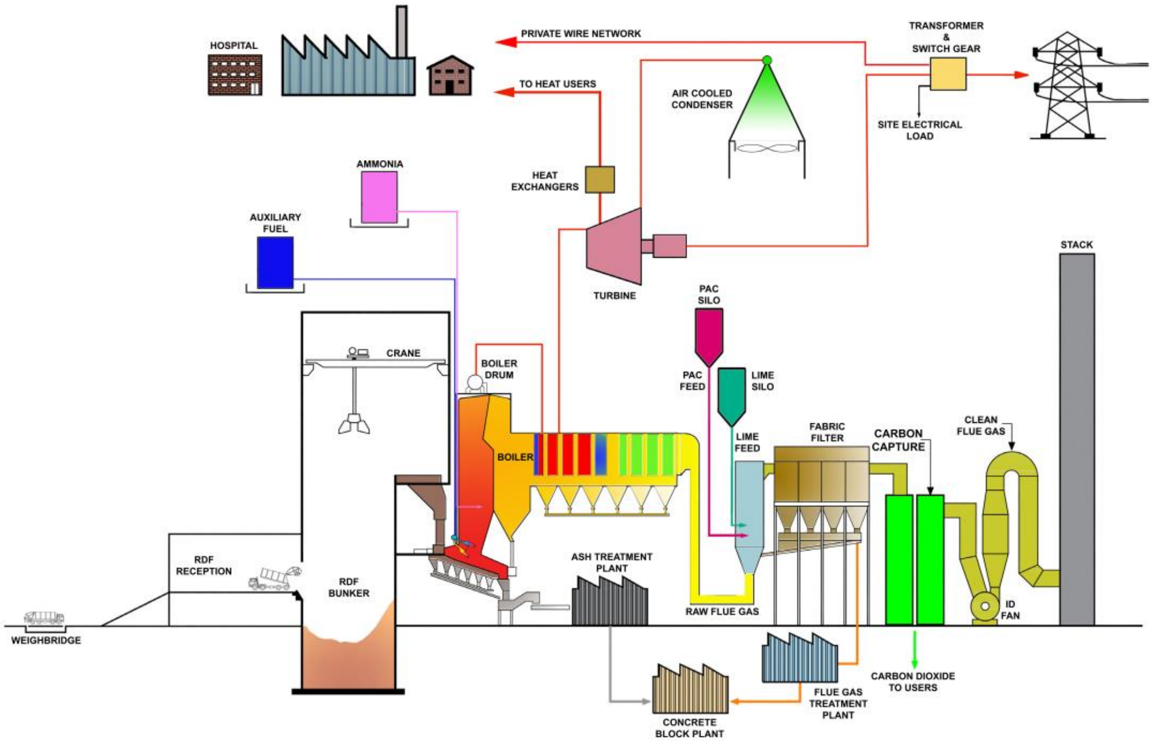
6.1.1.7 The Facility will be capable of processing fuel with an NCV range of 10-18 MJ/kg. Assuming the lowest the realistic annual average NCV is 12 MJ/kg, then the Facility will have a maximum capacity of up to approximately 739,075 tonnes per annum (again assuming 7,796 hours availability).

6.1.1.8 Steam to the carbon capture process will be provided via a low-pressure extraction from the EfW plant steam turbine. The carbon capture facility will be located within the Facility boundary, close to the flue gas treatment hall. A steam pipe will transport the steam to the carbon capture process, and a condensate pipe will return the condensed steam from the carbon capture process to the Facility. The carbon capture system will supply CO_2 to onsite users. The carbon capture system would reduce the gross output from 95.1 MW_e to 93.5 MW_e, and increase the parasitic load from 9.5 MW_e to 10.8 MW_e.

6.1.2 Combustion Process

6.1.2.1 Figure 2 is an indicative schematic of the combustion process that will be used in the Facility.

Figure 2: Process schematic



6.1.3 Energy Recovery

6.1.3.1 The heat released by the combustion of the incoming waste will be recovered by means of a water tube boiler, which is integral to the furnace and will produce (in combination with superheaters) high pressure superheated steam at 60 bar(a) and 430°C. The steam from the boiler will then feed a high-efficiency steam turbine which will generate electricity. The turbine will have a series of extractions at different pressures that will be used for preheating air and water in the steam cycle.

6.1.3.2 The remainder of the steam left after the turbine will be condensed back to water to generate the pressure drop to drive the turbine. A fraction of the steam will condense at the exhaust of the turbine in the form of wet steam, however the majority will be condensed and cooled using an air-cooled condenser. The condensed steam will be returned as feed water in a closed-circuit pipework system to the boiler.

6.1.3.3 Depending on the requirements of the heat users, either high pressure steam or hot water could be supplied. High pressure steam could be extracted from the turbine and piped directly to the heat users. Alternatively, low pressure steam exiting the turbine could pass through an onsite heat exchanger to heat up water for use in a heat network. The volume of steam extracted would vary depending on the heat load requirements of the heat users. It should be noted that at the time of writing this report, there are no formal agreements in place for the export of heat from the Facility.

6.1.4 Details of Input Waste

Table 1: Expected Facility input waste characteristics

Parameter	Unit	Value
Nominal waste throughput (lifetime average)	tpa	633,309
Maximum waste throughput	tpa	739,075
Proposed NCV	MJ/kg	14.0
Proposed GCV	MJ/kg	16.1

6.2 Details of Heat Supply System

6.2.1.1 Heat is typically supplied from the energy recovery process in the form of steam and / or hot water, depending on the grade of heat required by the end consumers.

6.2.1.2 The most commonly considered options for recovering heat are discussed below.

1. Heat recovery from the condenser

6.2.1.3 Wet steam emerges from the steam turbine typically at around 40 °C. This energy can be recovered in the form of low-grade hot water from the condenser depending on the type of cooling implemented.

6.2.1.4 An ACC will be installed at the Facility. Steam is condensed in a large air-cooled system which rejects the heat in the steam into the air flow, which is rejected to atmosphere. An ACC generates a similar temperature condensate to mechanical draught or hybrid cooling towers. The condensate then returns back to the boiler. Cooling this condensate further by extracting heat for use in a heat network requires additional steam to be extracted from the turbine to heat the condensate prior to being returned to the boiler. This additional steam extraction reduces the power generation from the plant and therefore reduce the plant power efficiency and power revenues.

2. Heat extraction from the steam turbine

6.2.1.5 Steam extracted from the steam turbine can be used to generate hot water for district heating schemes. District heating schemes typically operate with a flow temperature of 90 to 120 °C and return water temperature of 50 to 80 °C. Steam is preferably extracted from the turbine at low pressure to maximise the power generated from the steam. Extraction steam is passed through a condensing heat exchanger(s), with condensate recovered back into the feedwater system. Hot water is pumped to heat consumers for consumption before being returned to the primary heat exchangers where it is reheated.

6.2.1.6 Where steam is used for heating hot water, it is normally extracted from a lowest pressure bleeds on the turbine, depending on the heating requirements of the heat consumers.

6.2.1.7 This source of heat offers the most flexible design for a heat network. The steam bleeds can be sized to provide additional steam above the Facility's parasitic steam loads. However, the size of the heat load needs to be clearly defined to allow the steam bleeds and associated pipework to be adequately sized. The capacity of the bleeds cannot be increased once the turbine has been installed.

3. Heat extraction from the flue gas

6.2.1.8 The temperature of flue gas exiting the flue gas treatment plant is typically around 140 °C and contains water in vapour form. This can be cooled further using a flue gas condenser to recover the latent heat from the moisture. This heat can be used to produce hot water for district heating in the range 90 to 120 °C. This method of heat extraction does not significantly impact the power generation from the plant.

6.2.1.9 Condensing the flue gas can be achieved in a flue gas condenser. However, the recovered temperature is typically no more than 80 °C, which restricts the hot water temperature available for the consumer. Additionally, condensing water vapour from the flue gas reduces the flue gas volume and hence increases the concentration of non-condensable pollutants within it. The lower volume of cooler gas containing higher concentration of some pollutants would likely require a different stack height to effect adequate dispersion. The additional cooling of the flue gas results in the frequent production of a visible plume from the chimney and although this is only water vapour it can be misinterpreted as pollution. The water condensed from the flue gas needs to be treated and then discharged under a controlled consent.

6.2.1.10 The best solution to supply heat for the network under consideration is by extracting steam from the turbine. This method for the supply of heat is considered to be favourable for the following reasons.

1. The heat requirements of the identified consumers (as described in section 7.2) are too high for the temperatures attainable from the turbine exhaust steam.
2. The use of a flue gas condenser would generate a visible plume which would be present for significant periods of the year. This is not desirable as it will significantly add to the visual impact of the Facility and as such has not been included.
3. Extraction of steam from the turbine offers the most flexibility for varying heat quality and capacity to supply variable demands or new future demands.
4. Extraction of steam from the turbine, heat transfer to a hot water circuit and delivery of heat to consumers can be facilitated by well proven and highly efficient technology.

7 Heat Demand Investigation

7.1 Wider Heat Export Opportunities

7.1.1 The National Comprehensive Assessment

7.1.1.1 'National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK'[8] (the NCA), dated 16 December 2015, was published by Ricardo AEA Ltd on behalf of the Department of Energy and Climate Change (now part of the Department for Business, Energy and Industrial Strategy). The report was produced to fulfil the requirement (under Directive 2012/27/EU on energy efficiency) on all EU Member States to undertake a National Comprehensive Assessment (NCA) to establish the technical and socially cost-effective potential for high-efficiency cogeneration. The report also sets out information pertaining to heat policy development in the UK. Due to the low resolution of the data, the results of the NCA can be considered as an overview only.

7.1.1.2 Table 2 details the heat consumption in 2012 and estimated consumption in 2025 by sector for the Yorkshire & the Humber of the UK as extracted from the NCA. Heat consumption is greatest in the industrial and residential sectors. Heat demand from the industrial and residential sectors is above the national average. The estimated heat consumption in 2025 is lower than in 2012, most notably in the residential sector. The energy projections take account of climate change policies where funding has been agreed and where decisions on policy design are sufficiently advanced to allow robust estimates of policy impacts to be made, including measures such as building regulations.

7.1.1.3 Table 2:Heat consumption in the Yorkshire & the Humber of the UK

Sector	2012 consumption (TWh/annum)	2025 consumption (TWh/annum)
Industry (including agriculture)	25	24
Commercial services	2	1
Public sector	3	2
Residential	26	23
Total	56	50

7.1.1.4 Source: National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, Ricardo AEA, December 2015

7.1.1.5 Current and projected space cooling consumption data detailed in Table 3. Given the paucity of available data on energy consumption for cooling, these figures are estimates based on consumption indicators, building types and floor areas; consequently, they should be considered as indicative.

1.1.1.1

[8]National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, Ricardo AEA, December 2015

Table 3: Cooling consumption in the Yorkshire & the Humber region of the UK

Sector	2012 consumption (TWh/annum)	2025 consumption (TWh/annum)
Industry (including agriculture)	1	1
Commercial services	1	1
Public sector	1	0
Total	3	3

Source: National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK, Ricardo AEA, December 2015

7.1.1.6 It is assumed that the apparent discrepancy in the figures is due to rounding errors. It is not possible to verify this as access to the underlying data is not available.

