

FICHTNER

Consulting Engineers Limited



Humber Gate Waste Treatment Facility



Humber Resources Group Ltd

CHP Assessment

Document approval

	Name	Signature	Position	Date
Prepared by:	Vildan Taylor		Associate Senior Consultant	05/01/2026
Checked by:	James Sturman		Principal Consultant	05/01/2026

Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
01	05/01/2026	For client review	VBT	JRS
02				

© 2026 Fichtner Consulting Engineers. All rights reserved.

This document and its accompanying documents contain information which is confidential and is intended only for the use of Humber Resources Group Ltd. If you are not one of the intended recipients any disclosure, copying, distribution or action taken in reliance on the contents of the information is strictly prohibited.

Unless expressly agreed, any reproduction of material from this document must be requested and authorised in writing from Fichtner Consulting Engineers. Authorised reproduction of material must include all copyright and proprietary notices in the same form and manner as the original and must not be modified in any way. Acknowledgement of the source of the material must also be included in all references.

Management Summary

Humber Resources Group Ltd (HRG) is applying to the Environment Agency (EA) under the Environmental Permitting Regulations (EPRs) for an Environmental Permit (EP) to operate a thermal waste treatment facility, to be known as the Humber Gate Waste Treatment Facility (the Facility). The Facility will comprise of a waste reception area, feed system, counter-current rotary kiln, and a vertical post-combustion chamber. The Facility will be located at Humber Gate, Grimsby, DN31 2TT.

To meet the latest standards for energy efficiency, the Environment Agency (EA) requires an assessment of how heat is used in a Combined Heat and Power (CHP) setup, both technically and economically. Under the Environmental Permitting Regulations, facilities must show they are using the Best Available Techniques (BAT) when it comes to exporting heat to nearby users. If there are no existing heat supply contracts, this is usually demonstrated through a CHP assessment. This report, therefore, provides a Heat and Power Plan that assesses how the Facility meets the EA's CHP-Ready guidance and BAT requirements.

The Facility will treat up to 29,500 tonnes per annum of hazardous waste, with a design throughput of 3.5 tonnes per hour. Based on a net calorific value (NCV) of 17.8 MJ/kg, the plant will have a net rated thermal input of 17.8 MW and will be capable of exporting up to approximately 1.059 MWe to the National Grid after accounting for parasitic load. The Facility is being designed as CHP-Ready to allow future heat export to nearby consumers.

This assessment identifies local heat users and estimates an annual average heat demand of 14 MW. While no formal contracts are yet in place, active discussions with the developers of a nearby steam network are ongoing. The plant's design includes turbine steam extraction and space reserved for CHP infrastructure to support future integration.

In accordance with the EA's CHP-Ready Guidance, the Facility demonstrates Best Available Techniques (BAT) by maximising energy efficiency through the potential integration of Combined Heat and Power (CHP). The Facility achieves a boiler efficiency of 75.7%, which is within the BAT-Associated Energy Efficiency Level (BAT-AEEL) range of 60–80% for hazardous waste incineration, as specified in the Waste Incineration BREF (2019).

The Facility is located close to a proposed steam heat network, for which HRG is in active discussions with developers. The design includes technical provisions to supply up to 16 MWth of high-pressure steam to this network and return 2 MWth of condensate. Although no formal contracts are currently in place, this nearby heat network is considered the primary heat offtake option, which is considered viable subject to future commercial agreements.

The Facility will be capable of meeting the average annual heat demand of 14 MWth for the steam network option, and the turbine is designed to extract steam at 12 bar and 188 °C for external supply. Design features include steam bleeds and safeguarded space for CHP equipment to enable future heat export with minimal modification. However, under the latest Combined Heat and Power Quality Assurance (CHPQA) criteria, the Facility does not qualify as 'Good Quality CHP' due to the high efficiency thresholds introduced in the most recent guidance. The calculated Quality Index (QI) is 89.97, below the 105 threshold required at the design stage.

As the Facility has a rated thermal input below 20 MW, it is exempt from the requirement to undertake a full Cost-Benefit Assessment (CBA) under Article 14 of the Energy Efficiency Directive. Therefore, a full CBA has not been completed.

Based on the findings of this assessment, the Facility meets the technical criteria set out in the EA's CHP-Ready Guidance. The plant will be constructed to allow future CHP operation, demonstrating that it represents BAT for energy efficiency and heat export.

