FICHTNER

Consulting Engineers Limited

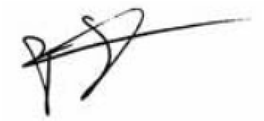
Redcar Energy Centre

Redcar Holdings Ltd

CHP Assessment

ENGINEERING + CONSULTING

Document approval

	Name	Signature	Position	Date
Prepared by:	Vildan Taylor		Associate Senior Consultant	28/06/2023
Checked by:	James Sturman		Lead Consultant	28/06/2023

Document revision record

Revision no	Date	Details of revisions	Prepared by	Checked by
00	10/02/2022	For client review	VBT	JRS
01	29/03/2022	Minor updates following Client comments	KLH	JRS
02	28/06/2023	Updated terminology following Duly Making request	KLH	JRS

Management Summary

Redcar Holdings Limited (herein referred to as Redcar) (the Applicant) is applying to the Environment Agency (EA) under the Environmental Permitting (England and Wales) Regulations 2016 (EPR) for an Environmental Permit (EP) to operate the Redcar Energy Centre (REC), which will comprise a fuel preparation facility, an Energy Recovery Facility (ERF) and an Incinerator Bottom Ash recycling facility (IBA facility), in Redcar & Cleveland Borough Council. This purpose of this report is to undertake a CHP-ready assessment for the ERF.

The ERF will be fuelled by pre-processed municipal and commercial & industrial non-hazardous waste (herein referred to as waste). The waste accepted at the ERF will be a mix of directly delivered waste and waste received from the adjacent fuel preparation facility.

Assuming a design NCV of 10.50 MJ/kg, the ERF will process approximately 450,000 tonnes per annum (at the design capacity of 56.25 tph, assuming 8,000 hours availability). It is expected that the maximum capacity of the ERF will be approximately 500,000 tonnes per annum.

The ERF has been designed to export power to the National Grid. The ERF will generate approximately 49.9 MW_e of electricity in full condensing mode with a parasitic load of approximately 4.99 MW_e. Therefore, the export capacity of the ERF, will be approximately 44.9 MW_e.

The Environment Agency (EA) Combined Heat and Power (CHP) Ready Guidance requires Best Available Techniques (BAT) to be demonstrated by maximising energy efficiency.

The South Tees Development Corporation (Teesworks), which incorporates REC, was launched in August 2017. The Teesworks covers 4,500 acres of prime land south of the River Tees in the borough of Redcar and Cleveland, including the site of the former Teeside Steel Works, and is considered to be the single biggest development opportunity in the UK today. For the purposes of this assessment the Teesworks is considered to be the potential heat consumer. There are no fixed contracts in place with specific heat users; however, it is assumed that the heat demand for the an annual average heat load of Teesworks is approximately 10 MW_{th}. The ERF will be technically capable of meeting this heat demand for Teesworks, subject to economic and commercial feasibility. The maximum heat capacity of the ERF will be confirmed during detailed design and will be set as a minimum to meet the requirements of the heat consumers identified. In the event that the heat demand of the Teesworks is more than 10 MW_{th}, the design of the ERF may need to be reconfigured to enable the additional heat export, and this would be subject to reaching appropriate commercial agreements with the relevant heat users.

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 for the ERF 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 20.5 % and the CHPQA Quality Index (QI) score was 64.9. 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.

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 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 the Environment Agency's CBA template 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 53.1 % and £8.32 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 need to be reassessed when there is certainty regarding the heat loads. The assessment will also need to into account any subsidies that might become available in the future to support the export of heat. Taking the above into consideration and given the current status of the Teesworks, the ERF will be constructed as CHP-Ready.

Therefore, it is considered that construction of the ERF as CHP-Ready demonstrates that the ERF represents BAT for the export of heat. A CHP Ready Assessment form has been completed and is provided in Appendix D of this report.

CHP-Ready means that the ERF 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 to house CHP equipment.

Contents

1 Introduction

1.1 Background

Redcar Holdings Limited is looking to develop the Redcar Energy Centre (REC) in Redcar, Teesside. The energy centre will constitute the following facilities.

1. A fuel preparation facility that will treat incoming waste to produce a residual waste-derived fuel.
2. An Energy Recovery Facility (ERF) that will process residual waste to produce electrical power (with the potential to export heat) using a mass-burn grate and boiler.
3. An incinerator bottom ash (IBA) recycling facility which will convert the waste ash from the ERF (in addition to other materials delivered directly to the IBA facility) into secondary aggregate.

As the ERF is the only facility which will generate heat, it is the only facility which has been considered within this CHP assessment.

1.2 Objective

The principal objectives of this study are to:

1. Prepare a CHP Assessment in line with the Environment Agency (EA) guidance on cost-benefit assessment (CBA) for combustion installations, which will support an Environmental Permit (EP) application.
2. Provide a technical description of the proposed ERF and heat export infrastructure.
3. Calculate heat demands based on identified heat consumers and assess the feasibility of connecting identified heat consumers to the network.
4. Based on the heat loads anticipated for the outline solution identified, calculate relevant energy efficiency measures to demonstrate legislative compliance.
5. Produce provisional pipe routing drawing from the ERF to the likely heat consumers.
6. Conduct an economic assessment feeding into the CBA as required under Article 14 of the Energy Efficiency Directive.
7. 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.

1.3 The Location

REC will be located on approximately 10 hectares of land at the Redcar Bulk Terminal, approximately 4.5 km west of Redcar town centre and 8.5km northeast of Middlesbrough city centre.

REC will be located at an approximate National Grid Reference of NZ 55890 26032, with the nearest postcode listed as TS10 5QW.

The site was previously heavily industrialised as it formed part of the former Teesside Steel Works (the Steel Works). The Redcar Bulk Terminal was used for the shipment of coal, coke and other bulk goods, and for importing iron ore.

The eastern boundary of the site is formed by coke ovens associated with the Steel Works, with a further area of the Steel Works located to the southeast of the site. The north and northeast boundaries of the site are formed of a high earth bund, beyond which lies an area of sand dunes which are part of the Bran Sands. The western boundary of the site is not enclosed or marked but a further storage area of the Redcar Bulk Terminal and the Tees Estuary lies beyond it.

Access to REC will be via a series of internal access roads which serve the industrial area, with a link to the A1085 which provides a strategic access to Middlesbrough and beyond via the A19.

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

2 Conclusions

2.1 Technical Solution

The ERF will have a gross electrical output of 49.9 MWe, (design when operating in fully condensing mode), with a parasitic load of approximately 4.99 MW_e with the balance exported to the National Grid. Therefore, the ERF will export approximately 44.9 MW_e in fully condensing mode. The ERF will be designed with the capability to export approximately 10 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 10 MW_{th}, resulting in an average gross electrical generation of approximately 48.4 MW_e.

A number of options for heat recovery and export from the ERF are available. Given the requirements of the heat consumers (refer to section 5), 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 ERF for reheating. This technology is well proven and highly efficient.

2.2 Potential Heat Consumers

A review of the potential heat demand within a 15 km radius of the ERF 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 ERF 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 existing 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.

Several large heat consumers (point heat demands greater than 5 MW_{th} as defined by the UK CHP Development Map) have been identified within the specified 15 km search radius. The large consumers identified were located a significant distance away from the ERF and scattered at different locations and would require a prohibitively costly pipe network to connect to each consumer. Therefore, these large heat consumers have been discounted. Nearby Wilton Power station, which is operated by Sembcorp has its own CHP plant; therefore, it has also been discounted.

The South Tees Development Corporation (Teesworks), which incorporates REC, was launched in August 2017. The Teesworks covers 4,500 acres of prime land south of the River Tees in the borough of Redcar and Cleveland, including the site of the former Teeside Steel Works, and is considered to be the single biggest development opportunity in the UK today. For the purposes of this assessment the Teesworks is considered to be the potential heat consumer. There are no fixed contracts in place with specific heat users; however, it is assumed that the heat demand for the an annual average heat load of Teesworks is approximately 10 MWth. The ERF will be technically capable of meeting this heat demand for Teesworks, subject to economic and commercial feasibility. The maximum heat capacity of the ERF will be confirmed during detailed design and will be set as a minimum to meet the requirements of the heat consumers identified. In the event that the heat demand of the Teesworks is more than 10 MWth, the design of the ERF may need to be reconfigured to enable the additional heat export, and this would be subject to reaching appropriate commercial agreements with the relevant heat users.