7.1.2 UK CHP Development Map

7.1.2.1 The Department for Business, Energy and Industrial Strategy (BEIS) UK CHP Development Map[9] geographically represents heat demand across various sectors in England, Scotland, Wales and Northern Ireland. A search of heat users within 15 km of the Facility was carried out, as shown in Table 4. This is represented as coloured contour areas in Figure 3, with each colour band representing a range of heat demand density values.

7.1.2.2 The data returned considers the entire regional area into which the search area extends. If a search radius extends marginally into a particular region, the data for the entire region will be included in the results table so there is a possibility that the heat demand can be overestimated.

7.1.2.3 With the exception of public buildings, the heat map is produced entirely without access to the meter readings or energy bills of individual premises. Therefore, results should be taken as estimates only.

Table 4: Heat demand within 15 km of the Facility

Sector	Heat demand	
	MWh/a	% share
Communications and Transport	787	0.04%
Commercial Offices	18,954	0.98%
Domestic	1,739,002	89.52%
Education	30,227	1.56%
Government Buildings	5,735	0.30%
Hotels	4,793	0.25%
Large Industrial	20,309	1.05%
Health	6,320	0.33%
Other	1,486	0.08%
Small Industrial	98,701	5.08%

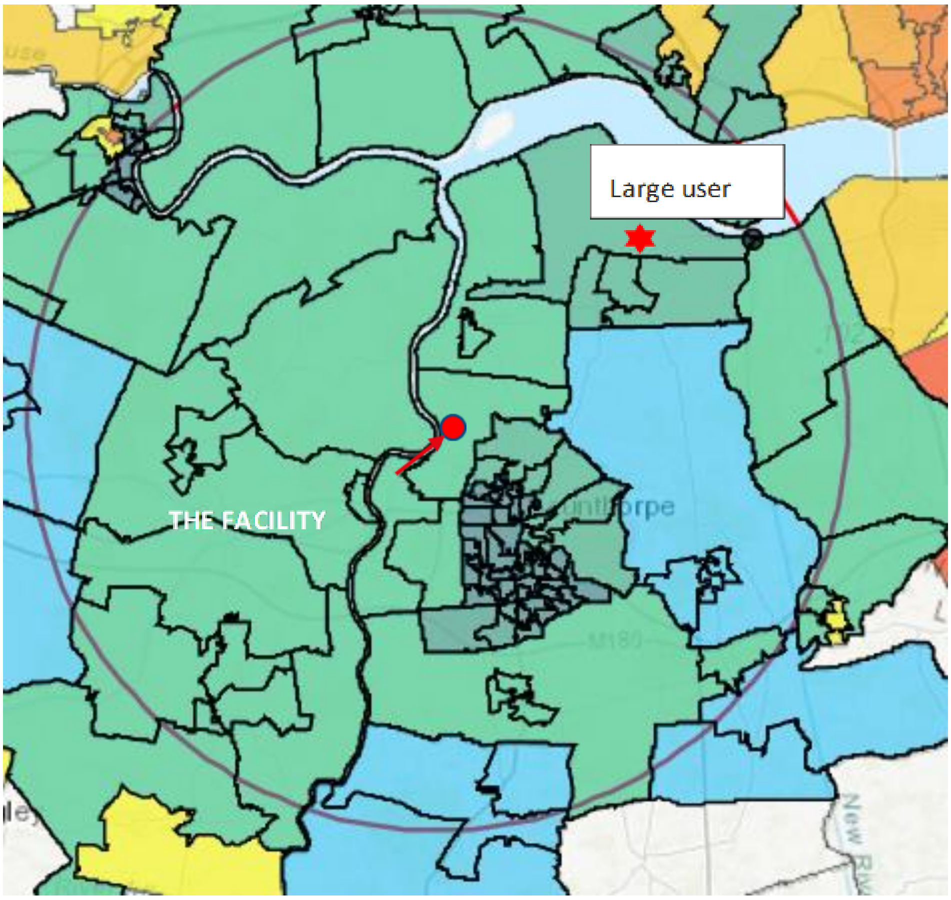
1.1.1.1

[9] http://chptools.decc.gov.uk/developmentmap/

Sector	Heat demand	
	MWh/a	% share
Prisons	-	0.00%
Retail	10,169	0.52%
Sport and Leisure	2,820	0.15%
Warehouses	3,297	0.17%
District Heating	-	0.00%
Total heat load in area	1,942,599	100%

Source: UK CHP Development Map

Figure 3: Local heat demand density



Source: UK CHP Development Map

7.1.2.4 The heat demand in the area surrounding the Facility is predominantly from the domestic and commercial/industrial sectors, and to a lesser extent, the education sector. In most cases, existing domestic buildings are unsuitable for inclusion in a heat network as a result of the prohibitive costs of replacing existing heating infrastructure and connecting multiple smaller heat consumers to a network. To secure the most economically viable heat network, Fichtner has attempted to identify consumers that will provide maximum return and carbon saving for the minimum cost. Therefore, the approach to this study has focused on industrial and commercial consumers within the search radius.

7.1.2.5 Sections 7.1.3 to 7.1.4 identify potential heat users that would provide maximum return and carbon saving.

7.1.3 Large Heat Consumers

7.1.3.1 One large heat consumer (point heat demands greater than 5 MW_{th}) was identified within 15km of the Proposed Development using the BEIS UK CHP Development Map[10] tool, as shown as shown in detailed in Table 5 and Figure 3.

Table 5: Large Heat Consumers

Site	Heat demand (MWh/annum)	Pipe distance from the Facility (km)	Postcode
Cement Works	20,309	16.5	DN18 6JL

7.1.3.2 The location of the large heat consumer identified is at distance that would require a prohibitively costly pipe network to connect. Physical constraints imposed by the local infrastructure and topology have a significant impact on which loads can viably be connected. River and rail crossings are technically challenging and may obstruct the most direct route to the consumer. Due to the estimated distances and complexity of the connections to the heat user, it has been discounted.

7.1.4 Identified Heat Users

7.1.4.1 The most applicable heat users have been identified in the following locations and are listed in Table 6. The locations of these heat consumers relative to the Facility are shown in Appendix A. Connecting these users would not require and rail, river or major road crossing and there would be no disruption to residential areas.

7.1.4.2 Since 2011, the Lincolnshire Lakes Development has been a key strategy for North Lincolnshire Council (NLC), is a major part of the Council's 5-year housing plan and will provide 7,000 houses as part of a six-village development.

7.1.4.3 The Lincolnshire Lakes housing development will use heat supplied from the heat network to heat homes within the development. The typical new build heat demands have been used for the new residential development.

7.1.4.4 The Scunthorpe hospital, which is being proposed by North Lincolnshire Council, will use heat from hot water supplied via the heat network for both space heating and cooling (using absorption chillers). In the absence of any data specific for the proposed and the existing hospital, the demand quantity has been taken from data on the similar size hospital.

7.1.4.5 All non-residential heat loads in the business park development have been calculated based on benchmark figures from the Chartered Institution of Building Services Engineers (CIBSE) Guide F (Energy Efficiency in Buildings). This document provides good practice benchmark figures based on energy performance of existing buildings. In the CIBSE Guide, loads are expressed in terms of kWh per square metre of floor space per year of fossil fuel use (natural gas is typically assumed). Based on estimates of floor areas and an assessment of the development type, it is possible to estimate annual energy usage.

7.1.4.6 The heat demand for the developments is listed in the below table, prepared by Vital Energy. In the absence of demand data for the actual developments, these assumptions have been generated from Vital Energy experience of similar projects. Heat demands are indicative and will need to be

1.1.1.1

[10] http://chptools.decc.gov.uk/developmentmap/

verified once there is more certainty of the nature of the developments. Given the close proximity of these developments to the Facility, the long-term security of the heat load and the ability to incorporate a heat network from the outset, this is an attractive export opportunity.

Table 6: Potential heat users

User	Heat load [MWh/a]	Estimated average heat load (MW)	Peak heat load (MW)
Visitor’s Centre	215	0.02	0.20
EFW (Concrete Manufacturing)	1,981	0.23	1.92
Plastics Processing Plant	245	0.03	0.27
Hydrogen Electrolysis Plant	223	0.03	0.30
Battery Energy Storage (BES)	80	0.01	0.15
Lincolnshire Lake Business Park	16,897	1.93	15.74
Scunthorpe Hospital (Existing)	20,241	2.31	8.52
Scunthorpe Hospital (New)	18,329	2.09	6.85
Cambridge Vertical Farm (HOK)	4,899	0.56	1.41
Museum Space (Cultural Art & Heritage)	260	0.03	0.24
Council Offices (Existing)	206	0.02	0.19
Data Centres	12,009	1.37	3.00
Glasshouses	33,150	3.78	8.32
Glanford Business Park	8,665	0.99	8.07
North Lincolnshire Lakes 1 bed	2,749	0.31	1.68
North Lincolnshire Lakes 2 bed	5,442	0.62	3.15
North Lincolnshire Lakes 3 bed	5,947	0.68	3.42
North Lincolnshire Lakes 4 bed	5,743	0.66	3.32
North Lincolnshire Lakes 5 bed	9,529	1.09	5.14

User	Heat load [MWh/a]	Estimated average heat load (MW)	Peak heat load (MW)
North Lincolnshire Lakes 6 bed	13,600	1.55	8.42
Tower blocks by new hospital	1,672	0.19	1.14
Low rise flats by new hospital	1,115	0.13	0.80

Source: Vital Energy

7.2 Estimated Overall Heat Load

7.2.1.1 The users identified in section 7.1.4 have a total annual heat consumption of 170,761 MWh/a, with a required heat export of 211,592 MWh/a when diversified and accounting for pipe losses. It should be noted that for large heating systems all individual peak loads do not necessarily occur at the same time. Therefore, the network peak demand is not the sum of the individual peak loads due to the diversity of demand.

7.3 Green Heat Network Fund (GHNF) Application

7.3.1.1 Vital Energy has been commissioned to complete a detailed application to the GHNF for the May 2023 or August 2023 allocation of funding.

7.3.1.2 The application to the GHNF will be supported by letters of support from potential off takers in addition to those identified 7.1.4.

7.3.1.3 These additional heat off takers are large industrial units with existing and future demands and include 2Sisters Food Group and 2 Agriculture.