Contents

Management Summary	3
1 Introduction.....	6
1.1 Background	6
1.2 Objective	6
1.3 The Location.....	6
2 Conclusions.....	7
2.1 Technical Solution	7
2.2 Potential Heat Consumers	7
2.3 Heat Network Profile	7
2.4 Energy Efficiency	7
2.5 CHP-Ready Assessment.....	7
3 Legislative Requirements	9
3.1 CHP-Ready Guidance.....	9
3.2 Energy Efficiency Directive.....	10
4 Description of the Facility Technology	11
4.1 Energy Recovery.....	12
4.2 Details of Input Waste.....	12
4.3 Details of Heat Supply System	12
5 Heat Demand Investigation.....	14
5.1 Heat network option.....	14
5.2 Estimated Overall Heat Load.....	14
6 Heat Network Technical Solution.....	15
6.1 Heat Network Profile	15
6.2 Heat Network Design	15
6.3 Back-up Heat Sources	16
6.4 Considerations for Pipe Route	16
6.5 Implementation Timescale	16
7 Energy Efficiency Calculations	18
7.1 Heat and Power Export	18
7.2 CHPQA Quality Index.....	18
7.3 BAT 20 of WI BREF - Boiler Efficiency.....	19
Appendices	20
A Pipe Route to the steam network	21

1 Introduction

1.1 Background

Humber Resources Group Ltd (HRG) is applying to the Environment Agency (EA) under the Environmental Permitting Regulations (EPRs) for an Environmental Permit (EP) to operate a thermal waste treatment facility, to be known as Humber Gate Waste Treatment Facility (the Facility). The Facility will comprise of a feed system, counter-current rotary kiln, and a vertical post-combustion chamber. The Facility will be located at Humber Gate, Grimsby, DN31 2TT.

1.2 Objective

The principal objectives of this study are to:

1. Prepare a CHP Assessment in accordance with the Environment Agency (EA) CHP-Ready Guidance to support an application for an Environmental Permit (EP) under the Environmental Permitting (England and Wales) Regulations.
2. Describe the technical design and operation of the proposed Facility, including its energy recovery systems and capability for future Combined Heat and Power (CHP) integration.
3. Identify potential local heat consumers and assess their estimated heat demand profiles and compatibility with the Facility's heat export capabilities.
4. Evaluate the technical feasibility of connecting the Facility to a proposed nearby steam heat network and/or other heat users.
5. Calculate heat demands based on identified heat consumers and assess the feasibility of connecting identified heat consumers to the network.
6. Calculate the Facility's boiler efficiency and assess compliance with the Best Available Techniques (BAT) energy efficiency levels set out in the Waste Incineration BREF (2019).
7. Outline the proposed steam supply system, including indicative pipework design and routing from the Facility to the connection point of the heat network.
8. Assess the potential for future CHP operation based on technical readiness, energy efficiency, and engagement with potential heat users, in line with EA guidance and applicable legislative thresholds.

1.3 The Location

The Site address is Humber Gate, Grimsby, DN31 2TT. The grid reference for the centre of the Site is NZ 523644 412867. The Site will be located on approximately 24 acres of land. The site is approximately 350m southwest of the Humber Estuary and 4.5km to the northwest of the town of Grimsby. The nearest residential properties are approximately 2km northwest to the Site.

A site location plan and Installation Boundary drawing are presented in Appendix A of the Supporting Information.

2 Conclusions

2.1 Technical Solution

The Humber Gate Waste Treatment Facility has been designed to generate electricity and, in the future, export heat to a local steam network. It will operate as a high-efficiency hazardous waste incinerator, recovering energy via a rotary kiln, post-combustion chamber, and a steam turbine. The plant includes design features to support Combined Heat and Power (CHP) integration, such as turbine steam bleeds and space for CHP equipment, allowing for future heat supply with minimal changes.

2.2 Potential Heat Consumers

A proposed local steam network located less than 100 metres from the Facility's boundary. Although no formal heat supply contracts are in place, discussions are ongoing with the steam network developer, and both opportunities are considered technically and commercially viable.