2.3 Heat Network Profile

The ERF will provide a constant rate of 10.0 MW_{th} heat, which is equivalent to an annual heat of 87,604 MWh/annum, including heat losses. Detailed techno-economic modelling will be undertaken when there is a better understanding of the final consumer heat demands within the Teesworks.

2.4 Economic Assessment

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 electricity revenue as a result of diverting energy to the heat network.

The results of the CBA indicate that the estimated £3.6 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 53.1 %, with a net present value of £8.32 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.

The detailed economic feasibility of the scheme will be reassessed in the future when the heat demands are confirmed, at which time a final decision will be made on connecting the development.

As construction of a district heating network is currently economically feasible, the ERF will initially be built to be CHP-Ready. A decision on progressing with the district heating network will be taken once the economic feasibility has been confirmed. As such, the ERF will meet the requirements of BAT tests outlined in the EA CHP Ready Guidance.

2.5 Energy Efficiency Measures

In order 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 ERF will achieve a primary energy saving (PES) of 17.81 %, 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 20.46 % which is in excess of the technical feasibility threshold and would therefore be technically feasible to supply.

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 62.8. 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.

2.6 CHP-Ready Assessment

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 assessment for the proposed heat network confirms it is economically viable at this stage, and constructing the ERF as CHP Ready is considered to represent BAT. This would enable the ERF to export heat when the heat loads have been confirmed and there are formal agreements in place with the potential heat users.

As CHP-Ready, the ERF will be designed to be ready, with minimum modification, to supply heat in the future. The EA CHP Ready Guidance in February 2013 states that given the uncertainty of future heat loads, the initial electrical efficiency 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 ERF will include steam capacity designed into the turbine bleeds to facilitate heat export in the future, and safeguarded space to house CHP equipment.

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

3 Legislative Requirements

3.1 CHP-Ready Guidance

In February 2013, the EA produced a guidance note titled 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants'[1]. This guidance applies to the following facilities, which will be regulated under the Environmental Permitting (England and Wales) Regulations 2016:

- new combustion power plants (referred to as power plants) with a gross rated thermal input of 50 MW or more; and
- 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.

The ERF 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.

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.

3.2 Energy Efficiency Directive

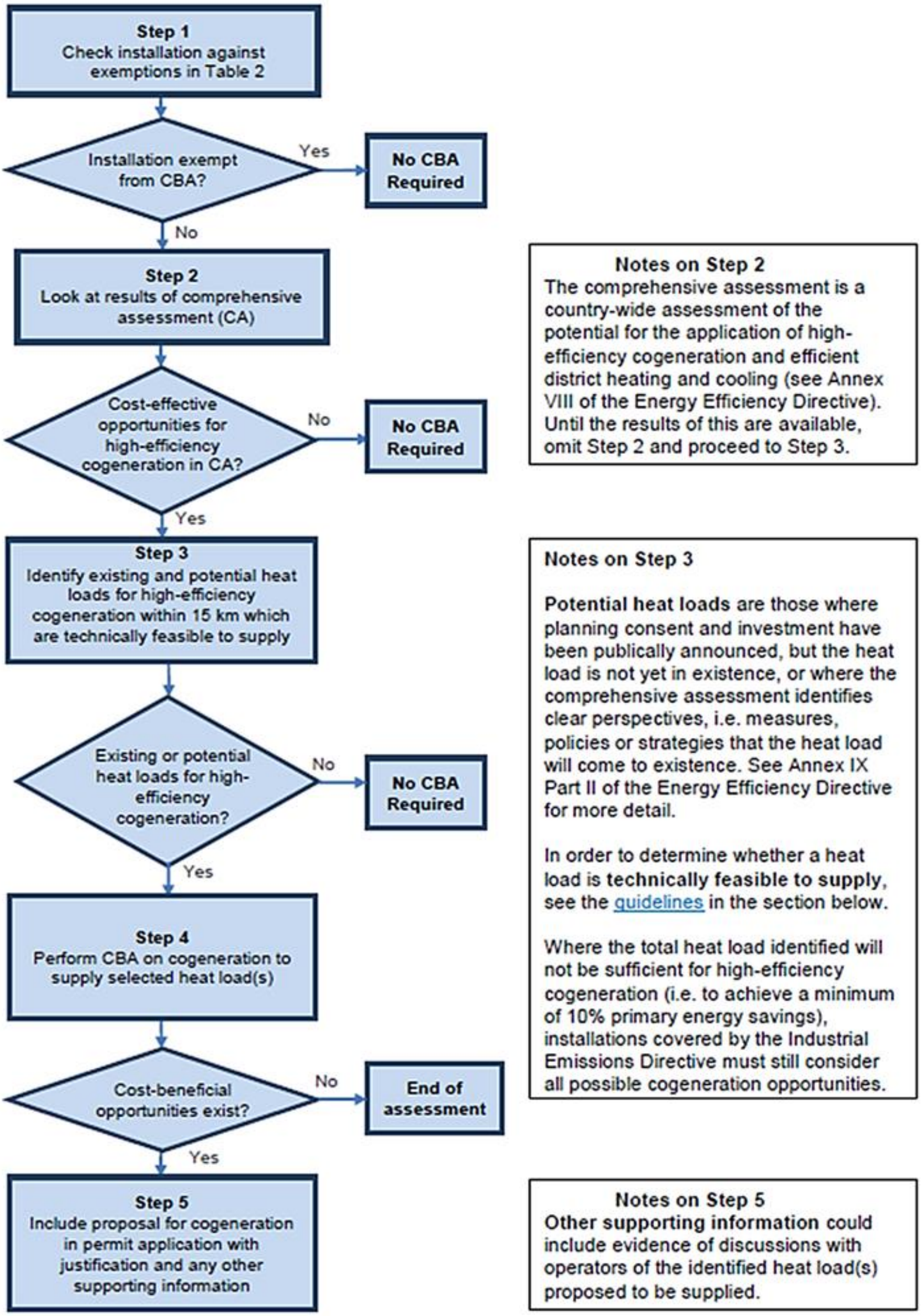
From 21 March 2015, operators of certain types of combustion installations are required to carry out a CBA of opportunities for CHP when applying for an EP. This is a requirement under Article 14 of the Energy Efficiency Directive and applies to a number of combustion installation types. As a new electricity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

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*'[2]. Figure 1 describes the process that must be followed for type 14.5(a) and 14.5(b) installations.

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

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

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



4 Description of the ERF Technology

4.1 The ERF

The main activities associated with the ERF will be the combustion of incoming non-hazardous 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 ERF will include the following key components/infrastructure:

- waste reception and storage areas;
- reagent and raw material tanks and silos;
- residue silos and storage areas (including wastewater storage facilities);
- water, fuel oil and air supply systems;
- two incineration lines;
- 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 ERF will have a design thermal input capacity (combined boiler capacity) of approximately 164 MWth. The ERF has been designed to export power to the National Grid. The ERF will generate up to approximately 49.9 MWe of electricity. The ERF will have a parasitic load of approximately 10% (approximately 4.99 MWe). Therefore, the export capacity of the ERF, with average ambient temperature, will be approximately 44.9 MWe. As the waste quality will fluctuate, and if heat is exported from the ERF to local heat users in the future, the power exported will fluctuate. The power exported will fluctuate also depending on the ambient temperature.