7.3.1.4 Heat loads and application details are currently being finalized and can be shared after the close of examination

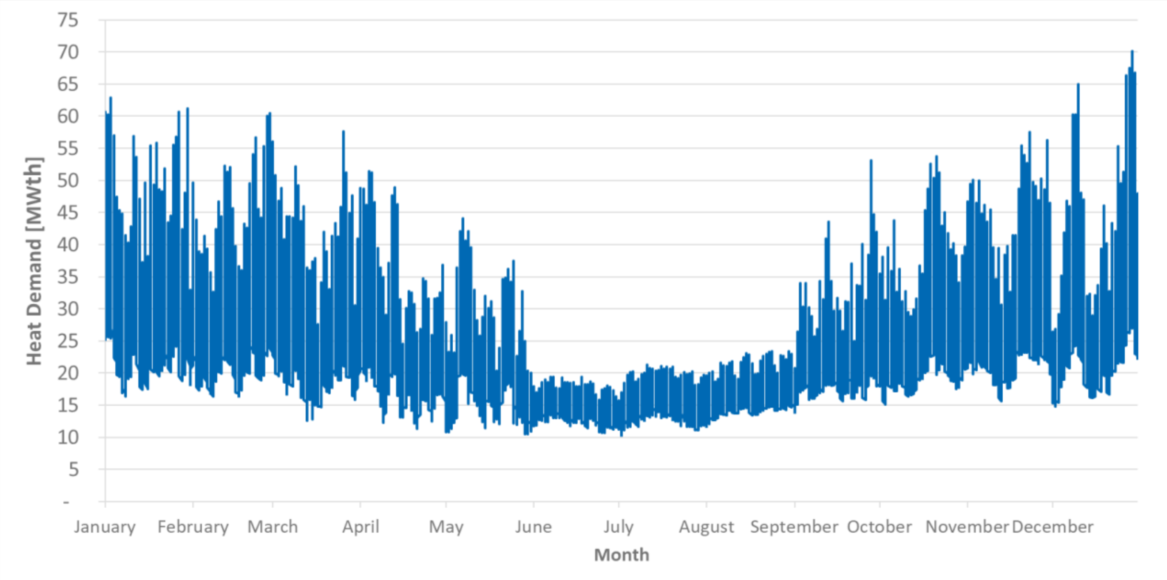
7.3.1.5 The commitment from large off takers will facilitate the establishment of the heat network and will provide a platform to grow the network.

8 Heat Network Technical Solution

8.1 Heat Network Profile

8.1.1.1 The heat network profile for the proposed heat network is shown in Figure 4 and illustrates the variation in heat demand during throughout a year. The profile represents heat demand at the point of delivery and therefore includes network heat losses and diversification.

Figure 4: Heat network profile



8.1.1.2 The total annual heat export, and average and peak instantaneous network values are projected in Table 7.

Table 7: Proposed heat network demand

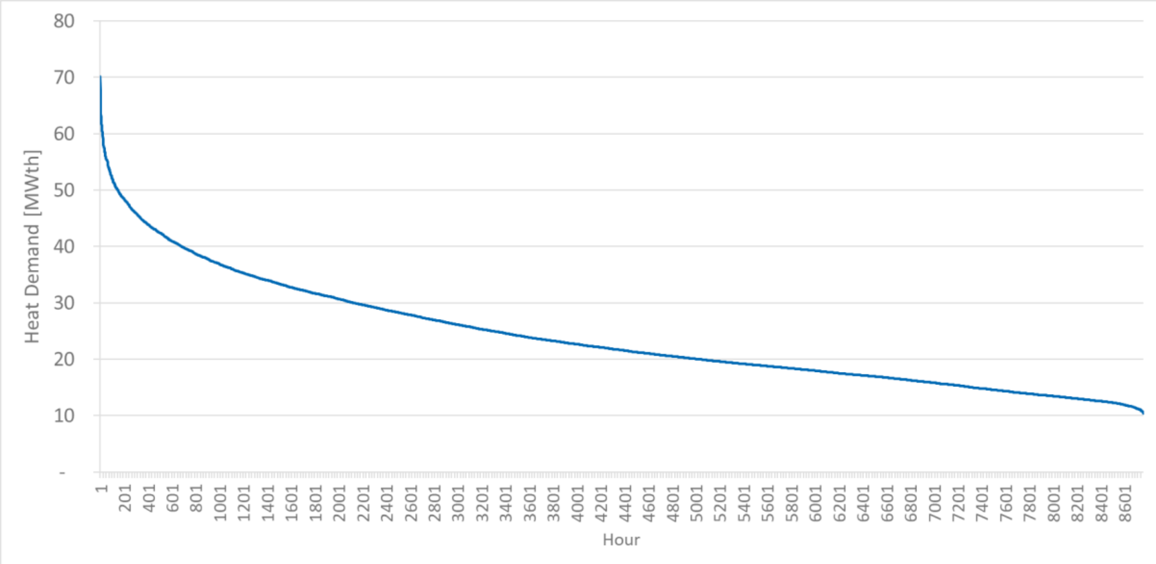
Annual Heat Load (MWh/a)		Average heat demand (MWth)		Peak heat demand (MWth)		
At point of use	Accounting for pipe losses	At point of use	Accounting for pipe losses	Peak winter value	After applying diversity factor	Diversified with pipe losses
170,761	211,592	19.49	24.15	84.31	65.46	70.12

8.1.2 Heat Load Duration Curve

8.1.2.1 The heat load duration curve presented in Figure 5 displays the instantaneous heat demand for the proposed heat network, arranged in order of decreasing magnitude, across the year.

8.1.2.2 Since detailed heat demand data is not available at this stage, the heat load duration curve has been developed on the basis of instantaneous heat demand at each hour of the day for each month. This demand data accounts for diversity or heat losses.

Figure 5: Heat load duration curve



8.2 Heat Network Design

8.2.1.1 As a conventional heat network, heat distribution between the Facility and the heat consumers would likely use buried pipework. Pre-insulated steel pipes would be used to supply pressurised hot water to the customer, and to return cooler water. Where pipes are small, two pipes may be integrated within a single insulated sleeve. For larger heat demands, large bore pipes would be installed as a single insulated run. Pipe technology is well proven and can provide a heat distribution system with a 30 year plus design life. Additional pipe work can be added retrospectively, and it is reasonably straightforward to add branches to serve new developments.

8.2.1.2 Modern heat-insulated piping technology enables hot water to be transferred large distances without significant losses. Where the topography creates challenges, heat exchangers and additional pumping systems can be installed to create pressure breaks, enabling the network to be extended.

8.2.1.3 Heat delivery arriving at a heat consumer's premises usually terminates using a secondary heat exchanger. The heat exchanger is typically arranged to supply heat to a tertiary heating circuit upstream of any boiler plant. The water in the tertiary circuit is boosted to the temperature required to satisfy the heating needs of the building.

8.2.1.4 Water is pumped continuously around the system. Pumps are operated with 100% standby capacity to maintain heat in the event of a pump fault. Pumps are likely to utilise variable speed drives to minimise energy usage.

8.2.1.5 The following conservative design criteria relate to a typical hot water network utilising conventional heat extraction (as detailed in section 6.2) and have been used to size the heat transmission pipe diameters. Where possible, the flow temperature will be reduced to minimise heat losses and this will be subject to the requirements of the heat consumers. Flow and return temperatures presented in Table 8 have been selected on the basis of the likely requirements of identified consumers.

Table 8: District heating network design criteria

Parameter	Value
Water supply temperature to consumer	90°C
Water return temperature from consumer	60°C
Distance between flow and return pipes	150mm
Soil temperature	10°C
Depth of soil covering	600 mm

8.2.1.6 The district heating pipe sizes have been estimated based on the peak heat demand from the plant turbine adjusted making an allowance for the heat losses through the system. The estimated pipe sizes and lengths of the main transmission pipe section within the network and the pipeline route are shown in Appendix A. The pipe sizes are based on the peak loads when diversified and accounting for pipe losses.

8.2.1.7 As the system is designed as flow and return, a single trench will be required for both the flow pipes to the consumer interface connection system, and return pipes back to the plant. It should be noted that trench depths may vary considerable due to the presence of existing utilities and the nature of the road construction.

8.3 Additional Heat Sources

8.3.1.1 To maximise the benefits associated with developing a CHP scheme, a review of potential heat sources in the area surrounding the Facility has been undertaken, which could increase the capacity of the heat network and associated benefits. However, there is no additional heat sources identified in the area surrounding the Facility.

8.4 Back-up Heat Sources

8.4.1.1 The Facility has been designed to achieve an availability of 89 % (i.e. 7,796 operational hours per year). During periods of routine maintenance or unplanned outages the Facility will not be operating, however the heat consumers will still require heat. There is therefore a need, somewhere within the heat distribution system, to provide a back-up source of heat to meet the needs of the heat consumers.

8.4.1.2 At the heat network scale under consideration, the standby plant will likely comprise oil- or gas-fired hot water heaters (boilers) with a separate dedicated chimney stack. Back-up boilers are typically designed to ensure that the peak heat export capacity can be met but also provide sufficient turndown to supply smaller summer loads with reasonable efficiency.

8.4.1.3 However, in the case that a majority of heat consumers were to retrofit connections to storage and distribution warehousing, it is possible that existing heating/cooling infrastructure could be retained as back up. The back-up strategy would need to be developed as part of the detailed design phase. Subject to detailed heat demand modelling once heat consumers are known with more certainty, opportunities for installing thermal stores may also be considered to lessen reliance on the back-up plant by storing excess heat generated during off peak periods for use during times of peak heat demand.

8.4.1.4 Indicative costs of installing and operating back-up plant have been included in the economic assessment in Section 10.3.

8.5 Considerations for Pipe Route

8.5.1.1 At the present time, no definitive fixed route has been established for the connections from the Facility to the various potential users since no specific agreements have been made. However, an indicative pipe route is presented in Appendix A.

8.5.1.2 An access road between the Facility and B1216 will be constructed in Phase 1 of the project before the Facility is constructed. DH heat pipework will be installed in this new access road prior to the Facility construction and wider heat network installations. The Facility will therefore be installed as CHP enabled from outset.

8.5.1.3 The projected timetable for the development of the heat mains is detailed in Section 8.6.

8.5.1.4 Discussion with the various potential heat users have been entered into which, if successful, would lead into the production of a heat supply agreement and designs for the pipework. A full economic analysis will need to be undertaken, considering the costs associated with pipe installation and lost electricity revenue in order to determine a suitable heat price per unit. However, without an EP and planning permission being granted for the Facility, any firm commitment to a supply of heat is difficult to achieve.

8.6 Implementation Timescale

8.6.1.1 The table below gives an indicative timetable for the programme for the construction of the Facility and heat network.

Table 9: Implementation programme

Description	Schedule
Obtain Permitting for the Facility	Day 1
Completion of Negotiation for Heat Supply Contracts	6 months
Start of Main New Access Road construction with installation of heat, gas and power network.	4.5 months
Start of Construction of the Facility	9 months
Start of Construction on Heat System	45 months
Start of commissioning of the Facility	51 months
Take Over of the Facility	57 months
Completion of Construction on Heat System	70 months
Testing & Commissioning of Heat Network	71 months
Start-up of the Heat Supply	72 months

9 Energy Efficiency Calculations

9.1 Heat and Power Export

9.1.1.1 The Z ratio, which is the ratio of reduction in power export for a given increase in heat export, can be used to calculate the effect of variations in heat export on the electrical output of the Facility. Steam for the district heating system could be supplied via a controlled steam flow extraction from a low pressure turbine bleed at approximately 1.5 bar(a). A value of 6.75 was obtained following CHPQA Guidance Note 28[11], with steam extraction at a pressure of 1.5 bar(a), which is considered sufficient to meet the requirements of the potential heat consumers identified for the Facility. The heat and power export has been modelled across a range of load cases and the results are presented in Table 10.