2.3 Heat Network Profile

The nearby heat network is expected to have a steady thermal demand of around 16 MWth, suitable for supply via turbine-extracted steam at 12 bar and 188 °C. The Facility is capable of supplying this demand and returning 2 MWth condensate at 85 °C and 3.5 bar. A projected net annual heat export of approximately 111,426 MWh (14 MW average) is achievable under the current design.

2.4 Energy Efficiency

The Facility's boiler achieves an efficiency of 75.7%, placing it comfortably within the BAT-Associated Energy Efficiency Levels (BAT-AEELs) of 60–80% for hazardous waste incineration, as defined by BAT 20 of the Waste Incineration BREF (2019). This demonstrates full compliance with the Industrial Emissions Directive (IED) energy efficiency requirements.

A Combined Heat and Power Quality Assurance (CHPQA) Quality Index (QI) of 89.97 was calculated for the heat export scenario. While this does not meet the 'Good Quality CHP' threshold (QI ≥ 105), the result reflects recent changes to CHPQA criteria and is consistent with industry-wide challenges under the new, more stringent standards.

2.5 CHP-Ready Assessment

The Facility meets all technical criteria set out in the Environment Agency's CHP-Ready guidance. It has been designed to:

- Export steam to a heat network with minimal future modifications.
- Include infrastructure such as turbine steam bleeds and safeguarded space for heat supply systems.
- Support future connection to identified consumers once formal agreements are established.

Although the Facility's net thermal input is below the 20 MW threshold that triggers a formal Cost-Benefit Assessment (CBA) under Article 14 of the Energy Efficiency Directive. Therefore, a full CBA has not been completed.

Based on the above, the Facility is considered CHP-Ready and represents Best Available Techniques (BAT) in line with the EA's requirements for energy efficiency and future heat supply.

3 Legislative Requirements

3.1 CHP-Ready Guidance

In February 2013, the Environment Agency (EA) issued guidance titled 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants'. This guidance applies under the Environmental Permitting (England and Wales) Regulations 2016 to:

- New combustion power plants with a gross rated thermal input of 50 MW or more.
- New Energy from Waste (EfW) facilities processing more than 3 tonnes per hour of non-hazardous waste or more than 10 tonnes per day of hazardous waste.

As the Facility will process more than 3 tonnes per hour of waste, it falls within the scope of this guidance and must meet CHP-Ready requirements.

The EA requires operators to demonstrate compliance with Best Available Techniques (BAT), including for energy efficiency. One of the key methods for achieving this is through the use of Combined Heat and Power (CHP). The guidance outlines three BAT-related tests for CHP-Ready status:

1. Demonstrate CHP-Readiness in the Environmental Permit Application

Applicants must show that the plant will either:

- Use CHP from the outset, or
- Be designed to allow for future CHP integration with minimal changes.

The Facility has explored local opportunities for heat use (Sections 5 and 6) and identified a potential steam network. While no contracts with heat users are currently in place, Section 7.3 confirms that the Facility complies with the Industrial Emissions Directive (IED), including BAT standards set out in the Waste Incineration BREF (2019). The boiler achieves an efficiency of 75.7%, which is within the required BAT-AEEL range of 60–80% for new hazardous waste incineration plants.

2. Design the Plant to Be CHP-Ready with Minimal Modification

The Facility will be designed to allow for future heat supply with minimal modifications. This includes:

- Integrating steam bleeds in the turbine for future heat export.
- Safeguarding space within the plant for the installation of CHP equipment.

3. Conduct Periodic Reviews of Heat Supply Opportunities

Humber Resources Group Ltd is committed to carrying out regular reviews of potential heat users to support future implementation of CHP as opportunities arise.

4. EA CHP-Ready Assessment Limitations

The Environment Agency assesses CHP-Ready status primarily by looking at combustion and electrical generation efficiency. This approach is generally suited to non-hazardous waste incineration technologies. As such, it may not be fully applicable to hazardous waste facilities like this one, where different technical and operational factors apply.

3.2 Energy Efficiency Directive

Since 21 March 2015, operators of certain types of combustion installations have been required to undertake a cost-benefit analysis (CBA) of opportunities for combined heat and power (CHP) when applying for an Environmental Permit (EP). This requirement falls under Article 14 of the Energy Efficiency Directive and applies to various categories of combustion installations.