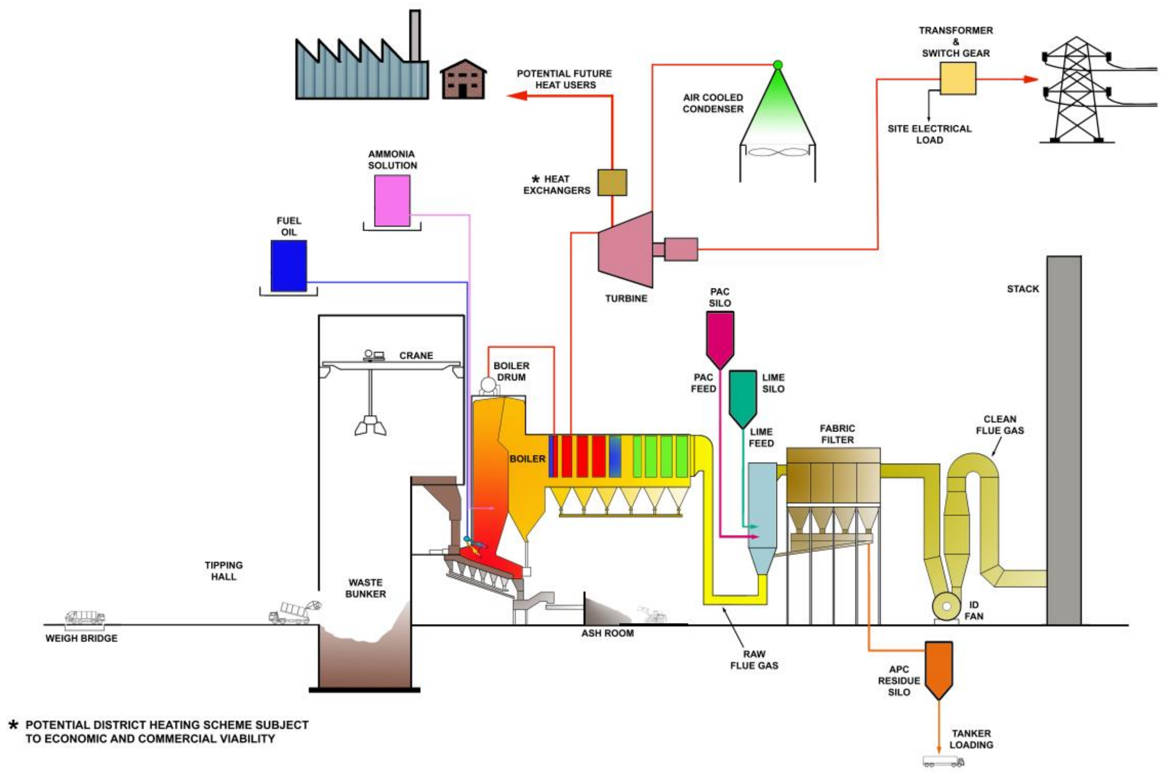
The ERF will be constructed as 'CHP Ready' and will have the capacity to export approximately 10 MWth of heat to the wider Teesworks. The maximum heat capacity will be confirmed during the detailed design stage and will be set as a minimum to meet the requirements of the heat consumers identified.

Based on the heat network identified within this Heat Plan, the heat export from the ERF to the Teesworks is expected to be constant at 10 MW_{th}, resulting in an average electrical export of approximately 43.4 MW_e. However, at the time of writing this report, there are no formal agreements in place for the export of heat from the ERF.

The ERF will be capable of approximately 450,000 tonnes per annum of waste, which is based on a processing capacity of 28.1 tonnes per hour per line with a design NCV of 10.5 MJ/kg and an availability of 8,000 hours. However, the ERF will be capable of processing wastes with a range of NCVs, typically between 7.5 – 11 MJ/kg. It is expected that the maximum capacity of the ERF will be approximately 500,000 tonnes per annum of waste.

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

Figure 2: Process schematic



4.1.1 Energy Recovery

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) at approximately 430 °C and approximately 60 bar(a). 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.

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.

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 ERF.

4.1.2 Details of Input Waste

Table 1: Expected ERF input waste characteristics

Parameter	Unit	Value
Nominal waste throughput	tpa	450,000
Maximum waste throughput	tpa	500,000
Proposed NCV	MJ/kg	10.50
Proposed GCV	MJ/kg	12.09

4.2 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 ERF. 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.

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 ERF'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.

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 5.2) 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 ERF 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.

5 Heat Demand Investigation

5.1 Wider Heat Export Opportunities

5.1.1 The National Comprehensive Assessment

'National Comprehensive Assessment of the Potential for Combined Heat and Power and District Heating and Cooling in the UK'[3] (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.

Table 2 details the heat consumption in 2012 and estimated consumption in 2025 by sector for the North East of England 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.

Table 2: Heat consumption in the North East of England

Sector	**2012 consumption (TWh/annum)**	**2025 consumption (TWh/annum)**
Industry (including agriculture)	11	10
Commercial services	1	1
Public sector	1	1
Residential	13	11
Total	**25**	**22**

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

Current and projected space cooling consumption data is 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.

[3] 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 North East of England

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

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

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.

5.1.2 UK CHP Development Map

The Department for Business, Energy and Industrial Strategy (BEIS) UK CHP Development Map[4] geographically represents heat demand across various sectors in England, Scotland, Wales and Northern Ireland. A search of heat consumers within 15 km of the ERF 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.

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.

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.

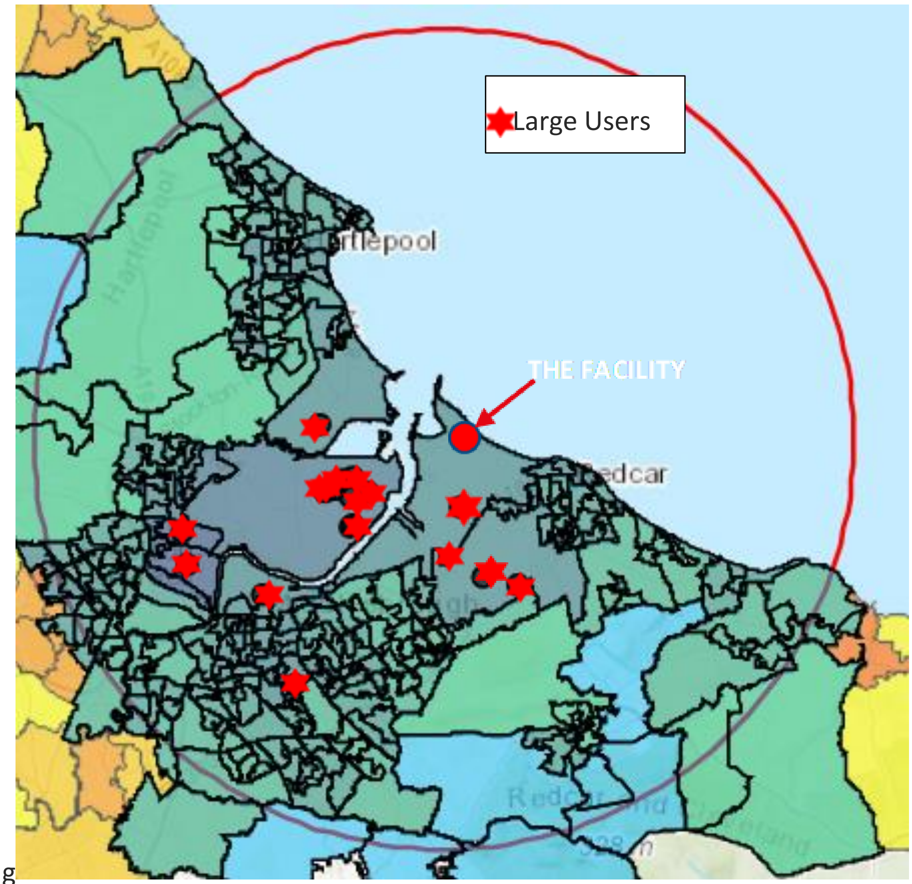
[4] http://chptools.decc.gov.uk/developmentmap/

Table 4: Heat demand within 15 km of the ERF

Sector	Heat demand	
	MWh/a	% share
Communications and Transport	4,881	0%
Commercial Offices	125,875	1%
Domestic	2,254,105	19%
Education	67,524	1%
Government Buildings	18,446	0%
Hotels	18,495	0%
Large Industrial	6,356,851	55%
Health	45,479	0%
Other	4,757	0%
Small Industrial	105,824	1%
Prisons	-	0%
Retail	35,172	0%
Sport and Leisure	9,859	0%
Warehouses	4,087	0%
District Heating	2,583,902	22%
Total heat load in area	**11,635,256**	**100%**

Source: UK CHP Development Map

Figure 3: Local heat demand density



g

Source: UK CHP Development Map

The heat demand in the area surrounding the ERF is predominantly from the commercial/industrial sectors, and to a lesser extent, the domestic 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.

Sections 5.1.3 and 5.1.4 identify potential heat users that would provide maximum return and carbon saving.

5.1.3 Large Heat Consumers

Seventeen large heat consumers (point heat demands greater than 5 MW_{th}) were identified within 15km of the ERF using the BEIS UK CHP Development Map[5] tool, as shown as shown in detailed in Table 5 and Figure 3.