Table 10: Heat and power export

Load case	Heat export at turbine (MW_{th})	Gross power generated (MWe)	Net power exported (MW_e)	Z ratio
1. No heat export	0.0	95.1	85.6	N/A
2. Proposed network heat load (see Section 8.1)	24.2	91.5	82.0	6.8
3. Maximum heat export capacity	90.0	81.8	72.2	6.8

9.1.1.2 The results indicate that for the heat consumers identified in Section 7.1.4 and 7.2, load case 2 corresponding to an average heat export of 24.2 MW_{th} will result in a net power export of 82.0 MW_e.

9.2 CHPQA Quality Index

9.2.1.1 CHPQA is an energy efficiency best practice programme initiative by the UK Government. CHPQA aims to monitor, assess and improve the quality of CHP in the UK. In order to prove that a plant is a 'Good Quality' CHP plant, a QI of at least 105 must be achieved at the design, specification, tendering and approval stages. Under normal operating conditions (i.e. when the scheme is operational) the QI threshold drops to 100. The QI for CHP schemes is a function of their heat efficiency and power efficiency according to the following formula:

$QI = X\eta_{power} + Y\eta_{heat}$
where: η_{power} = power efficiency; and
η_{heat} = heat efficiency.

9.2.1.2 The power efficiency within the formula is calculated using the gross electrical output and is based on the gross calorific value of the input fuel. The heat efficiency is also based on the gross calorific

1.1.1.1

[11] http://www.chpqa.com/guidance_notes/GUIDANCE_NOTE_28.pdf

value of the input fuel. The coefficients X and Y are defined by CHPQA based on the total gross electrical capacity of the scheme and the fuel / technology type used.

9.2.1.3 In December 2018, the Government released a revised CHPQA Standard Issue 7. The document sets out revisions to the design and implementation of the CHPQA scheme. These revisions are intended to ensure schemes which receive Government support are supplying significant quantities of heat and delivering intended energy savings. The following X and Y coefficients apply to the Facility:

1. X value = 220; and
2. Y value = 120.

9.2.1.4 The QI and efficiency values (based on a gross calorific value of 14.0 MJ/kg) have been calculated in accordance with CHPQA methodology for various load cases and the results are presented in Table 11.

Table 11: QI and efficiency calculations

Load case	Gross power efficiency (%)	Heat efficiency (%)	Overall efficiency (%)	CHPQA QI
1. No heat export	26.18	0.00	26.18	57.6
2. Proposed network heat load (see Section 8.1)	25.19	6.65	31.84	63.4
3. Maximum heat export capacity	22.51	24.77	47.28	79.2

9.2.1.5 The results indicate that the Facility will not achieve a QI score in excess of the 'Good Quality' CHP threshold (QI of 105 at the design stage) for the average heat load exported to the proposed heat network. The highly onerous efficiency criteria set out in the latest CHPQA guidance, most notably the underpinning requirement to achieve an overall efficiency (NCV basis) of at least 70%, means that none of the load cases considered will enable heat export from the Facility to be considered Good Quality.

9.2.1.6 For reference, assuming the same Z ratio as set out in the preceding section, an average heat export of 198 MW_{th} would be required for a heat network to achieve Good Quality status. It is clear that the design proposed for heat recovery is not capable of supplying this quantity of heat at the assumed conditions required by the local network.

10 Heat Network Economic Assessment

10.1 Fiscal Support

10.1.1.1 The following fiscal incentives are available to energy generation projects and impact the feasibility of delivering a district heating network.

10.1.2 Capacity Market for electricity supplied by the Facility

10.1.2.1 Under the Capacity Market, subsidies are paid to electricity generators (and large electricity consumers who can offer demand-side response) to ensure long-term energy security for the UK. Capacity Agreements are awarded in a competitive auction and new plants (such as the Facility) are eligible for contracts lasting up to 15 years. Based on the eligibility criteria of the mechanism, the Facility will be eligible for Capacity Market support. Since support is based on electrical generation capacity (which would reduce when operating in CHP mode), these payments will act to disincentivise heat export and have therefore not been included in the economic assessment.

10.1.3 Renewable Heat Incentive

10.1.3.1 The Renewable Heat Incentive (RHI) was created by the Government to promote the deployment of heat generated from renewable sources. However, no funding announcements have been published for the RHI post March 2022. Therefore, it is unlikely the Facility will receive incentives under the RHI. In addition, to be eligible, the plant in question must not receive any other support or subsidy from public funds including any support received under the Capacity Market. Therefore, if the Facility qualifies for support under the Capacity Market mechanism, it will not be eligible for the RHI.

10.1.4 Contracts for Difference

10.1.4.1 Contracts for Difference (CfD) has replaced the Renewables Obligation (RO) as the mechanism by which the Government supports low carbon power generation. CfD de-risks investing in low carbon generation projects by guaranteeing a fixed price (the Strike Price) for electricity over a 15-year period. In the second CfD allocation round (executed on 11 September 2017) no funding was allocated for Energy from Waste plants, with or without CHP, on the basis that these are now considered established technologies. The third allocation[12] round was executed in September 2019 with contracts awarded to eligible less established technologies only[13].

10.1.4.2 The Government has confirmed that it plans to hold the next allocation round in 2021. The Government has also announced that it intends to hold further auctions every two years on a rolling basis. Under the current regulations, CfD delivery years subject to auction must end on 31st March 2026. BEIS has released a consultation[14] on changes ahead of the fourth allocation round for CfD. This consultation proposes that the CfD scheme be extended to cover delivery years until 31st March 2030 and confirms that allocation round 4 will include auctions for both established (Pot 1) and less established (Pot 2) technologies, with energy from waste with CHP included in Pot 1. The

1.1.1.1

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832924/Contracts_for_Difference_CfD_Allocation_Round_3_Results.pdf

[13] https://www.gov.uk/government/collections/contracts-for-difference-cfd-third-allocation-round

[14] https://www.gov.uk/government/consultations/contracts-for-difference-cfd-proposed-amendments-to-the-scheme-2020

justification is that the strike price at auction for Pot 1 will likely be below or near the wholesale price for electricity, meaning these projects would effectively be zero subsidy. In this case, the CfD might not provide financial support, but it would provide long term security on the price to be achieved, which can be useful in securing financing. On this basis, the Facility would not receive support under the CfD mechanism but could secure long term security on the electricity price.

10.1.5 Heat Network Investment Project funding

10.1.5.1 The Heat Network Investment Project (HNIP) aims to deliver carbon savings and create a self-sustaining heat network market through the provision of subsidies, in the form of grants and loans, for heat network projects. £ 320 million has been made available to fund the HNIP between 2019 and 2022. Following a pilot scheme, which ran from October 2016 to March 2017, the Department for Business, Energy and Industrial Strategy (BEIS) has confirmed that funding will be available for both public and private sector applicants, and that there will be no constraints on scheme size. The 2020 Budget confirms £ 96 million for the final year of the HNIP, which ends in March 2022.

10.1.5.2 The HNIP may be a source of funding that would improve the economic viability of the heat network. The level of funding that the Facility could achieve under this program would depend on the final size of the network and commercial arrangements.

10.1.5.3 Relatively modest grant funding, to assist local authorities in heat network project development, is also available through the Heat Networks Delivery Unit (HNDU), although this could not be received by the Facility directly and would not serve to support project delivery.

10.1.6 Green Heat Network Fund

10.1.6.1 After HNIP ends in March 2022, the government will invest a further £ 270 million in a new Green Heat Networks Fund (GHNF), enabling new and existing heat networks to be low carbon and connect to waste heat that would otherwise be released into the atmosphere.

10.1.6.2 Following discussions with BEIS, the UK District Energy Association (ukDEA) can advise the following regarding this new GHNS and difference to HNIP:

1. GHNF is to enable new and existing networks to be low carbon and connect to waste heat. It is not for the construction of heat networks in themselves as the HNIP fund is. To be clear this new GHNF is very much about driving the transition towards a low carbon source of heat for planned and existing networks and not specifically about delivering large scale heat networks as HNIP is.
2. GHNF is a capital grant fund and not a split loan and grant as HNIP is.
3. The GHNF fund will be available from 2022 to 2025.
4. The exact mechanics of how it will work are to be confirmed.

10.1.6.3 It is expected that the same state aid rules will apply to this new fund and therefore it would be unlikely to fund greater than 50 % of the capital costs of the heat source.

10.1.6.4 GHNF is aimed at waste heat as a heat source and would not apply to steam extractions from turbine. Therefore, the Facility will not be eligible for the GHNS in its current design.

10.2 Technical feasibility

10.2.1.1 Step 3 of the CBA methodology requires identification of existing and proposed heat loads which are technically feasible to supply. The draft Article 14 guidance states that the following factors should be accounted for when determining the technical feasibility of a scheme, pertaining to a type 14.5(a) installation.

1. **The compatibility of the heat source(s) and load(s) in terms of temperature and load profiles**

10.2.1.2 The CHP scheme has been developed on the basis of delivering heat at typical district heating conditions (refer to Section 8.2). It is reasonable to assume that identified potential heat consumers would be able to utilise hot water at the design conditions. Consumer requirements (in terms of hot water temperature and load profiles) will need to be verified in any subsequent design process prior to the implementation of a heat network. Therefore, the heat source and heat load are considered to be compatible.

2. **Whether thermal stores or other techniques can be used to match heat source(s) and load(s) which will otherwise have incompatible load profiles**

10.2.1.3 Conventional thermal stores or back-up boilers (as detailed in Section 8.4) will likely be included in the CHP scheme to ensure continuity of supply. The specific arrangement will be selected when there is greater certainty with regards heat loads.

3. **Whether there is enough demand for heat to allow high-efficiency cogeneration**

10.2.1.4 High-efficiency cogeneration is cogeneration which achieves at least 10% savings in primary energy usage compared to the separate generation of heat and power. Primary energy saving (PES) is calculated in the following section.

10.2.2 Primary energy savings

10.2.2.1 To be considered high-efficiency cogeneration, the scheme must achieve at least 10% savings in primary energy usage compared to the separate generation of heat and power. PES have been calculated in accordance with European Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015 Annex II part (b), using the following assumptions.

1. Annual nominal throughput capacity of 633,309 tonnes per annum based on an NCV of 14 MJ/kg.
2. Nominal gross electrical output (expected capacity in fully condensing mode) of 95.1 MW_e.
3. Parasitic load is 9.5 MW_e.
4. Z ratio of 6.75.
5. Efficiency reference values for the separate production of heat and electricity have been taken as 80% and 25% respectively as defined in Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015[15].

10.2.2.2 When operating in fully condensing mode (i.e. without heat export) the Facility will achieve a PES of 16.96 %. This is in excess of the technical feasibility threshold defined in the draft Article 14 guidance. The inclusion of heat export at the design case level anticipated for the proposed heat network increases PES to 20.28 %. On this basis, the Facility will qualify as a high-efficiency cogeneration operation when operating in CHP mode.