In April 2015, the Environment Agency (EA) issued draft guidance titled *'Draft Guidance on Completing Cost-Benefit Assessments for Installations under Article 14 of the Energy Efficiency Directive'*¹ to assist operators in fulfilling this requirement.

As a new electricity generation installation, the Facility has a total aggregated net thermal input of 17.8 MW, which **falls below the 20 MW threshold** outlined in Table 1 of the EA's draft guidance. Therefore, a full CBA has not been completed.

¹ Draft guidance on completing cost-benefit assessments for installations under Article 14 of the Energy Efficiency Directive, V9.0 April 2015

4 Description of the Facility Technology

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, with the potential to export heat subject to commercial and economic viability.

The Facility will include the following key components/infrastructure:

- waste reception and storage areas;
- various waste feeding systems;
- counter-current rotary kiln furnace;
- high temperature secondary combustion zone;
- reagent and raw material tanks and silos;
- residue silos and storage areas (including wastewater storage facilities);
- water, fuel oil and air supply systems;
- boilers;
- steam turbine/generator set;
- facilities for the treatment of exhaust or flue gases;
- flues with associated stack; and
- devices and systems for controlling combustion operations and recording and monitoring conditions.

In addition to the following ancillary equipment/infrastructure:

- offices, control room and staff welfare facilities;
- site fencing, security barriers, gates and landscaping;
- drainage infrastructure;
- lighting and CCTV;
- external hard standing areas for vehicle manoeuvring/parking;
- internal access roads and car parking;
- transformer and sub-station enclosure; and
- fire water tank and water treatment plant.

The Facility will have a design gross thermal input capacity of approximately 20 MWth (based on gross calorific value) and 17.801 MWth (based on net calorific value). It is designed to export electricity to the National Grid, generating up to approximately 1.64 MWe. With a parasitic load of approximately 0.579 MWe, the net power export capacity at average ambient temperature will be around 1.059 MWe. Exported power levels may fluctuate depending on waste quality, ambient temperatures, and future heat export operations.

The Facility will be constructed as "CHP Ready" and will have the capacity to export up to 16 MWth of steam heat to a nearby steam heat network central hub. GRG is actively engaging with potential heat users; however, no formal agreements for heat export have been established at the time of writing.

The Facility is designed to process up to approximately 29,500 tonnes of waste per year, equivalent to 88 tonnes per day. The nominal design case assumes 3.5 tonnes per hour, a design net calorific value (NCV) of 17.8 MJ/kg, and an operational availability of 8,000 hours per year and equivalent to nominal yearly throughput of 28,037 tonnes per year.

4.1 Energy Recovery

The heat generated from the combustion of incoming waste will be recovered through a water tube boiler, integrated into the furnace. This boiler will produce saturated steam at approximately 215 °C and 21 bar(a). The steam will be supplied to a steam turbine and generator set to produce electricity. A portion of the steam, bypassing the turbine, will be used to preheat water within the steam cycle.

Following expansion through the turbine, the remaining steam will condense to create the necessary pressure drop to drive the turbine. The exhaust steam, initially in the form of wet steam, will primarily be condensed and cooled using an air-cooled condenser. The resulting condensate will then be returned as feedwater to the boiler via a closed-circuit pipework system.

Subject to the demands of potential heat users, high-pressure steam can be extracted from the turbine and piped directly for external use. The volume of steam extracted will vary depending on the heat load requirements. It should be noted that, at the time of writing, no formal agreements have been established for the export of heat from the Facility.

4.2 Details of Input Waste

Table 1: Expected Facility input waste characteristics

Parameter	Unit	Value
Nominal waste throughput	tpa	28,037
Proposed NCV	MJ/kg	17.80
Proposed GCV	MJ/kg	20.00

4.3 Details of Heat Supply System

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.

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

1. Heat recovery from the condenser

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.

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 reduces the plant power efficiency and power revenues. Humber Resources Group are currently exploring the use of heat from the condensate return to use for a novel plate flash evaporator process for reuse of treated wet scrubber effluent. This will further reduce the requirement on local water supplier of the facility.

2. Heat extraction from the steam turbine

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.

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.

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

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.

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.