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

Table 5: Large Heat Consumers

Site	Heat demand (MWh/annum)
Large heat consumer 1	2,675,750
Large heat consumer 2	2,551,929
Large heat consumer 3	1,670,138
Large heat consumer 4	546,827
Large heat consumer 5	471,251
Large heat consumer 6	379,236
Large heat consumer 7	225,499
Large heat consumer 8	103,784
Large heat consumer 9	98,076
Large heat consumer 10	75,926
Large heat consumer 11	49,773
Large heat consumer 12	36,959
Large heat consumer 13	28,589
Large heat consumer 14	27,975
Large heat consumer 15	27,807
Large heat consumer 16	23,284

The locations of the large heat consumers identified are at distances 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. Connecting most of these large heat users to a heat network from the ERF would require river and rail crossings. The above distances assume river crossings and rail crossings will use existing road bridges. Crossings and associated new infrastructure will increase the cost of the network. Due to the estimated distances and complexity of the connections to these heat consumers, they have been discounted. Nearby Wilton Power station, which is operated by Sembcorp has its own CHP plant therefore it has been discounted.

5.1.4 Teesworks

The South Tees Development Corporation (Teesworks), which incorporates REC, was launched in August 2017. The Teesworks covers 4,500 acres of prime land south of the River Tees in the borough of Redcar and Cleveland, including the site of the former Teeside Steel Works, and is considered to be the single biggest development opportunity in the UK today. For the purposes of this assessment the Teesworks is considered to be the potential heat consumer. There are no fixed contracts in place with specific heat users; however, it is assumed that the heat demand for the an annual average heat load of Teesworks is approximately 10 MW_{th}. The ERF will be technically capable of meeting this heat demand for Teesworks, subject to economic and commercial feasibility. The maximum heat capacity of the ERF will be confirmed during detailed design and will be set as a minimum to meet the requirements of the heat consumers identified. In the event that the heat demand of the Teesworks is more than 10 MW_{th}, the design of the ERF may need to be reconfigured to enable the additional heat export, and this would be subject to reaching appropriate commercial agreements with the relevant heat users.

Teesworks is also home to many thriving companies, including PD Ports, British Steel, Redcar Bulk Terminal, Northumbrian Water and BOC. It benefits from river access as well as the deep water ports available through Teesport and Redcar Bulk Terminal. It also benefits from proximity to the facilities at Sembcorp and the neighbouring Wilton International site. The Development Corporation was awarded £123million of funds from Government to begin land remediation, paving the way for large-scale industrial investment.

Comprising 11 zones, alongside five site entrances, construction work is currently ongoing around existing businesses.

The Teesworks is part of the ambitious Tees Valley Strategic Economic Plan to create 25,000 new jobs by 2026.

The ERF would be capable of exporting up to 10 MW of heat to a connection point within the Teesworks. The Masterplan for the Teesworks is presented in Figure 4.

Figure 4: Teesworks Masterplan

Source: https://www.teesworks.co.uk/the-development/masterplan

5.2 Estimated Overall Heat Load

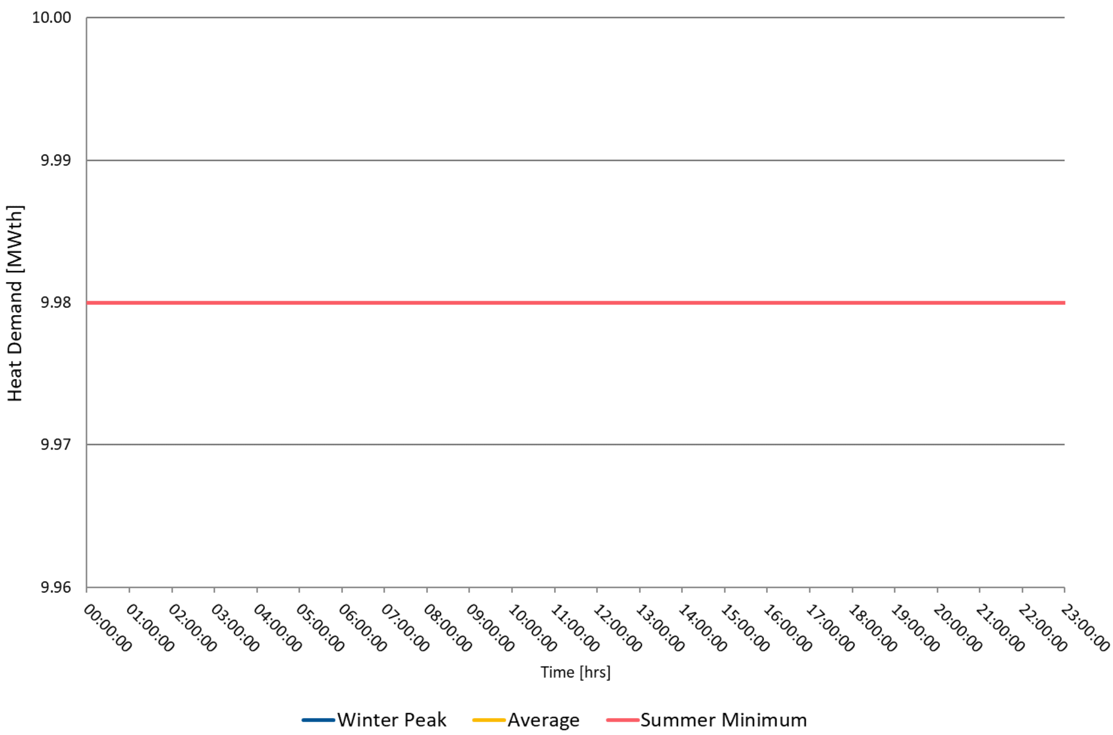
For the purposes of this report, the Teesworks has been identified as the potential heat user for the ERF. The ERF will export up to 87,425 MWh of heat per annum to the Teesworks, with a required heat export of 87,604 MWh of heat per annum when accounting for pipe losses.

6 Heat Network Technical Solution

6.1 Heat Network Profile

The heat network profile for the proposed heat network is shown in Figure 5 and illustrates the constant heat demand that is anticipated. The profile represents heat demand at the point of use and does not include for any heat losses from the network.

Figure 5: Heat network profile



The total annual heat export, and average and peak instantaneous network values are projected in Table 6.

Table 6: Proposed heat network demand

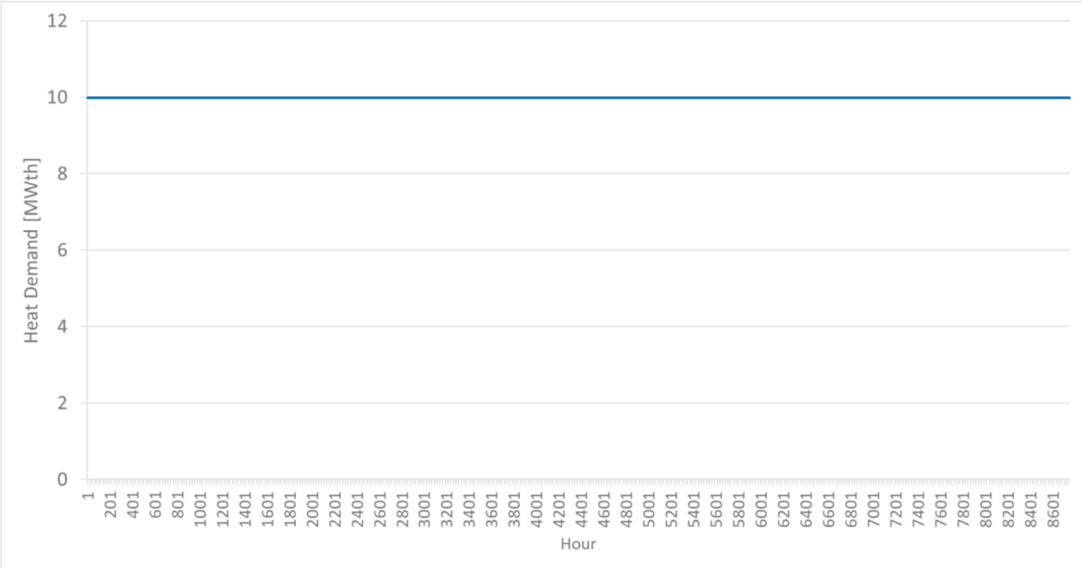
Annual Heat Load (MWh/a)		Average heat demand (MWth)		Peak heat demand (MWth)		
At point of use	Accounting for pipe losses	At point of use	Accounting for pipe losses	Peak winter value	After applying diversity factor	diversified with pipe losses
87,425	87,604	9.98	10.00	10.00	10.00	10.00

6.1.1 Heat Load Duration Curve

The heat load duration curve presented in Figure 6 displays the instantaneous heat demand for the proposed heat network, arranged in order of decreasing magnitude, across the year.

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 does not heat losses and shows a constant load.