10.3 Results of CBA

10.3.1.1 A CBA has been carried out on the selected heat load, in accordance with section 3 of the draft Article 14 guidance. The CBA uses an Excel template, '*Environment Agency Article 14 CBA*

1.1.1.1

[15] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R2402

Template.xlsx' provided by the EA, with inputs updated to correspond with the specifics of this Heat Plan.

10.3.1.2 The CBA model considers:

1. the revenue streams (heat sales);
2. the costs streams for the heat supply infrastructure (construction and operational, including back-up plant); and
3. the lost electricity sales revenue, over the lifetime of the scheme (electricity sales).

10.3.1.3 The following assumptions have been made:

1. The DH scheme will commence operation in 2027.
2. The heat export infrastructure required to export heat from the Facility to the consumers identified is estimated to have a capital cost of approximately £50.58 million, split over a two-year construction programme.
3. The heat station will cost approximately £3.89million, split over a two-year construction programme.
4. Back-up boilers will be provided to meet the peak heat demand, at a cost of approximately £4.47 million.
5. Operational costs have been estimated based on similar sized projects.
6. Heat sales revenue will be £58.3[16] / MWh, current price and index linked for inflation in CBA.
7. Electricity sales revenue will be £56[17] / MWh, current price and index linked for inflation in CBA.
8. Standby boiler fuel costs will be £23.4[18] / MWh, current price and index linked for inflation in CBA.
9. Standby boiler(s) will supply 8.3% of annual heat exported.

10.3.1.4 The results of the CBA indicate that both the nominal project internal rate of return and net present value (before financing and tax) over 30 years are 19.9 % and £9.16million respectively. Therefore, it is considered that the proposed heat network does yields an economically viable scheme in its current configuration. Model inputs and key outputs are presented in Appendix C.

1.1.1.1

[16] Based on information supplied by NLGEPL

[17] Annex M. Wholesale baseload price, reference scenario tab from https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019

[18] Annex M, Retail prices, industrial sector, reference scenario tab. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019

11 CHP-Ready BAT Assessment

11.1 CHP-Ready BAT Assessment

11.1.1.1 This report includes a CHP-Ready Assessment which considers the requirements of the EA's CHP-Ready Guidance. The completed CHP-Ready Assessment form is provided in Appendix D.

11.1.1.2 The 'CHP envelope' as outlined under requirement 2 of the CHP-Ready guidance, which identifies the potential operational range of a new plant where it could be technically feasible to operate electrical power generation with heat generation, is provided in Figure 6.

11.1.1.3 The points defining the CHP envelope are as follows.

A: minimum stable load (with no heat extraction).

B: minimum stable load (with maximum heat extraction).

Line A to B: minimum electrical power output for any given heat load (corresponds to the minimum stable plant load).

C: 100% load (with maximum heat extraction).

D: 100% load (with no heat extraction).

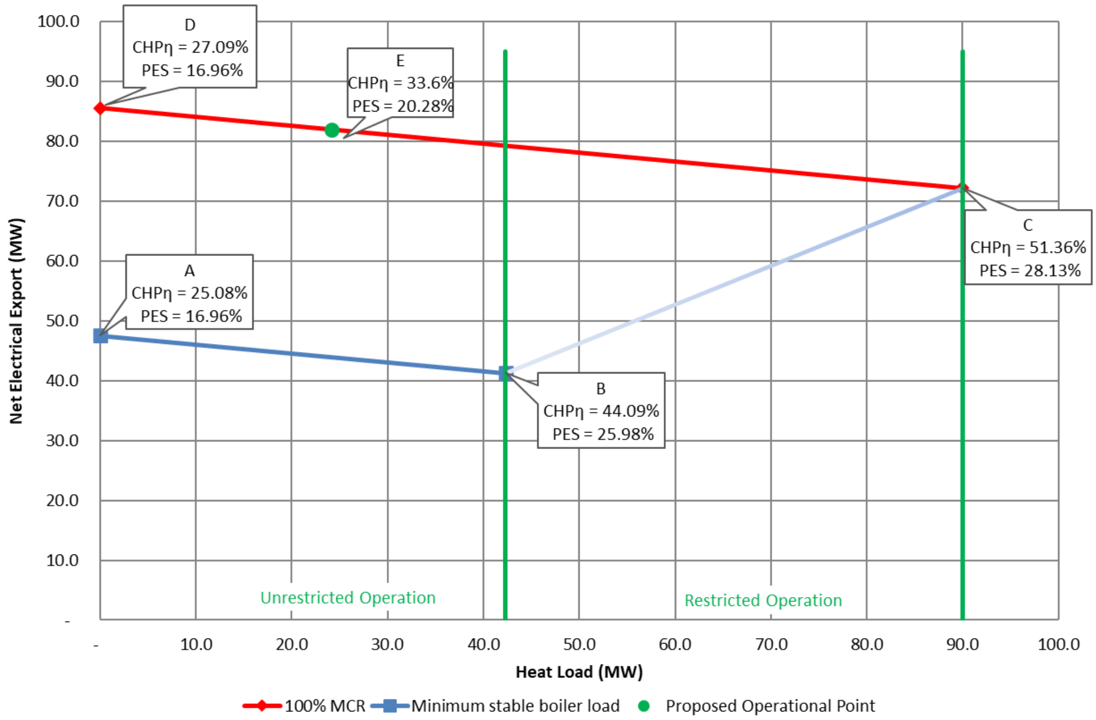
Line D to C: maximum electrical power output for any given heat load (corresponds to 100% plant load).

E: proposed operational point of the Facility, based on the proposed heat network.

Unrestricted operation: if a selected heat load is located in this region, the Facility will have the ability to operate at any load between minimum stable plant load and 100% plant load whilst maintaining the selected heat load.

Restricted operation: if a selected heat load is located in this region, the Facility will not have the ability to operate over its full operational range without a reduction in heat load.

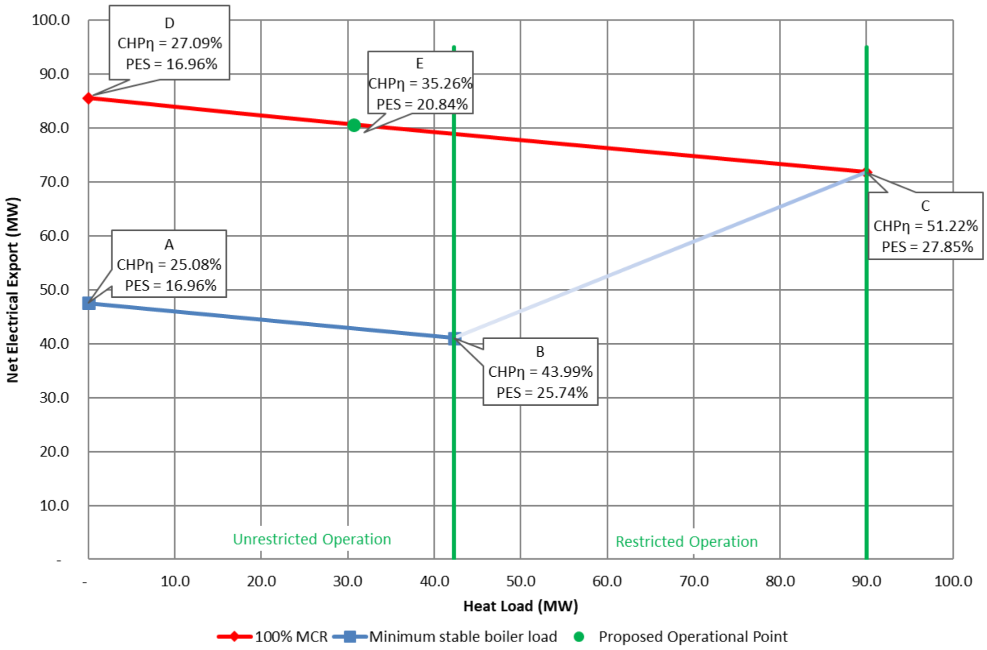
Figure 6: Graphical representation of CHP envelope for proposed heat network



11.1.1.4 The proposed operational point (point E) represents the annual average heat demand exported to the proposed heat network detailed in section 7 and 8.1. It considers the heat losses and pressure drop in the pipe network and therefore corresponds to the annual average heat demand predicted at the Facility site boundary. The operational range for the Facility will ultimately be subject to the required hot water flow temperature and final steam turbine selection, which are subject to detailed design.

11.1.1.5 The carbon capture and CHP Envelope is show in the figure below.

Figure 7: Graphical representation of CHP and Carbon Capture Envelope



12 Action Plan

12.1.1.1 It is theoretically feasible to export heat from the Facility to potential heat consumers. Additional heat consumers may emerge as development of the project progresses.

12.1.1.2 To build the Facility as CHP from the outset and realise the full energy export potential of the facility it is recommended that an action plan is implemented. The outcome of this action plan will be to ensure that the Facility can expand as a CHP facility by maintaining momentum with key stakeholders in the development process.

12.1.1.3 The action plan should be structured and have well defined objectives, involving all the local stakeholders and be supported at the highest levels within NLGEPL. The action plan should identify the strategic phases required for the heat network development. Potential heat consumers are more likely to engage in the process if they know that there is a realistic prospect of a connection; it is therefore proposed that the action plan would be implemented alongside the construction program. The following project development phases are suggested.

12.1.1.4 Initial phase

1. Follow up initial heat load plan and research with a detailed heat load survey when more information is available from potential consumers.
2. Engage with the local authority.
3. Agree annual progress targets with the EA and review annually.
4. Build a detailed database of potential heat consumers.
5. Target buildings identified as potential heat consumers.
6. Carry out heat use surveys at targeted heat consumers.
7. Verify seasonal heat demand over time.
8. Develop pipe routing options and / or phases.
9. Size and configure the required infrastructure.
10. Confirm technical viability.
11. Develop capital cost estimates.
12. Develop cost estimates for operation and maintenance.
13. Assess economic viability.
14. Establish a carbon saving benchmark.
15. Draw up a project master plan.
16. Set up a joint working group with stakeholders.
17. Develop a marketing strategy.

12.1.1.5 Intermediate phase

1. Undertake detailed negotiations with heat consumers.
2. Finalise initial heat demand.
3. Finalise sizing of infrastructure.
4. Discuss pipe routing options with the local highway authority.
5. Finalise pipe routing.
6. Tender for initial infrastructure.
7. Sign heads of terms for heat supply agreements with Energy Services Company (ESCo).
8. Install initial infrastructure.
9. Sign heat supply agreement with an ESCo.

10. Commission the heat network.

12.1.1.6 Final phase

1. Market the scheme.
2. Expand the scheme by adding heat consumers if possible.
3. Expand the scheme by developing on existing infrastructure or connecting additional heat sources if possible.

12.1.1.7 Based on consumers identified as part of this CHP Assessment, the Facility will be CHP enabled to be able to deliver up to 90 MW_{th}, subject to heat demand verification and plant design. To achieve CHP status, the scope of the proposed heat network needs to be well defined and technically assessed to prove that it is deliverable. Potential consumers need to be approached so that there is a high degree of certainty regarding heat sales. The economic viability of the heat network then needs to be confirmed.