Based on these considerations, the most favourable solution for supplying heat to the proposed network is via steam extraction from the turbine. This approach is preferred for the following reasons:

1. The heat requirements of the identified consumers (as described in section 5.2) are too high to be met by low-grade heat recovered from turbine exhaust steam.
2. The use of a flue gas condenser would result in a persistent visible plume, significantly impacting the Facility's visual profile, and has therefore been excluded from consideration.
3. Steam extraction from the turbine offers the greatest flexibility to meet varying heat quality and quantity demands, including the potential for future expansion.
4. Steam extraction systems are well-established, highly efficient, and based on proven technology.

5 Heat Demand Investigation

5.1 Heat network option

The Facility is located at Humber Gate, Grimsby, DN31 2TT, occupying approximately 24 acres of land. It is situated around 350 metres southwest of the Humber Estuary and approximately 4.5 kilometres northwest of Grimsby town centre. The nearest residential properties are located roughly 2 kilometres northwest of the Site.

GRG is actively engaging with potential heat users to develop a heat export scheme from the Facility. The Facility is located close to a prospective steam heat network, which would require steam at 12 bar pressure.

To facilitate heat export, steam generated at 21 bar and approximately 214.9 °C will first pass through a steam turbine to generate electricity for onsite use, reducing the pressure to 12 bar for export to the heat network. The turbine will produce approximately 346 kW of electricity for the Facility's internal consumption.

The steam input to the turbine will be 20,654 kg/hr at 21 bar and 214.9 °C, and the output, after energy extraction, will remain at 20,654 kg/hr but at 188 °C and 12 bar, ready for export to the heat network. The condensate will be return at 85 °C and 3.5 bar.

For the purposes of this assessment, the nearby steam heat network is considered the primary potential heat consumer. Although no formal contracts with specific users are currently in place, it is assumed that the annual average heat demand for the steam network will be approximately 14 MWth. The Facility will be technically capable of meeting this demand, subject to economic and commercial feasibility.

Discussions with the steam network developers are already happening, but no final agreement has been made yet. If these talks are successful, they will lead to the creation of a heat supply agreement and detailed design for the necessary pipes. A full economic review will also be needed to look at the costs of installing the pipework and the loss of electricity income, to work out a fair heat price. However, without an Environmental Permit (EP) for the Facility, it is not yet possible to make any firm commitments to supplying heat.

5.2 Estimated Overall Heat Load

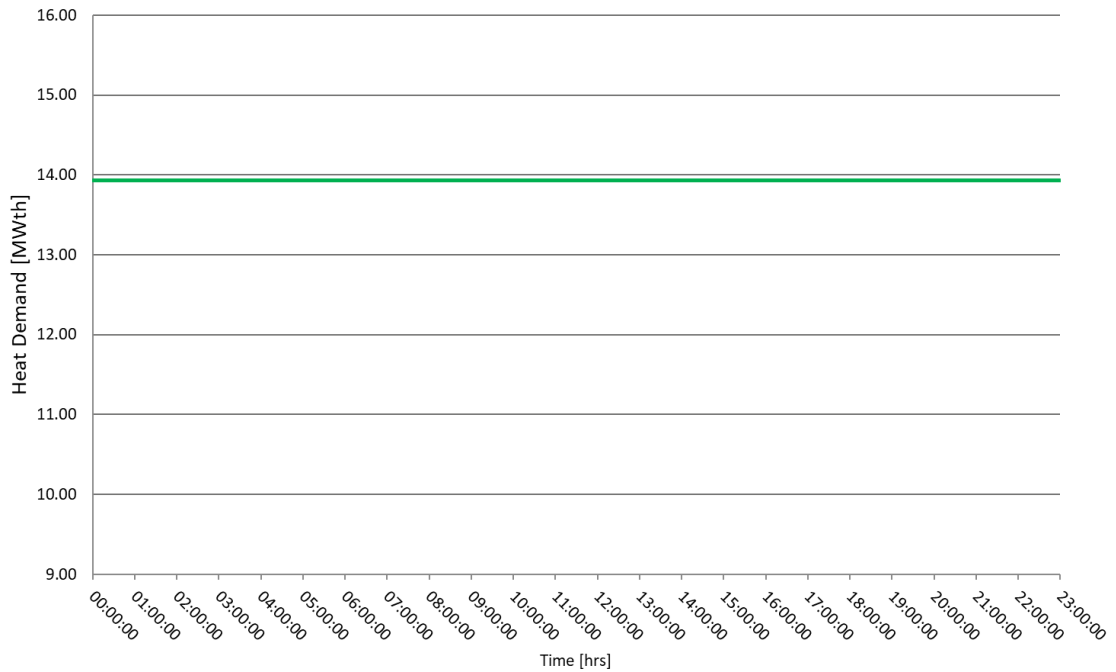
The Facility is expected to export up to 127,773 MWh of steam annually to the steam heat network, corresponding to an average thermal output of 16 MW. The anticipated condensate return is 16,348 MWh per year, with an average thermal input of 2 MWth. This results in a net heat export of approximately 111,426 MWh per year, equivalent to an average of 14 MW.