Figure 6: Heat load duration curve



6.2 Heat Network Design

As a conventional heat network, heat distribution between the ERF and Teesworks is assumed to be via a 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 will be able to be added retrospectively, and it would be reasonably straightforward to add branches to serve any new/additional developments.

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.

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.

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.

The following conservative design criteria relate to a typical hot water network utilising conventional heat extraction (as detailed in section 4.2) 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 7 have been selected on the basis of the likely requirements of identified consumers.

Table 7: District heating network design criteria

Parameter	Value
Water supply temperature to consumer	95°C
Water return temperature from consumer	55°C
Distance between flow and return pipes	250 mm
Soil temperature	10°C
Depth of soil covering	600 mm

Using the above design criteria and allowing for the estimated heat demand for the preferred network, the primary hot water transmission pipe size has been calculated as DN250. This is an indicative figure and will be subject to heat demand verification and subsequent network design. Assuming the difference between the flow and return temperatures (deltaT) remains constant, it will be possible to reduce the flow temperature in the future in line with the CIBSE Code of Practice without impacting the pipe size and thereby reduce system energy losses.

6.3 Back-up Heat Sources

The ERF has been designed to achieve an availability of 91.3 % (i.e. 8,000 operational hours per year. During periods of routine maintenance or unplanned outages the ERF 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.

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. Electric boiler may become an option in the future.

Indicative costs of installing and operating back-up plant have been included in the economic assessment in Section 8.3.

6.4 Considerations for Pipe Route

At the present time, no definitive fixed route has been established for the connections from the ERF to the Teesworks connection point, since no specific agreements have been made. However, an indicative pipe route is presented in Appendix A.

Planning permission, easements and Highways Licenses would need to be obtained for access, construction, and maintenance of the pipeline infrastructure. There is a significant financial implication for obtaining easements, and these would only be progressed once planning permission and an EP have been granted for the ERF and heat supply agreements put in place. Traffic management requirements would need to be agreed prior to being able to obtain the necessary Highways Licenses granting permission to install the pipework. The projected timetable for the development of the heat mains is detailed in Section 6.5.

Discussions with Teesworks developers will need to be 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 being granted for the ERF, any firm commitment to a supply of heat is difficult to achieve.

6.5 Implementation Timescale

The table below gives an indicative timetable for the programme for the construction of the ERF and heat network. The start of the construction of the heat system is dependent on the viability of the system and the location of the connection point to Teesworks. For example, planning and gaining consent for installation of the pipework off the site would take a significant amount of time due to the potential impact on local traffic management. Until a core of heat consumers in Teesworks have been identified and contracted to take heat, pipeline installation will not commence. The indicative timetable allows for obtaining Planning consent, discharging Planning conditions, negotiating heat supply agreements and some nominal float to cover possible ERF construction delays.

Table 8: Implementation programme

Description	Schedule (from Day 1)
Obtain Permitting for the ERF	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 ERF	+30 months
Take Over of the ERF	+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 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 ERF. A value of 6.85 was obtained following the approach set out in CHPQA Guidance Note 28[6], assuming steam extraction at a pressure of 1.9 bar(a), which is considered sufficient to meet the requirements of the potential heat consumers identified for the ERF. The heat and power export has been modelled across a range of load cases and the results are presented in Table 9.

Table 9: 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	49.9	44.9	N/A
2. Proposed network heat load (see Section 6.1)	10.00	48.4	43.4	6.85
3. Maximum heat export capacity	10.00	48.4	43.4	6.85

The results indicate that for the heat consumers identified in Section 5.1 and 5.2, load case 2 corresponding to an average heat export of 10 MW_{th} will result in a net power export of 43.4 MW_e.

7.2 CHPQA Quality Index

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.

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 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.

[6] CHPQA Guidance Note 28, 2007

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 ERF:

- X value = 220; and
- Y value = 120.

The QI and efficiency values (based on a gross calorific value of 12.09 MJ/kg) have been calculated in accordance with CHPQA methodology for various load cases and the results are presented in Table 10.

Table 10: QI and efficiency calculations

Load case	Gross power efficiency (%)	Heat efficiency (%)	Overall efficiency (%)	CHPQA QI
1. No heat export	26.41	0.00	26.41	58.1
2. Proposed network heat load (see Section 6.1)	25.64	5.29	30.93	62.8
3. Maximum heat export capacity	25.64	5.29	30.93	62.8

The results indicate that the ERF 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 ERF to be considered Good Quality.

For reference, assuming the same Z ratio as set out in the preceding section, an average heat export of 101 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.

8 Heat Network Economic Assessment

8.1 Fiscal Support

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

8.1.1 Capacity Market for electricity supplied by the ERF

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 ERF) are eligible for contracts lasting up to 15 years. Based on the eligibility criteria of the mechanism, the ERF 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.

8.1.2 Renewable Heat Incentive

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. As the Facility will not be operational before March 2022, it will not be eligible for RHI.

8.1.3 Contracts for Difference

Contracts for Difference (CfD) replaced the Renewables Obligation (RO) as the mechanism by which the UK Government has supported low carbon power generation. Launched in 2014, there have been three rounds aimed at incentivising investment in renewable energy. CfD incentives investment by providing project developers with protection from volatile wholesale prices while protecting consumers from paying increased support costs when electricity prices are high. CfD de-risks investments by guaranteeing a fixed price (the Strike Price) for electricity over a 15-year period. In the fourth CfD allocation round (AR4) (executed on the 13th December 2021 with deadline for bids on the 14th of January 2022).

The new CfD round has identified three pots of technology based on how well technologies are established, risks, costs, and ability to move the country towards its net zero emissions target. The three pots and technologies allocated to each pot is shown below in Table 11. The table also provides indications of maxima and minima where applicable. Maxima and minima have been included to either restrict certain technologies or encourage others.

Table 11: Summary of technology pots in AR4

	Pot 1	Pot 2	Pot 3
Eligible Technologies	Solar larger than 5 MW; Onshore wind larger than 5 MW; Landfill gas; Hydro (greater than 5 MW but less than 50 MW); Energy from	Remote Island wind greater than 5 MW; Floating offshore wind; Anaerobic digestion greater than 5 MW; Geothermal; Dedicated Biomass	Offshore wind.

	Pot 1	Pot 2	Pot 3
	Waste with CHP; Sewage gas.	with CHP; Advanced Conversion Technology (ACT); Tidal stream; Wave.	
Budget	£10m per year	£75m	£200m
Minima or Maxima	Maxima 1: Solar PV 3,500 MW		

Source: BEIS "Contracts for Difference (CfD): Budget Notice for the fourth Allocation Round, 2021" published 25th November 2021

Note that cap breaches and/or budget breaches if they occur in any one of the four years covered by AR4 will close an auction. Additionally based on the budget allocation Energy from Waste with CHP and dedicated Biomass with CHP are not high priorities with most of the focus continuing to be offshore fixed wind with some effort to encourage offshore floating and tidal stream (both have minima) and restraints placed pot 1 because of very limited budget and more specifically on solar PV and onshore wind (maxima caps in pot 1). In this case, the ERF would not receive support under the CfD mechanism.

8.1.4 Heat Network Investment Project funding

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 confirmed £96 million for the final year of the HNIP, which ends in March 2022. As the Facility will not be operational before March 2022, it will not be eligible for HNIP.

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 ERF directly and would not serve to support project delivery.

8.1.5 Green Heat Networks Scheme

When the HNIP ends in March 2022 it will be replaced by the Green Heat Networks Scheme (GHNS). The GHNS will provide for £270 million of funding for new and existing heat networks to be low carbon and connect to waste heat that would otherwise be released into the atmosphere.

Following discussions with BEIS, the UK District Energy Association (ukDEA) has confirmed that:

1. GHNS 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.
2. GHNS is a capital grant fund and not a split loan and grant.
3. The GHNS fund will be available from 2022 to 2025.
4. The GHNF will fund up to, but not including, 50 per-cent of a project's total combined commercialisation and capex costs.

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

8.2 Technical feasibility

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**

The CHP scheme has been developed on the basis of delivering heat at typical district heating conditions (refer to Section 6.2). 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**

Conventional thermal stores or back-up boilers (as detailed in Section 6.3) 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**

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.

8.2.1 Primary energy savings

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 450,000 tonnes per annum based on an NCV of 10.5 MJ/kg.
2. Nominal gross electrical output (expected capacity in fully condensing mode) of 49.9 MW_e.
3. Parasitic load is 4.99 MW_e.
4. Z ratio of 6.85.
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[7].