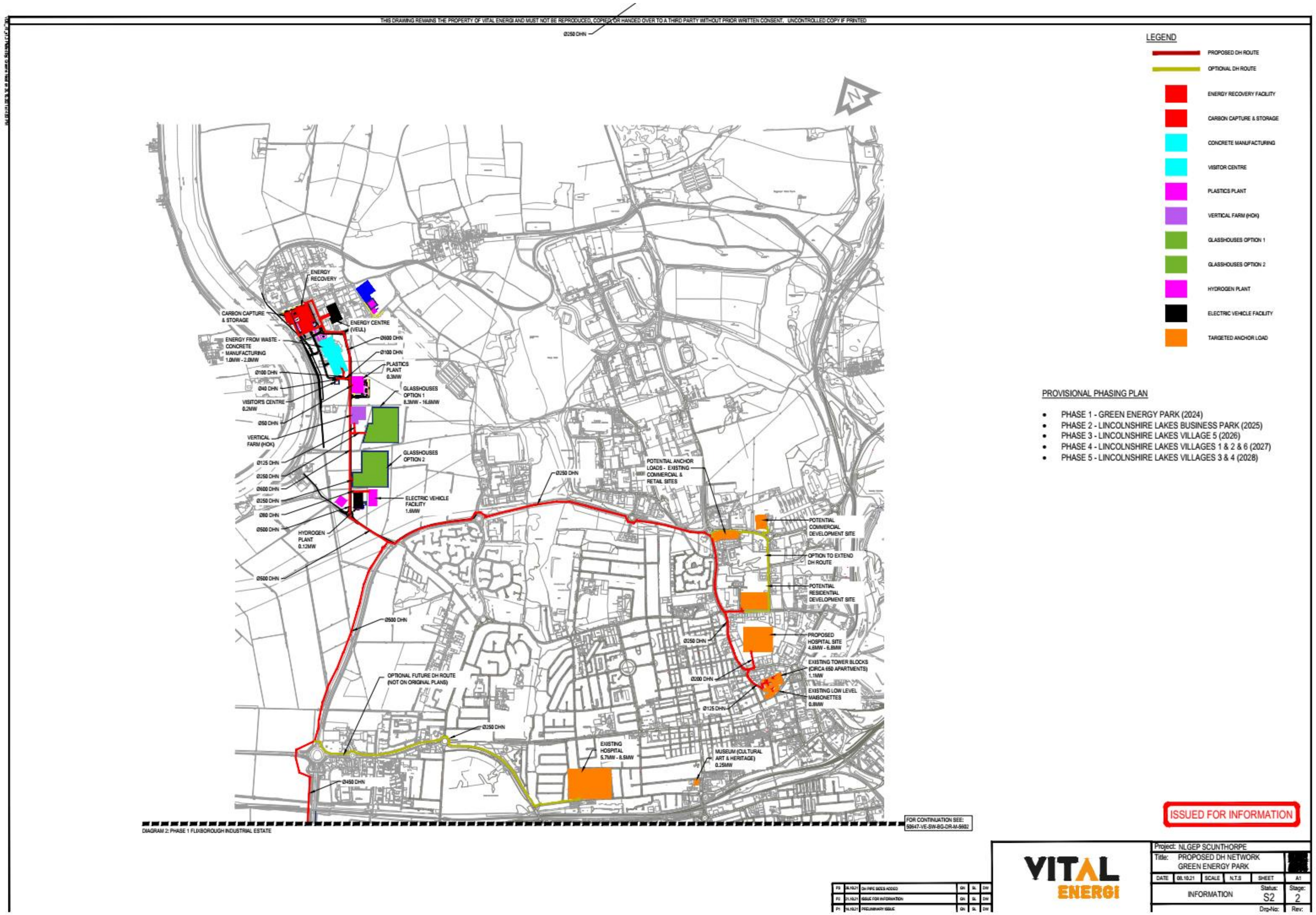
12.1.1.8 Constructing a detailed and reliable database of potential heat consumers is a key activity. This should be revisited and updated at least every two years so that new developments can be added and existing developments can be updated. Change in building ownership and use can affect the potential to be a heat customer. Boiler age can be tracked so that the consumer can be targeted when they are already considering investing in a new heating system.

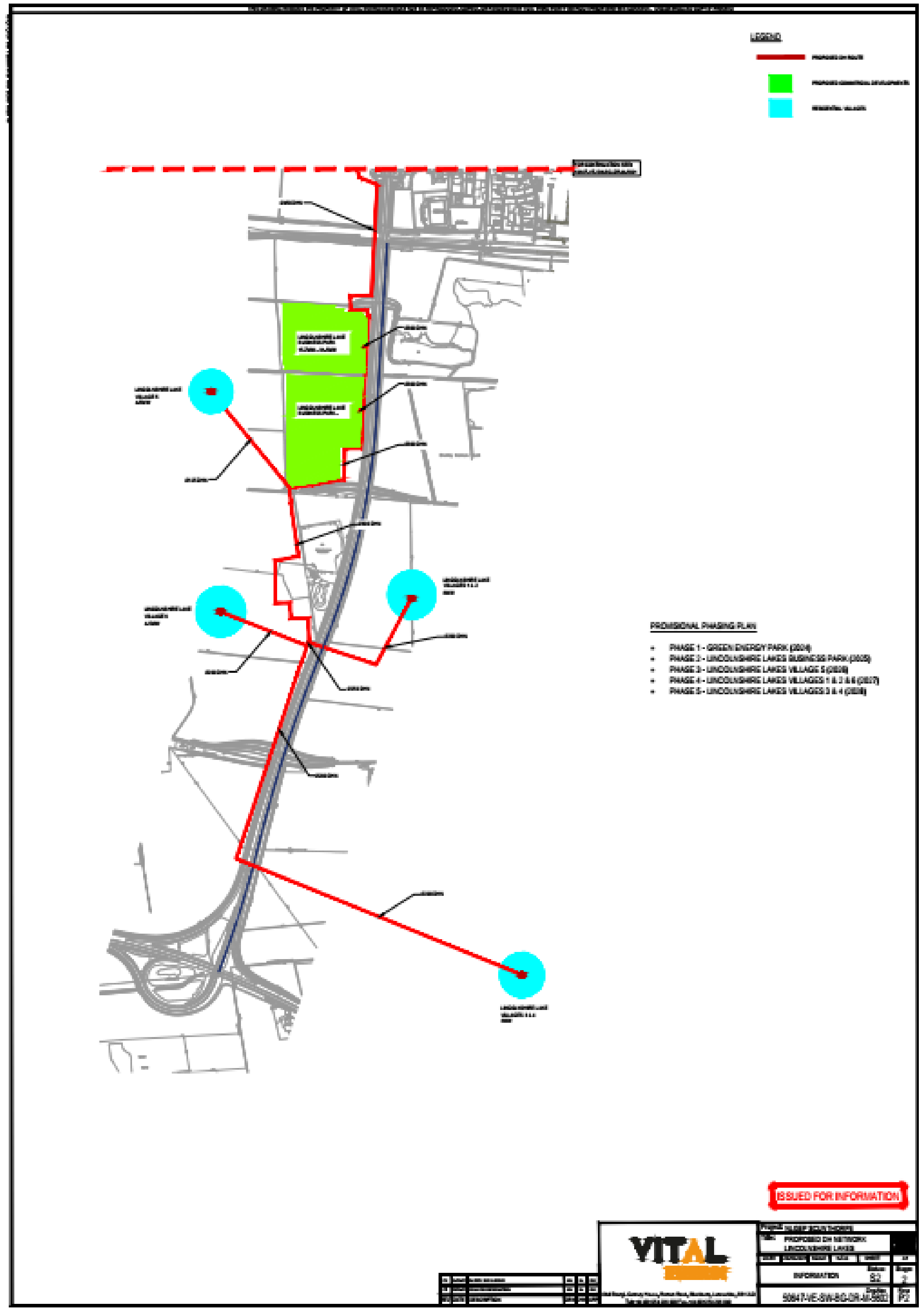
Appendices

A District Heating Pipe route and heat users

Summary	Peak Heating (kW)	Annual Heating (kWh)	Peak Cooling (kW)	Annual Cooling (kWh)
VISITOR'S CENTRE	200	215,239	-	-
EFW (CONCRETE MANUFACTURING)	1,919	1,980,917	-	-
PLASTICS PROCESSING PLANT	270	244,809	-	-
HYDROGEN ELECTROLYSIS PLANT	62	29,995	237	192,831
BATTERY ENERGY STORAGE (BES)	152	79,733	-	-
LINCOLNSHIRE LAKE BUSINESS PARK	15,738	16,896,755	-	-
SCUNTHORPE HOSPITAL (EXISTING)	8,523	20,240,527	-	-
SCUNTHORPE HOSPITAL (NEW)	6,845	18,329,245	-	-
CAMBRIDGE VERTICAL FARM (HOK)	-	-	1,411	4,899,438
MUSEUM SPACE (CULTURAL ART & HERITAGE)	242	259,950	-	-
COUNCIL OFFICES (EXISTING)	192	206,054	-	-
DATA CENTRES	-	-	3,000	12,008,547
Glasshouses	8,320	33,150,256	-	-
Glanford Business Park	8,071	8,665,002	-	-
North Lincolnsire Lakes 1 bed	1,681	2,749,154	-	-
North Lincolnsire Lakes 2 bed	3,145	5,442,390	-	-
North Lincolnsire Lakes 3 bed	3,420	5,946,526	-	-
North Lincolnsire Lakes 4 bed	3,318	5,743,323	-	-
North Lincolnsire Lakes 5 bed	5,144	9,528,500	-	-
North Lincolnsire Lakes 6 bed	8,424	13,599,769	-	-
Tower blocks by new hospital	1,142	1,672,455	-	-
Low rise flats by new hospital	797	1,114,970	-	-
Totals	**77,606**	**146,095,566**	**4,649**	**17,100,816**
Diversified + including losses	**62,925**	**182,573,354**	**4,993**	**20,118,607**