6 Heat Network Technical Solution

6.1 Heat Network Profile

The heat network profile the steam heat network is shown in Figure 1 and illustrates the constant heat demand that is anticipated. The profile represents heat demand at the Facility boundary.

Figure 1: Heat network profile



The total annual heat export and average instantaneous network values are projected in Table 2.

Table 2: Proposed heat network demand - Supply from Facility

Annual Heat Load	MWh/a	111,426
Average heat demand	MW _{th}	13.93

6.2 Heat Network Design

The steam from the Facility's turbine will be delivered to a connection point managed and owned by the steam network operator. From there, the steam will be distributed to individual heat users by the operator. A condensate return system will also be in place to return condensate from the network back to the Facility.

The design criteria for the steam delivery pipeline are provided in Table 3 .

Steam entering the turbine will be at 20,654 kg/hr, with a pressure of 21 bar and a temperature of 214.9 °C. After energy extraction, the steam will exit the turbine at the same flow rate (20,654 kg/hr), but at a reduced pressure of 12 bar and temperature of 188 °C, ready for supply to the heat network. The returning condensate will be at 85 °C and 3.5 bar.

Table 3: Steam piping design criteria

Parameter	Value
Steam supply to steam network	188°C, 12 bar
Condensate return	85 °C, 3.5 bar.
Length of pipe required	100 m
Estimated heat demand	13.93 MW
Steam pipe size (indicative)	DN 250
Condensate pipe size (indicative)	DN 80

Based on the estimated heat demand and the design parameters above, the proposed pipe sizes are DN250 for the steam delivery and DN80 for the condensate return. These sizes are indicative and will be confirmed following detailed heat demand verification and final network design.

6.3 Back-up Heat Sources

The Facility is designed to achieve an availability rate of 91.3% (equivalent to approximately 8,000 operational hours per year). During periods of routine maintenance or unexpected outages, the Facility will be offline, but heat demand from consumers will remain. Therefore, it is essential to provide a back-up heat source within the steam distribution network to maintain continuous service.

At the scale of the heat network under consideration, the back-up system will likely consist of oil- or gas-fired hot water boilers, each with a dedicated chimney stack. These back-up boilers will be designed to meet the peak heat export capacity while offering sufficient turndown capability to efficiently handle lower summer demands. Electric boilers may also become a viable option in the future as technology and economics evolve.

The back-up plant will be located outside the Facility’s boundary and will be installed and operated by the steam network operator.

6.4 Considerations for Pipe Route

Steam will be delivered via a direct pipeline—referred to as "48" to the local heat network infrastructure, maintaining a pressure of 12 bar. The proposed pipeline connection point is located less than 100 metres from the Facility’s boundary, as shown in the attached drawing.

At this stage, a definitive route for the pipeline connection between the Facility and the steam network has not been established, as no formal agreements are currently in place. An indicative pipe route is, however, provided in Appendix A.

6.5 Implementation Timescale

The table below outlines an indicative programme for the construction of the Facility and associated heat network.

Pipeline installation will not begin until a core group of heat consumers within the steam network has been identified and formal heat supply agreements have been secured. The proposed timetable includes allowances for obtaining planning consent, discharging planning conditions, negotiating heat supply contracts, and incorporates a nominal contingency to account for potential delays in Facility construction.