When operating in fully condensing mode (i.e. without heat export) the ERF will achieve a PES of 17.81 %. 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 20.46 %. On this basis, the ERF will qualify as a high-efficiency cogeneration operation when operating in CHP mode.

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

8.3 Results of CBA

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

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.

The following assumptions have been made:

1. The DH scheme will commence operation in 2025.
2. The heat export infrastructure required to export heat from the ERF to the consumers identified is estimated to have a capital cost of approximately £1.41 million, split over an up to two-year construction programme.
3. The heat station will cost approximately £1.43million, split over an up to two-year construction programme.
4. Back-up boilers will be provided to meet the peak heat demand, at a cost of approximately £0.77 million.
5. Operational costs have been estimated based on similar sized projects.
6. Heat sales revenue will be £40 / MWh, current price and index linked for inflation in CBA.
7. Electricity sales revenue will be £57 / MWh, current price and index linked for inflation in CBA.
8. Standby boiler fuel costs will be £25 / MWh, current price and index linked for inflation in CBA.
9. Standby boiler(s) will supply 11% of annual heat exported.

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 53.1 % and £8.32 million respectively. Therefore, it is considered that the proposed heat network yields an economically viable scheme in its current configuration. Model inputs and key outputs are presented in Appendix C.

9 CHP-Ready BAT Assessment

9.1 CHP-Ready BAT Assessment

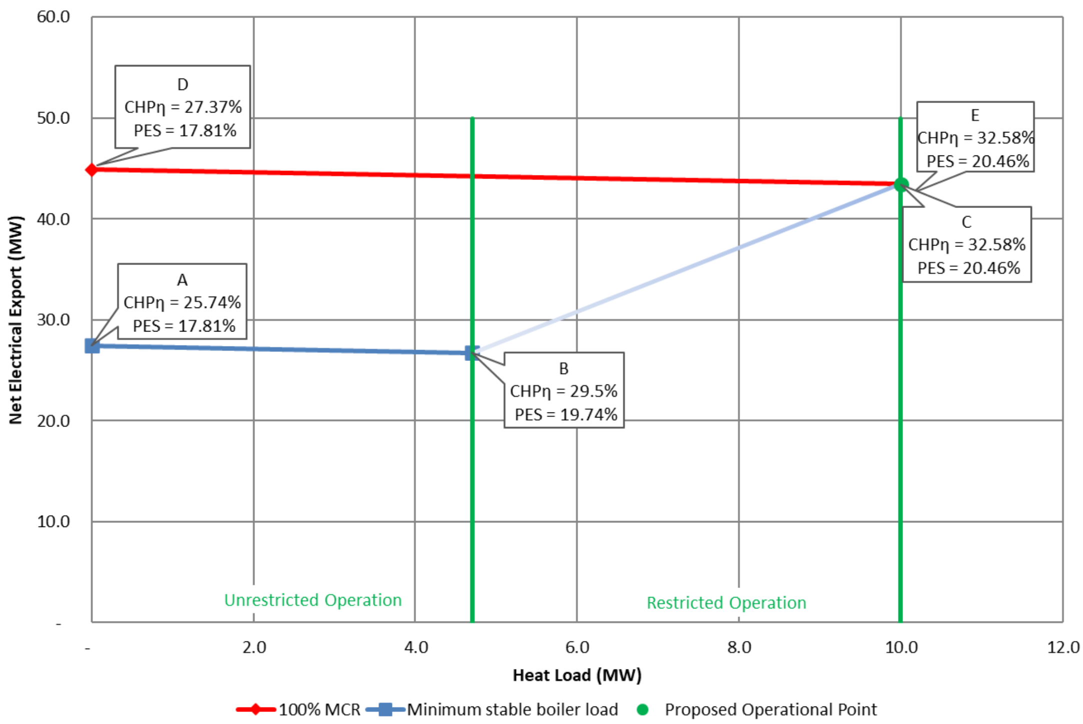
This report includes a CHP-Ready Assessment which considers the requirements of the EA's CHP-Ready Guidance. The completed CHP-Ready Assessment form is provided in Appendix D.

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 7.

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 ERF, based on the proposed heat network.
- Unrestricted operation: if a selected heat load is located in this region, the ERF 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 ERF will not have the ability to operate over its full operational range without a reduction in heat load.