B Site Location and Layout Drawings


THIS DRAWING REMAINS THE PROPERTY OF VITAL ENERGI AND MUST NOT BE REPRODUCED, COPIED OR HANDED OVER TO A THIRD PARTY WITHOUT PRIOR WRITTEN CONSENT. UNCONTROLLED COPY IF PRINTED
LEGEND
PROPOSED DH ROUTE
OPTIONAL DH ROUTE
ENERGY RECOVERY FACILITY
CARBON CAPTURE & STORAGE
CONCRETE MANUFACTURING
VISITOR CENTRE
PLASTICS PLANT
VERTICAL FARM (HOK)
GLASSHOUSES OPTION 1
GLASSHOUSES OPTION 2
HYDROGEN PLANT
ELECTRIC VEHICLE FACILITY
TARGETED ANCHOR LOAD
PROVISIONAL PHASING PLAN
PHASE 1 - GREEN ENERGY PARK (2024)
PHASE 2 - LINCOLNSHIRE LAKES BUSINESS PARK (2025)
PHASE 3 - LINCOLNSHIRE LAKES VILLAGE 5 (2026)
PHASE 4 - LINCOLNSHIRE LAKES VILLAGES 1 & 2 & 6 (2027)
PHASE 5 - LINCOLNSHIRE LAKES VILLAGES 3 & 4 (2028)
ENERGY RECOVERY
CARBON CAPTURE & STORAGE
ENERGY CENTRE (VEUL)
ENERGY FROM WASTE - CONCRETE MANUFACTURING 1.0MW - 2.0MW
PLASTICS PLANT 0.3MW
GLASSHOUSES OPTION 1 8.3MW - 16.6MW
VISITOR'S CENTRE 0.2MW
VERTICAL FARM (HOK)
GLASSHOUSES OPTION 2
ELECTRIC VEHICLE FACILITY 1.6MW
HYDROGEN PLANT 0.12MW
POTENTIAL ANCHOR LOADS - EXISTING COMMERCIAL & RETAIL SITES
POTENTIAL COMMERCIAL DEVELOPMENT SITE
OPTION TO EXTEND DH ROUTE
POTENTIAL RESIDENTIAL DEVELOPMENT SITE
PROPOSED HOSPITAL SITE 4.6MW - 6.8MW
EXISTING TOWER BLOCKS (CIRCA 650 APARTMENTS) 1.1MW
EXISTING LOW LEVEL MAISONETTES 0.8MW
OPTIONAL FUTURE DH ROUTE (NOT ON ORIGINAL PLANS)
EXISTING HOSPITAL 5.7MW - 8.5MW
MUSEUM (CULTURAL ART & HERITAGE) 0.25MW
Ø250 DHN
Ø500 DHN
Ø450 DHN
Ø200 DHN
Ø125 DHN
DIAGRAM 2: PHASE 1 FLIXBOROUGH INDUSTRIAL ESTATE
FOR CONTINUATION SEE: 50647-VE-SW-BG-DR-M-5602
ISSUED FOR INFORMATION
P3 08.10.21 DH PIPE SIZES ADDED GN SL DW
P2 21.10.21 ISSUE FOR INFORMATION GN SL DW
P1 14.10.21 PRELIMINARY ISSUE GN SL DW
VITAL ENERGI
Project: NLGEP SCUNTHORPE
Title: PROPOSED DH NETWORK GREEN ENERGY PARK
DATE 08.10.21 SCALE N.T.S SHEET A1
INFORMATION
Status: S2
Stage: 2
Drg-No:
Rev:


LEGEND
PROVISIONAL PHASING PLAN
PHASE 1 - GREEN ENERGY PARK (2024)
PHASE 2 - LINCOLNSHIRE LAKES BUSINESS PARK (2025)
PHASE 3 - LINCOLNSHIRE LAKES VILLAGE 5 (2026)
PHASE 4 - LINCOLNSHIRE LAKES VILLAGES 1 & 2 & 6 (2027)
PHASE 5 - LINCOLNSHIRE LAKES VILLAGES 3 & 4 (2028)
ISSUED FOR INFORMATION
VITAL
PROPOSED DH NETWORK
LINCOLNSHIRE LAKES
INFORMATION
S2
P2

C CBA Inputs and Key Outputs

INPUTS Version Jan 2015

Scenario Choice (dropdown box)	1	Power generator (Heat Source) same fuel amount
Technical solution features		
Heat carrying medium (hot water, steam or other) (dropdown box)	Hot water	
Total length of supply pipework (kms)	19.042	
Peak heat demand from Heat User(s) (MWth)	70.124	
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) (MWh)	Lines 49 & 79	
DCF Model Parameters		
Discount rate (pre-tax pre-financing) (%) - 17% suggested rate	17%	
Project lifespan (yrs)	30	
Exceptional shorter lifespan (yrs)	0	

Key	Hot water	Steam	Other
2	Participant to define		
2	Regulatory prescribed		
2	Calculated		
2	Prescribed - but possibility to change if make a case		

Cost and revenue streams

Construction costs and build up of operating costs and revenues during construction phase

	% operating costs and revenues during construction phase	Heat Supply Infrastructure - used in Scenarios 1, 2, 3 and 5	Heat Station - used in Scenarios 1, 2 and 3	Standby boilers (only if needed for Scenarios 1, 2 and 3)	Industrial CHP - used in Scenario 4 *
Project asset lifespan (yrs)		30	30	30	
Exceptional reason for shorter lifespan of Heat Supply Infrastructure, Standby Boiler and/ or Heat Station (yrs)					
Construction length before system operational and at steady state (yrs)	2				
Number of years to build		2	2	2	0

	% (ONLY IF APPLICABLE)	£m	£m	£m	£m
Year 1 costs (£m) and build up of operating costs and revenues (%)	0%	25.28782456	1.9467009	2.234402495	
Year 2 costs (£m) and build up of operating costs and revenues (%)	0%	25.28782456	1.9467009	2.234402495	
Year 3 costs (£m) and build up of operating costs and revenues (%)					
Year 4 costs (£m) and build up of operating costs and revenues (%)					
Year 5 costs (£m) and build up of operating costs and revenues (%)					

Non-power related operations

OPEX for full steady state Heat Supply Infrastructure on price basis of first year of operations (partial or steady state) (£m)	0.1
OPEX for full steady state Heat Station on price basis of first year of operations (partial or steady state) (£m)	0.3
OPEX for full steady state Standby Boilers on price basis of first year of operations (partial or steady state) (£m)	0.1
OPEX for full steady state Industrial CHP on price basis of first year of operations (partial or steady state) (£m) *	
Additional equivalent OPEX to pay for a major Industrial CHP overall spread over the life of the asset (£m) on price basis of first year of operations (partial or steady state) (£m) *	
Other 1 - Participant to define (£m)	
Other 2 - Participant to define (£m)	
Total non-power related operations	0.5
Annual inflation for all non-power related OPEX from first year of operations (full or partial) (%)	2.0%

Unit Energy Prices, Energy Balance, Fuel Related Operational costs and Revenue Stream

	Scenario used	1 Power generator (Heat Source) same fuel amount	2 Power generator (Heat Source) same electrical output	3 Industrial installation (Heat Source) - use waste heat	4 Industrial installation (Heat Source) - CHP set to thermal input	5 District heating (Heat User)
Heat sale price (£/ MWh) at first year of operations (partial or full)	58.25	58.25				
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	252,423	252,423				
Equivalent heat sales if first year of operations is steady state (£ m)	14.7					
Heat sale price inflation from first year of operations (full or partial) (% per year)	2.0%	2.0%				
Percentage of heat supplied by Standby Boiler (if relevant)	8%	8%				
'Lost' electricity sale price (£/ MWh) at first year of operations	56.00	56.00				
Z-ratio (commonly in the range 3.5 - 8.5)	6.75	6.75				
Power generation lost at steady state (MWh)	34,292	34,292				

Equivalent 'lost' revenue from power generation if first year of operations is steady state (£ m)	1.92					
Electricity sale price inflation from first year of operations (full or partial) (% per year)	2.0%	2.0%				
Industrial CHP electricity sale price (£/ MWh) at first year of operations (full or partial)	0.00				[redacted]	
Industrial CHP electrical generation in steady state (MWh)	0				[redacted]	
Equivalent revenue from power generation if first year of operations is steady state (£ m)	0.00					
Industrial CHP electricity price inflation from first year of operations (full or partial) (% per year)	0.0%				[redacted]	
Fuel price for larger power generator/ CHP at first year of operations (full or partial) (£ / MWh)	0.00		[redacted]		[redacted]	
Z-ratio (commonly in the range 3.5 - 8.5)	0		[redacted]			
Power efficiency in cogeneration mode (%)	0		[redacted]			
Additional fuel required per year for larger power generator / CHP in steady state (MWh)	0		[redacted]		[redacted]	
Equivalent additional fuel costs if first year of operations is steady state (£ m)	0.00					
Fuel price inflation from first year of operations (full or partial) (% per year)	0.0%		[redacted]		[redacted]	
Fuel price for Standby Boiler at first year of operations (£ / MWh)	23.39	23.39	[redacted]	[redacted]		
Boiler efficiency of Standby Boiler (%)	80%	80%	[redacted]	[redacted]		
Additional fuel required per year for Standby Boiler in steady state (MWh)	26,189	26,189	[redacted]	[redacted]		
Equivalent additional fuel costs if first year of operations is steady state (£m)	0.61					
Fuel price inflation for Standby Boiler from first year of operations (full or partial) (% per year)	2.00%	2.0%	[redacted]	[redacted]		
Heat purchase price (£/ MWh) at first year of operations (partial or full)	0.00					[redacted]
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	0					[redacted]
Equivalent cost of heat purchased if first year of operations is steady state (£ m)	0.0					
Heat purchase price inflation from first year of operations (full or partial) (% per year)	0.0%					[redacted]
Fuel price (£ / MWh) at first year of operations (partial or full)	0.00					[redacted]
Boiler efficiency of district heating plant	0%					[redacted]
Fuel avoided per year in steady state (MWh)	0					[redacted]
Equivalent fuel savings if first year of operations is steady state (£m)	0.0					
Fuel price inflation from first year of operations (full or partial) (% per year)	0.0%					[redacted]
Fiscal benefits (£m) in first year of operations assuming it is at steady state **	0.00	0.00	[redacted]		[redacted]	

Fiscal benefits inflation rate from first year of opeations (full or partial) (%) **	0.0%

* In the case of Industrial CHP a separate model template is available for typical indicative CAPEX, non-power related OPEX, additional equivalent OPEX to pay for a major overall, MWh of electricity generated in the steady state and the additional fuel required.

** Operator only needs to enter a value for fiscal benefits (£m) and the annual fiscal benefit inflation rate (%) if the NPV without fiscal benefits is negative at the specified discount rate

OUTPUTS

Nominal Project IRR (before financing and tax) over 32 years	19.9%
Nominal NPV (before financing and tax) (£m) over 32 years	9.16

D CHP-R Assessment Form

#	Description	Units	Notes / Instructions
Requirement 1: Plant, Plant location and Potential heat loads			
1.1	Plant name		Flixborough Energy Recovery Facility
1.2	Plant description		The main activities associated with the Facility will be the combustion of incoming waste to raise steam and the generation of electricity in a steam turbine/generator. The Facility includes three waste incineration lines, waste reception hall, main thermal treatment process, turbine hall, on-site facilities for the treatment or storage of residues and waste water, flue gas treatment, stack, boilers, devices and systems for controlling operation of the waste incineration plant and recording and monitoring conditions. In addition to the main elements described, the Facility will also include weighbridges, water, auxiliary fuel and air supply systems, site fencing and security barriers, external hardstanding areas for vehicle manoeuvring, internal access roads and car parking, transformers, grid connection compound, firewater storage tanks, offices, workshop, stores and staff welfare facilities. The Facility has been designed to export power to the National Grid. The Facility will generate approximately 95.1 MWe of electricity in full condensing mode. The Facility will have a parasitic load of 9.52 MWe. Therefore, the maximum export capacity of the Facility is 85.6 MWe. In addition to generating power, the Facility has been designed to be capable of exporting up to 90 MW_{th} heat to local district heating users, which is suitable for the identified district heating network. The maximum heat capacity will be subject to the requirements of the heat consumers and confirmed during detailed design stage. At the time of writing this report, there are no formal agreements in place for the export of heat from the Facility. The power exported may fluctuate as fuel quality fluctuates, and if heat is exported from the Facility to local heat users in the future. The Facility has been designed to thermally treat waste with a range of net calorific values (NCV's) with a Net Calorific Value (NCV) of 10 MJ/kg to 18 MJ/kg.