Table 4: Implementation programme

Description	Schedule (from Day 1)
Obtain Permitting for the Facility	Day 1
Completion of Negotiation for Heat Supply Contracts	+6 months
Start of Construction of plant	+9 months
Submit planning application for heat mains	+18 months
Start of commissioning of the Facility	+30 months
Take Over of the Facility	+36 months
Completion of Construction on Heat System	+46 months
Testing & Commissioning of Heat Network	+47 months
Start-up of the Heat Supply	+48 months

7 Energy Efficiency Calculations

7.1 Heat and Power Export

The Z ratio, which is the ratio of the reduction in power export to the increase in heat export, can be used to assess how variations in heat export affect the Facility’s electrical output. A Z ratio of 11.06 was calculated by using the technology provides heat and mass balance.

The heat and power export has been modelled across a range of load cases and the results are presented in Table 5.

Table 5: 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	1.64	1.06	N/A
2. Steam network heat load	13.93	0.35	0.00	11.06

The results show that, for the heat consumers identified in section 5.1, a heat export of 13.93 MW_{th} to the steam network would result in a gross power generation of 0.35 MWe, with no net power exported from the Facility.

7.2 CHPQA Quality Index

The Combined Heat and Power Quality Assurance (CHPQA) programme is a UK Government initiative promoting best practice in energy efficiency. CHPQA aims to monitor, assess, and improve the performance of CHP (Combined Heat and Power) schemes across the UK.

To qualify as a ‘Good Quality’ CHP plant under the programme, a Quality Index (QI) of at least 105 must be achieved at the design, specification, tendering, and approval stages. Once operational, the threshold reduces slightly, requiring a minimum QI of 100.

The QI is calculated as a function of a scheme’s power and heat efficiencies, using the following formula:

$$QI = X\eta_{power} + Y\eta_{heat}$$

where:

- η_{power} = power efficiency (based on gross electrical output and the gross calorific value of the input fuel); and
- η_{heat} = heat efficiency (also based on the gross calorific value of the input fuel)

The coefficients X and Y are defined by CHPQA and vary depending on the scheme’s total gross electrical capacity, fuel type, and technology type.

In March 2021, the Government issued a revised CHPQA Standard (Issue 8), introducing updates aimed at ensuring that supported schemes deliver meaningful energy savings and significant heat supply.

For the Facility, the applicable CHPQA coefficients are:

- X value = 370; and

- Y value = 120.

The QI and associated efficiency values have been calculated based on a fuel gross calorific value of 20.55 MJ/kg. Results for different operating load cases are presented below in Table 6.

Table 6: QI and efficiency calculations

Load case	Gross power efficiency (%)	Heat efficiency (%)	Overall efficiency (%)	CHPQA QI
1. No heat export	8.02	0.00	8.19	29.69
2. Steam network heat load	1.73	69.64	71.37	89.97

The results show that under the modelled conditions, the Facility would not meet the ‘Good Quality’ CHP threshold (QI of 105 at the design stage) for the steam network heat load scenario.

This outcome reflects the stringent efficiency criteria introduced in the latest CHPQA guidance, which mean that none of the considered load cases allow heat export from the Facility to qualify as Good Quality under the scheme.

7.3 BAT 20 of WI BREF - Boiler Efficiency

The Industrial Emissions Directive (IED), adopted on 7 January 2013, is the main EU law that regulates industrial activities across Europe. Under this directive, each industry sector has a guidance document called a BREF, which sets out what is considered Best Available Techniques (BAT). The BREF for Waste Incineration (WI BREF) was published in 2019 and includes the BAT Conclusions in section 5.

BAT 20 in the WI BREF sets standards for energy efficiency, known as BAT-Associated Energy Efficiency Levels (BAT-AEELs). For new plants that incinerate hazardous waste (excluding hazardous wood waste) and sewage sludge, these efficiency levels are expressed as boiler efficiency.

According to BAT 20, the required boiler efficiency for new hazardous waste incineration plants is between 60% and 80%. Boiler efficiency is defined as the ratio of energy produced by the boiler (like steam or hot water) to the energy content of the waste and any additional fuel used, based on their lower heating values.