Figure 7: Graphical representation of CHP envelope for proposed heat network

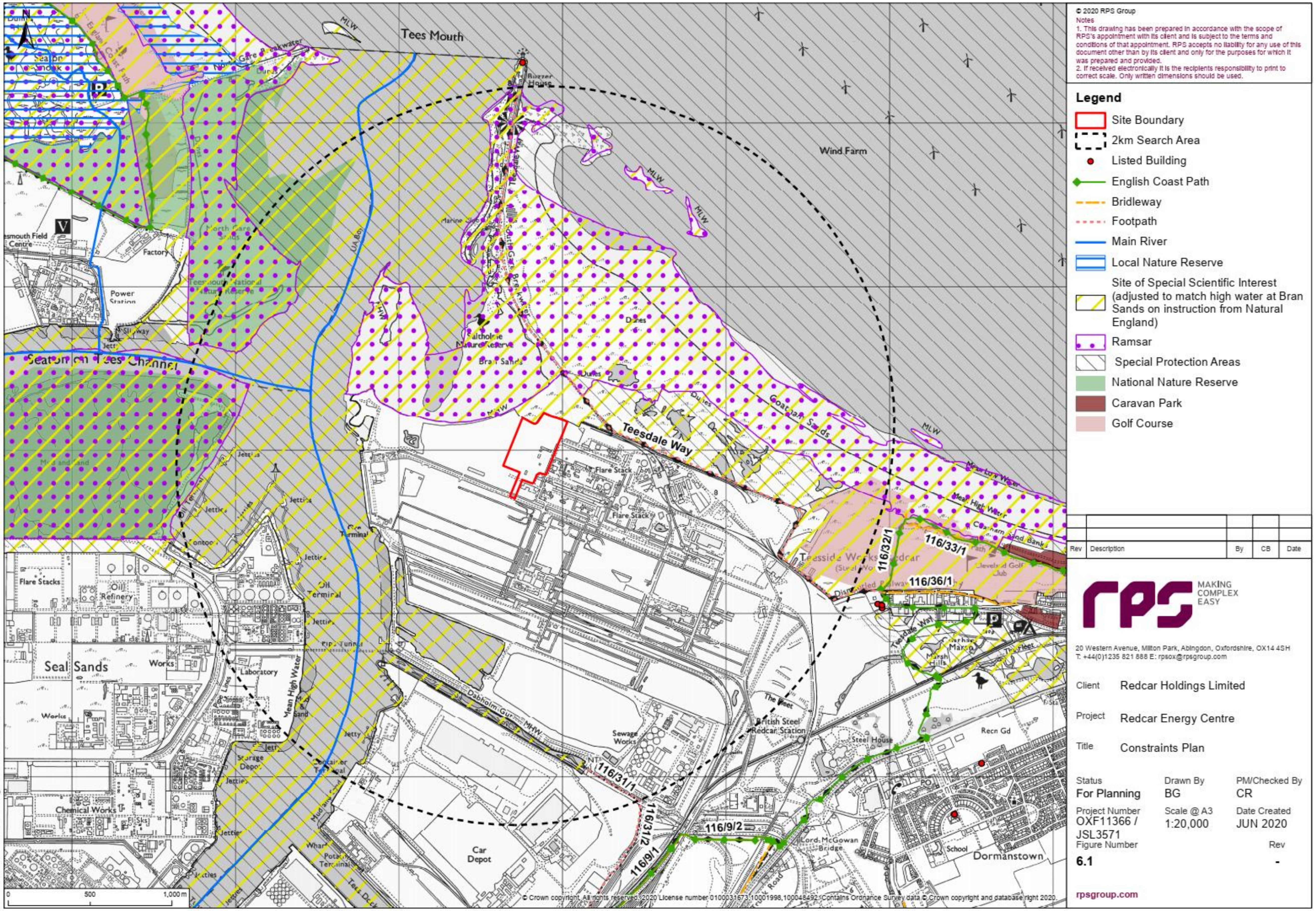


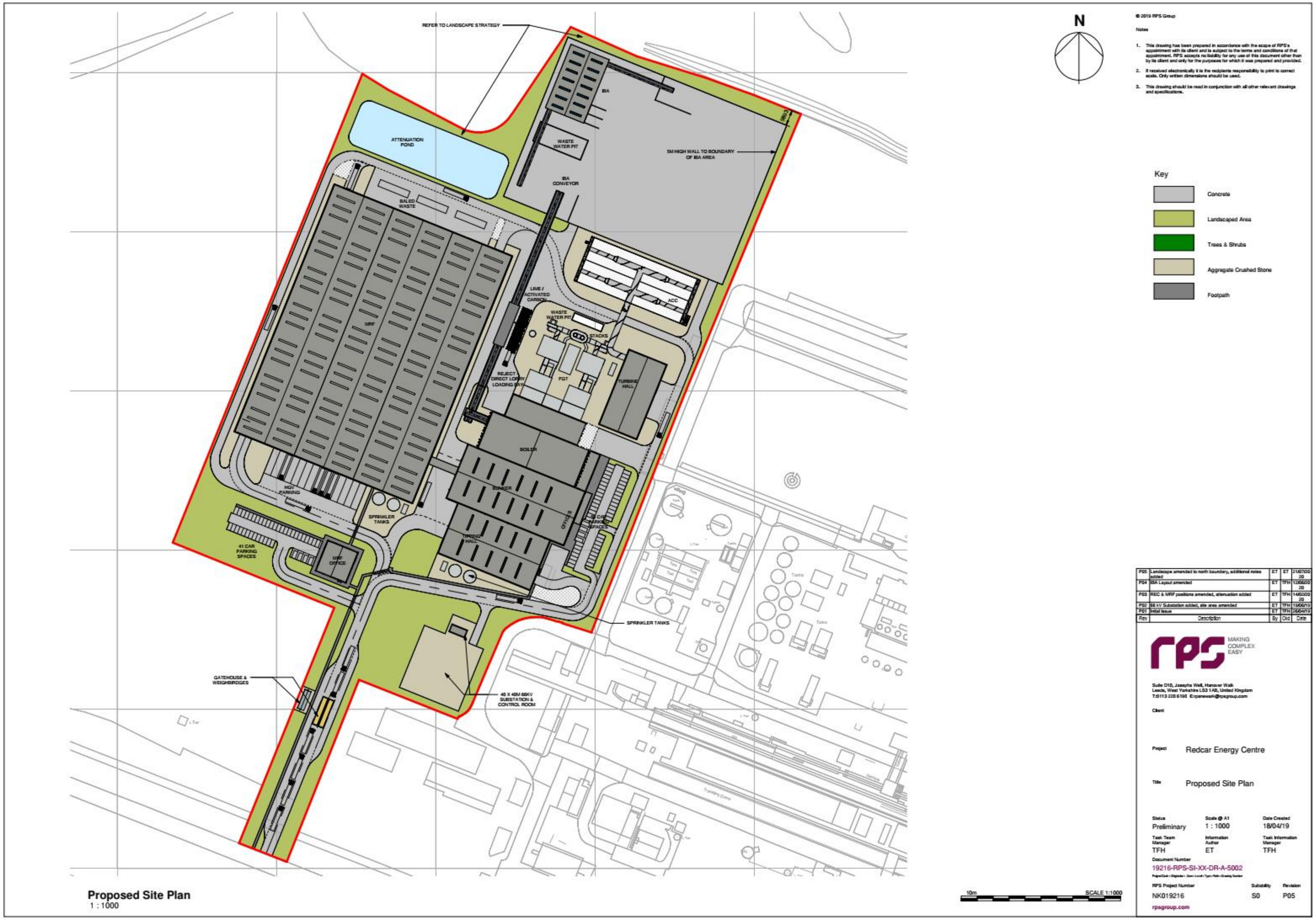
The proposed operational point (point E) represents the annual average heat demand exported to the proposed heat network detailed in section 5 and 6.1. It considers the heat losses and pressure drop in the pipe network and therefore corresponds to the annual average heat demand predicted at the ERF site boundary. The operational range for the ERF will ultimately be subject to the required hot water flow temperature and final steam turbine selection, which are subject to detailed design.

Appendices

A Pipe route and heat users

B Site Location and Layout Drawings


© 2020 RPS Group
Notes
1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
Legend
Site Boundary
2km Search Area
Listed Building
English Coast Path
Bridleway
Footpath
Main River
Local Nature Reserve
Site of Special Scientific Interest (adjusted to match high water at Bran Sands on instruction from Natural England)
Ramsar
Special Protection Areas
National Nature Reserve
Caravan Park
Golf Course
Rev
Description
By
CB
Date
MAKING COMPLEX EASY
20 Western Avenue, Milton Park, Abingdon, Oxfordshire, OX14 4SH
T: +44(0)1235 821 888 E: rpsox@rpsgroup.com
Client
Redcar Holdings Limited
Project
Redcar Energy Centre
Title
Constraints Plan
Status
For Planning
Drawn By
BG
PM/Checked By
CR
Project Number
OXF11366 / JSL3571
Scale @ A3
1:20,000
Date Created
JUN 2020
Figure Number
6.1
Rev
-
rpsgroup.com
Tees Mouth
Wind Farm
Teesdale Way
Seal Sands
Coatham Sands
Dormanstown
Car Depot
116/33/1
116/32/1
116/36/1
116/31/1
116/31/2
116/9/2
116/9/1
0
500
1,000 m
© Crown copyright. All rights reserved. 2020 License number 0100031673,10001998,100048492. Contains Ordnance Survey data © Crown copyright and database right 2020.


N
Key
Concrete
Landscaped Area
Trees & Shrubs
Aggregate Crushed Stone
Footpath
REFER TO LANDSCAPE STRATEGY
ATTENUATION POND
IBA
WASTE WATER PIT
5M HIGH WALL TO BOUNDARY OF IBA AREA
IBA CONVEYOR
BALED WASTE
MRF
ACC
STACKS
FGT
TURBINE HALL
BOILER
BUNKER
SPRINKLER TANKS
41 CAR PARKING SPACES
MRF OFFICE
GATEHOUSE & WEIGHBRIDGES
40 X 40M 66KV SUBSTATION & CONTROL ROOM
P05 Landscape amended to north boundary, additional notes added ET ET 21/07/2020
P04 IBA Layout amended ET TFH 12/06/2020
P03 REC & MRF positions amended, attenuation added ET TFH 14/02/2020
P02 66 kV Substation added, site area amended ET TFH 19/06/19
P01 Initial issue ET TFH 26/04/19
Rev Description By Chd Date
MAKING COMPLEX EASY
Suite D10, Josephs Well, Hanover Walk
Leeds, West Yorkshire LS3 1AB, United Kingdom
Client
Project Redcar Energy Centre
Title Proposed Site Plan
Status Preliminary
Scale @ A1 1 : 1000
Date Created 18/04/19
Task Team Manager TFH
Information Author ET
Task Information Manager TFH
Document Number 19216-RPS-SI-XX-DR-A-5002
RPS Project Number NK019216
Suitability S0
Revision P05
rpsgroup.com
10m
SCALE 1:1000
Proposed Site Plan
1 : 1000

C CBA Inputs and Key Outputs

INPUTS

Version Jan 2015

Scenario Choice (dropdown box)

1

Power generator (Heat Source) same fuel amount

Key

2	Participant to define
2	Regulatory prescribed
2	Calculated
2	Prescribed - but possibility to change if make a case

Technical solution features

Heat carrying medium (hot water, steam or other) (dropdown box)	Hot water
Total length of supply pipework (kms)	0.4
Peak heat demand from Heat User(s) (MWth)	10
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

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%	0.706593697	0.715048201	0.382581279	
Year 2 costs (£m) and build up of operating costs and revenues (%)		0%	0.706593697	0.715048201	0.382581279	
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)	0.0
OPEX for full steady state Heat Station on price basis of first year of operations (partial or steady state) (£m)	0.1
OPEX for full steady state Standby Boilers on price basis of first year of operations (partial or steady state) (£m)	0.0
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	**0.2**
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)	40.00	40.00				
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	87,604	87,604				
Equivalent heat sales if first year of operations is steady state (£ m)	3.5					
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)	11%	11%				
'Lost' electricity sale price (£/ MWh) at first year of operations	57.00	57.00				
Z-ratio (commonly in the range 3.5 - 8.5)	6.85	6.85				
Power generation lost at steady state (MWh)	11,382	11,382				
Equivalent 'lost' revenue from power generation if first year of operations is steady state (£ m)	0.65					
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					
Industrial CHP electrical generation in steady state (MWh)	0					
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%					
Fuel price for larger power generator/ CHP at first year of operations (full or partial) (£ / MWh)	0.00					
Z-ratio (commonly in the range 3.5 - 8.5)	0					
Power efficiency in cogeneration mode (%)	0					
Additional fuel required per year for larger power generator / CHP in steady state (MWh)	0		#DIV/0!			
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%					
Fuel price for Standby Boiler at first year of operations (£ / MWh)	25.00	25.00				
Boiler efficiency of Standby Boiler (%)	80%	80%	80%	80%		
Additional fuel required per year for Standby Boiler in steady state (MWh)	12,046	12,046	-	-		
Equivalent additional fuel costs if first year of operations is steady state (£m)	0.30					
Fuel price inflation for Standby Boiler from first year of operations (full or partial) (% per year)	2.00%	2.0%				