#	Description	Units	Notes / Instructions
			The nominal capacity of the Facility is 81.2 tonnes per hour of fuel with an NCV of 14 MJ/kg. The expected operational availability is 7,796 hours per annum (~89%), which is regarded as typical for an EfW plant in the UK. Therefore, the nominal capacity for the installation is 633,309 tonnes per annum. However, the annual fuel input capacity could increase or decrease depending on the availability of the plant. If the Facility performed above average and/or operated above the nominal availability during the year, it could be required to shut down unnecessarily if there was no 'headroom' allowance in the annual permitted tonnage. Moreover, there will also be fluctuations in the net calorific value of the incoming fuel. If the net calorific value of the fuel received is lower than expected, the plant will operate at a higher mechanical throughput than its nominal capacity. In this case, it again could be required to shut down unnecessarily before the end of the year if there was no 'headroom' allowance in the annual permitted tonnage. To allow for the above (i.e. higher availability or lower CV fuel), the maximum capacity of the Facility is up to 758,376 tonnes per annum, based on NCV of 12 MJ/kg.
1.3	Plant location (Postcode / Grid Ref)		The site is located on at the Flixborough Industrial Estate, adjacent to the River Trent in North Lincolnshire. The Energy Recovery Facility (ERF) will form part of the wider North Lincolnshire Green Energy Park (NLGEP). The site is centred approximately on National Grid Reference (SE8555015325). The nearest postcode of the site is DN15 8RY.
1.4	Factors influencing selection of plant location		Transport connections to road, rail and river. Proximity to grid connection options. Commercial availability of land Regional waste availability.
1.5	Operation of plant		
a)	Proposed operational plant load	%	100
b)	Thermal input at proposed operational plant load	MW	315.90
c)	Net electrical output at proposed operational plant load	MW	85.58

#	Description	Units	Notes / Instructions
d)	Net electrical efficiency at proposed operational plant load	%	27.09%
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	315.90
g)	Net electrical output at maximum plant load	MW	85.58
h)	Net electrical efficiency at maximum plant load	%	27.09%
i)	minimum stable plant load	%	60%
j)	Thermal input at minimum stable plant load	MW	189.54
k)	Net electrical output at minimum stable plant load	MW	41.27
l)	Net electrical efficiency at minimum stable plant load	%	21.78%
1.6	Identified potential heat loads		
			Details of the identified heat loads are in Sections 7 and 8.1. Following consumer screening and accounting for network heat losses and consumer diversity, potential consumers were identified with an average heat load of 24.15 $MW_{th.}$ and a peak load of 70.12 MW_{th} for the proposed heat network. The estimated heat use of the identified network is 211,592 MWh/year.
1.7	Selected heat load(s)		
a)	Category (e.g. industrial / district heating)		District heating
b)	Maximum heat load extraction required	MW	The average and diversified peak heat demand of the proposed heat network has been calculated to be 24.15 MW_{th} and 70.12 MW_{th} respectively.
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		Network to supply hot water at typical district heating temperatures (approximately 90°C) via turbine steam extractions at approximately 1.5 bar(a) via a controlled steam flow extraction from low pressure turbine bleed.

#	Description	Units	Notes / Instructions
b)	Description of heat load profile		The heat load profile is variable due to mixed use developments (primarily industrial and commercial). A detailed heat load profile can be found in section 8.1 of the Heat Plan. The consumer heat load and profile is subject to verification.
c)	Export pressure	bar a	3.0
d)	Export temperature	°C	90
e)	Export flow	t/h	690.67 (nominal case)
f)	Return pressure	bar a	1.24
g)	Return temperature	°C	60
h)	Return flow	t/h	690.67 (nominal case)
Requirement 2: Identification of CHP Envelope			
2.0	Comparative efficiency of a standalone boiler for supplying the heat load	% LHV	80% - updated in accordance with CHPQA Stakeholder Engagement Document, April 2016, Table 1.
2.1	Heat extraction at 100% plant load		
a)	Maximum heat load extraction at 100% plant load	MW	90.00
b)	Maximum heat extraction export flow at 100% plant load	t/h	Assuming steam extraction at 1.5 bar(a), export flow rate would be: 148.04 t/hr
c)	CHP mode net electrical output at 100% plant load	MW	72.25
d)	CHP mode net electrical efficiency at 100% plant load	%	22.87%
e)	CHP mode net CHP efficiency at 100% plant load	%	51.36%
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	28.13%
2.2	Heat extraction at minimum stable plant load		
a)	Maximum heat load extraction at minimum stable plant load	MW	42.30
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Assuming steam extraction at 1.5 bar(a), export flow rate would be: 69.58 t/hr

#	Description	Units	Notes / Instructions
c)	CHP mode net electrical output at minimum stable plant load	MW	41.27
d)	CHP mode net electrical efficiency at minimum stable plant load	%	21.78%
e)	CHP mode net CHP efficiency at minimum stable plant load	%	44.09%
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	25.98%
2.3	Can the plant supply the selected identified potential heat load (i.e.is the identified potential heat load within the 'CHP envelope')?		Yes, but not deemed 'Good Quality' CHP as detailed in section 9 of the Heat Plan.
Requirement 3: Operation of the Plant with the Selected Identified Heat Load			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	82.00
b)	CHP mode net electrical efficiency at proposed operational plant load	%	25.96%
c)	CHP mode net CHP efficiency at proposed operational plant load	%	33.60%
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	MW	3.58
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	1.13%
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	20.28%
g)	Z ratio		6.75
Requirement 4: Technical provisions and space requirements			
4.1	Description of likely suitable extraction points		Steam for the district heating system could be supplied via a controlled steam flow extraction from low pressure turbine bleed at approximately 1.5 bar(a). Full details are provided in section 6.2 of the Heat Plan.

#	Description	Units	Notes / Instructions
4.2	Description of potential options which could be incorporated in the plant, should a CHP opportunity be realised outside the 'CHP envelope'		The CHP opportunity lies within the CHP envelope.
4.3	Description of how the future costs and burdens associated with supplying the identified heat load / potential CHP opportunity have been minimised through the implementation of an appropriate CHP-R design		If the scheme were to be implemented, space will be allocated for the CHP equipment in the area adjacent to the turbine hall to avoid the cost of building a dedicated heat station at a later date. The route for the steam main will be identified and preserved. An access road between the Facility and B1216 will be constructed in Phase 1 of the project, before the Facility is constructed. District heating pipework will be installed in this new access road prior to the Facility construction. A controlled steam extraction valve will be included in the steam turbine to provide steam for the district heating system. Therefore, the Facility will be constructed as CHP enabled from outset and configured as a CHP plant and not just optimised for electricity only operation. The turbine design will be selected to maximise CHP efficiency so maximising the ability of heat export to be implemented in the future. This is in line with the EA CHP-Ready Guidance which states that the initial electrical efficiency of a CHP-R plant (before any opportunities for the supply of heat are realised) should be no less than that of the equivalent non-CHP-R plant.
4.4	Provision of site layout of the plant, indicating available space which could be made available for CHP-R		Detailed design of the Facility has not been undertaken at this stage. However, space will be left available in the area adjacent to turbine hall for heat export infrastructure. Please see the site layout in Appendix B. The heat network will (likely) include steam extraction piping, control and shutoff valves, heat exchangers, district heating supply and return lines, district heating circulation pumps, condensate return piping (to the condensate tank), control and instrumentation / electrical connections, an expansion tank for pressurisation of the district heating pipe network and heat metering. If necessary, a back-up boiler will be located at a suitable location within the installation boundary for ease of connection to the primary hot water circuit.
Requirement 5: Integration of CHP and carbon capture			

#	Description	Units	Notes / Instructions
5.1	Is the plant required to be CCR?		Yes
5.2	Export and return requirements identified for carbon capture		
	100% plant load		
a)	Heat load extraction for carbon capture at 100% plant load	MW	6.58
b)	Description of heat export (e.g. steam / hot water)		Low pressure steam
c)	Export pressure	bar a	4.85
d)	Export temperature	°C	152
e)	Export flow	t/h	10.85
f)	Return pressure	bar a	3.5
g)	Return temperature	°C	138
h)	Return flow	t/h	10.85
i)	Likely suitable extraction points		Low pressure superheated steam
	Minimum stable plant load		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	3.09
k)	Description of heat export (e.g. steam / hot water)		Low pressure steam
l)	Export pressure	bar a	4.85
m)	Export temperature	°C	152
n)	Export flow	t/h	5.10
o)	Return pressure	bar a	3.5
p)	Return temperature	°C	138
q)	Return flow	t/h	5.10
r)	Likely suitable extraction points		Low pressure steam
5.3	Operation of plant with carbon capture (without CHP)		
a)	Maximum plant load with carbon capture	%	100
b)	Carbon capture mode thermal input at maximum plant load	MW	315.9

#	Description	Units	Notes / Instructions
c)	Carbon capture mode net electrical output at maximum plant load	MW	82.72
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	26.19
e)	Minimum stable plant load with CCS	%	60%
f)	Carbon capture mode CCS thermal input at minimum stable plant load	MW	189.54
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	45.49
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	24.00
5.4	Heat extraction for CHP at 100% plant load with carbon capture		
a)	Maximum heat load extraction at 100% plant load with carbon capture [H]	MW	90
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	40.45
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	71.84
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	22.73
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	51.22
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	27.85
5.5	Heat extraction at minimum stable plant load with carbon capture		
a)	Maximum heat load extraction at minimum stable plant load with carbon capture	MW	42.30
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	59.31

#	Description	Units	Notes / Instructions
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	41.07
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	21.67
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	43.99
f)	reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	25.74
5.6	Can the plant with carbon capture supply the selected identified potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		Yes
5.7	Description of potential options which could be incorporated in the plant for useful integration of any realised CHP system and carbon capture system		The plant has sufficient capacity to simultaneously meet the CCS requirements and produce steam for the identified heat loads (District Heating).
Requirement 6: Economics of CHP-R			
6.1	Economic assessment of CHP-R		In order to assess the economic feasibility of the CHP scheme (as required under Article 14 of the Energy Efficiency Directive) a cost benefit assessment has been carried out in accordance with the draft Article 14 guidance. The results of the CBA indicate an internal rate of return of 19.9 % and a net present value of £9.16 million. The proposed heat network will yield an economically viable scheme in its current configuration. The economic feasibility of the scheme will be reassessed in the future when there is a better understanding of heat demands and considering any subsidies that support the export of heat.
BAT assessment			
	Is the new plant a CHP plant at the outset (i.e. are there economically		No

#	Description	Units	Notes / Instructions
	viable CHP opportunities at the outset)?		
	If not, is the new plant a CHP-R plant at the outset?		Yes
	Once the new plant is CHP-R, is it BAT?		Yes

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