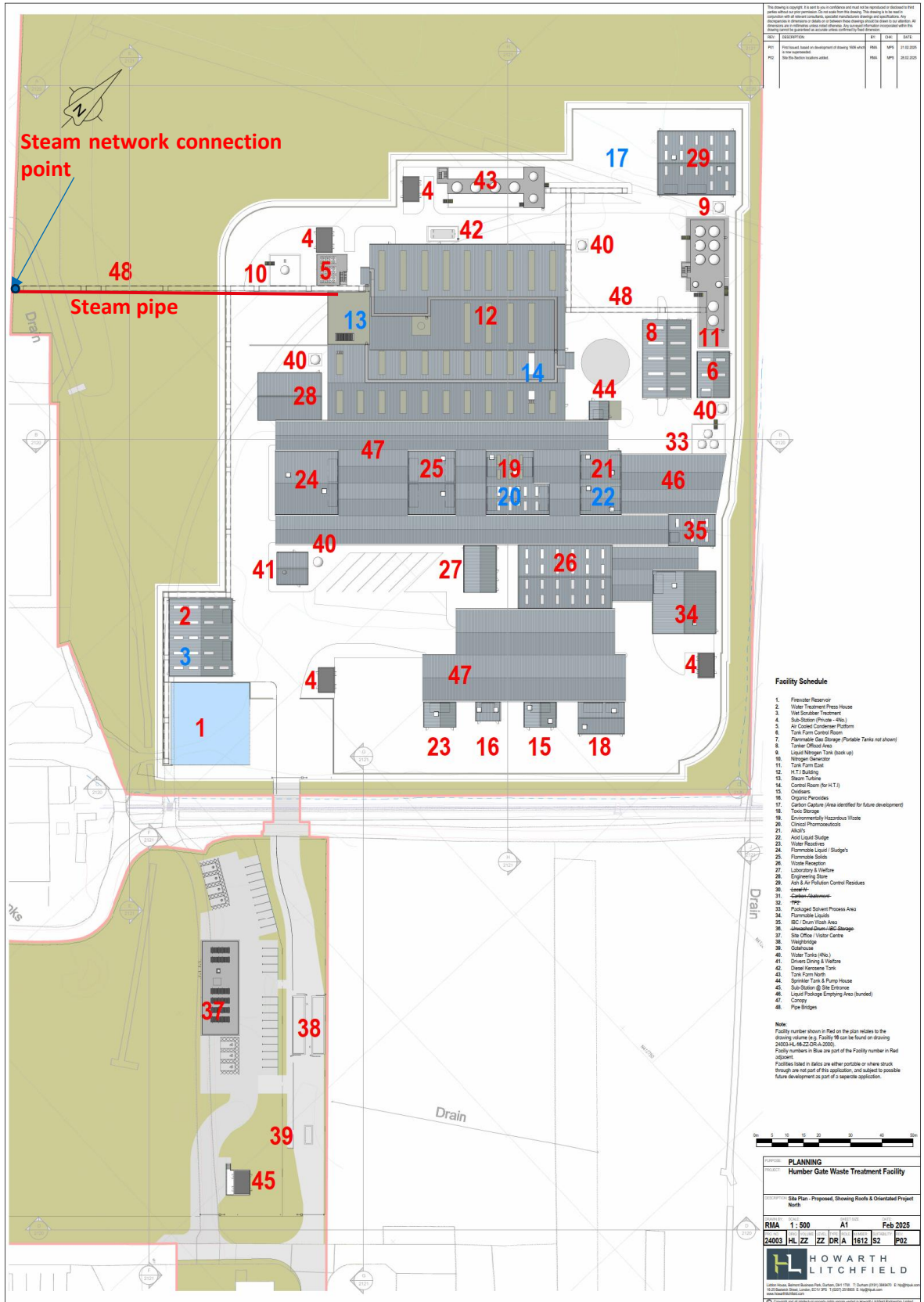
Table 7 shows that the facility’s boiler efficiency for each operating scenario falls within this required range of 60–80%, demonstrating compliance with BAT-AEELs.

Table 7: BAT 20- Boiler Efficiency

Load Case	Waste thermal input (NCV) MW	Boiler energy output MW	Boiler Efficiency (%), NCV	BAT-AEEL (%)
1. No heat export	17.8	13.5	75.7	60 - 80
2. Annual average heat export to steam network	17.8	13.5	75.7	60 - 80

Appendices

A Pipe Route to the steam network



ENGINEERING  CONSULTING

FICHTNER

Consulting Engineers Limited

Kingsgate (Floor 3), Wellington Road North,
Stockport, Cheshire, SK4 1LW,
United Kingdom

t: +44 (0)161 476 0032

f: +44 (0)161 474 0618

www.fichtner.co.uk