Heat purchase price (£/ MWh) at first year of operations (partial or full)	0.00		
Annual quantity of heat supplied from the Heat Source(s) to Heat User(s) at steady state (MWh)	0		
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%		
Fuel price (£ / MWh) at first year of operations (partial or full)	0.00		
Boiler efficiency of district heating plant	0%		80%
Fuel avoided per year in steady state (MWh)	0		-
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%		4.0%
Fiscal benefits (£m) in first year of operations assuming it is at steady state **	0.00	0.00	
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	53.1%
Nominal NPV (before financing and tax) (£m) over 32 years	8.32

D CHP-R Assessment Form

#	Description	Units	Notes / Instructions
Requirement 1: Plant, Plant location and Potential heat loads			
1.1	Plant name		Redcar Energy Recovery Facility
1.2	Plant description		The main activities associated with the ERF will be the combustion of incoming waste to raise steam and the generation of electricity in a steam turbine/generator. The ERF includes two 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 ERF 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 ERF has been designed to export power to the National Grid. The ERF will generate approximately 49.9 MWe of electricity in full condensing mode. The ERF will have a parasitic load of 4.99 MWe. Therefore, the maximum export capacity of the ERF is 44.9 MWe. In addition to generating power, the ERF has been designed to be capable of exporting approximately 10 MW_{th} heat to the identified district heating network of Teesworks. 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 ERF. The power exported may fluctuate as fuel quality fluctuates, and if heat is exported from the ERF to local heat users in the future. The ERF has been designed to thermally treat waste with a range of net calorific values (NCV's) with a Net Calorific Value (NCV) of 8 MJ/kg to 12.5 MJ/kg. The nominal capacity of the ERF is 56.3 tonnes per hour of fuel with an NCV of 10.5 MJ/kg. The expected operational availability is 8,000 hours per annum

#	Description	Units	Notes / Instructions
			(~91.3%), which is regarded as typical for an EfW plant in the UK. Therefore, the nominal capacity for the installation is 450,000 tonnes per annum. It is expected that the maximum capacity of the ERF will be approximately 500,000 tonnes per annum.
1.3	Plant location (Postcode / Grid Ref)		The site is located on a section of disused land on the Redcar Bulk Terminal, approximately 4.5km north-west of Redcar town centre, and 8.5km north-east of Middlesbrough city centre. The Redcar Bulk Terminal is a port used for import and export of coal and coke as well as other bulk goods. Directly to the east of the site is the remains of the now disused Teesside Steel Works. Main access to the site is via a double lane road which links the site to a large roundabout on Trunk Road. Teesside Steel Works borders the access road on either side. Numerous pipe bridges and conveyors cross the access road, but these are unlikely to impact operational traffic. The ERF will be located at an approximate national grid reference 455890, 526032.
1.4	Factors influencing selection of plant location		Refer to Chapter 3 of EIA, submitted with planning application.
1.5	Operation of plant		
a)	Proposed operational plant load	%	100
b)	Thermal input at proposed operational plant load	MW	164.06
c)	Net electrical output at proposed operational plant load	MW	44.91
d)	Net electrical efficiency at proposed operational plant load	%	27.37%
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	164.06
g)	Net electrical output at maximum plant load	MW	44.91
h)	Net electrical efficiency at maximum plant load	%	27.37%
i)	minimum stable plant load	%	65%
j)	Thermal input at minimum stable plant load	MW	106.64
k)	Net electrical output at minimum stable plant load	MW	26.76
l)	Net electrical efficiency at minimum stable plant load	%	25.09%

#	Description	Units	Notes / Instructions
1.6	Identified potential heat loads		
			Details of the identified heat loads are in Sections 5 and 6.1. Teesworks is a potential heat user with a constant heat load of 10 MW_{th} for the proposed heat network. The estimated heat use of the identified network is 87,604 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 heat demand of the proposed heat network has been calculated to be 10 MW_{th} .
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 95°C) via turbine steam extractions at approximately 1.9 bar(a).
b)	Description of heat load profile		The heat load profile is constant. A detailed heat load profile can be found in section 6.1 of the Heat Plan. The consumer heat load and profile is subject to verification.
c)	Export pressure	bar a	10
d)	Export temperature	°C	95
e)	Export flow	t/h	214.29 (nominal case)
f)	Return pressure	bar a	3
g)	Return temperature	°C	55
h)	Return flow	t/h	214.29 (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	10.00
b)	Maximum heat extraction export flow at 100% plant load	t/h	Assuming steam extraction at 1.91 bar(a), export flow rate would be: 15.33 t/hr

#	Description	Units	Notes / Instructions
c)	CHP mode net electrical output at 100% plant load	MW	43.45
d)	CHP mode net electrical efficiency at 100% plant load	%	26.48%
e)	CHP mode net CHP efficiency at 100% plant load	%	32.58%
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	20.46%
2.2	Heat extraction at minimum stable plant load		
a)	Maximum heat load extraction at minimum stable plant load	MW	4.70
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Assuming steam extraction at 1.91 bar(a), export flow rate would be: 7.21 t/h
c)	CHP mode net electrical output at minimum stable plant load	MW	26.76
d)	CHP mode net electrical efficiency at minimum stable plant load	%	25.09%
e)	CHP mode net CHP efficiency at minimum stable plant load	%	29.50%
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	19.74%
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 7 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	43.45
b)	CHP mode net electrical efficiency at proposed operational plant load	%	26.48%
c)	CHP mode net CHP efficiency at proposed operational plant load	%	32.58%
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	MW	1.46

#	Description	Units	Notes / Instructions
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	0.89%
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	20.46%
g)	Z ratio		6.85
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 1.91 bar(a). Full details are provided in section 4.2 of the Heat Plan.
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 within or in the area adjacent to the turbine hall to avoid the cost of building a dedicated heat station at a later date. The turbine design will be selected to maximise electrical efficiency while allowing for the option 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 ERF has not been undertaken at this stage. However, space will be left available within the 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.

#	Description	Units	Notes / Instructions
Requirement 5: Integration of CHP and carbon capture			
5.1	Is the plant required to be CCR?		No
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	N/A
b)	Description of heat export (e.g. steam / hot water)		N/A
c)	Export pressure	bar a	N/A
d)	Export temperature	°C	N/A
e)	Export flow	t/h	N/A
f)	Return pressure	bar a	N/A
g)	Return temperature	°C	N/A
h)	Return flow	t/h	N/A
i)	Likely suitable extraction points		N/A
	Minimum stable plant load		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	N/A
k)	Description of heat export (e.g. steam / hot water)		N/A
l)	Export pressure	bar a	N/A
m)	Export temperature	°C	N/A
n)	Export flow	t/h	N/A
o)	Return pressure	bar a	N/A
p)	Return temperature	°C	N/A
q)	Return flow	t/h	N/A
r)	Likely suitable extraction points		N/A
5.3	Operation of plant with carbon capture (without CHP)		
a)	Maximum plant load with carbon capture	%	N/A
b)	Carbon capture mode thermal input at maximum plant load	MW	N/A
c)	Carbon capture mode net electrical output at maximum plant load	MW	N/A

#	Description	Units	Notes / Instructions
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	N/A
e)	Minimum stable plant load with CCS	%	N/A
f)	Carbon capture mode CCS thermal input at minimum stable plant load	MW	N/A
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	N/A
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	N/A
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	N/A
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	N/A
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	N/A
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	N/A
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	N/A
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	N/A
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	N/A

#	Description	Units	Notes / Instructions
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	N/A
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	N/A
f)	reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	N/A
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')?		N/A
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		N/A
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 53.1 % and a net present value of £8.32 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 viable CHP opportunities at the outset)?		No
	If not, is the new plant a CHP-R plant at the outset?		Yes

#	Description	Units	Notes / Instructions
	Once the new plant is CHP-R, is it BAT?		Yes

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