Eggborough CCGT Project

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The Eggborough CCGT (Generating Station) Order

Land at and in the vicinity the Eggborough Power Station site, near Selby, North Yorkshire, DN14 0BS

Combined Heat and Power Assessment

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Regulation – 5(2)(q)

Applicant: Eggborough Power Limited
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GLOSSARY

Abbreviation	Description
ADMS	Atmospheric Dispersion Monitoring System
AGI	Above Ground Installation
BAT	Best Available Techniques
BEIS	Department for Business, Energy & Industrial Strategy
CCGT	Combined Cycle Gas Turbine
CCR	Carbon Capture Readiness
CCS	Carbon Capture and Storage
CHP	Combined Heat and Power
DCO	Development Consent Order
DCO Site	The proposed DCO Application boundary (see also Main Site below)
DECC	Department for Energy and Climate Change (now BEIS)
EA	Environment Agency
EPL	Eggborough Power Limited
GW	Gigawatts
HCA	Homes and Communities Agency
HRSG	Heat Recovery Steam Generator
km	Kilometre
kv	kilovolt
m	metres
MW	Megawatts
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
NTS	National Transmission System
NYCC	North Yorkshire County Council
OCGT	Open Cycle Gas Turbine
PES	Primary Energy Savings
PINS	Planning Inspectorate
Power Station site	The existing Eggborough Power Station site, comprising the land owned by EPL
SDC	Selby District Council
SoS	Secretary of State

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Executive Summary

This CHP Assessment has been undertaken in line with the requirements of National Policy Statements NPS EN-1 and EN-2 and the Environment Agency (EA) CHP Ready Guidance, to support the application for a Development Consent Order and meet the Best Available Techniques (BAT) requirements of the CHP Ready Guidance.

A review of the UK CHP Development Map, and DECC National Heat Map has indicated that there are a number of theoretical identified heat users within a 15 km radius of the Proposed Development. These include:

- a total domestic annual average heat load of approximately 122 MWth across the whole search area;
- a total small industrial annual average heat load of approximately 14.2 MWth across the whole search area; and
- a total large industrial annual average heat load of approximately 327.9 MWth across the whole search area.

In addition, there is one potential future CHP opportunity identified through a review of projects currently in the planning system, and future CHP opportunities could potentially be identified during the period in which the Proposed Development is consented and moves towards construction and operation.

It is considered that the most feasible option relates to meeting industrial heat demand along a corridor bounded by the M62 to the south, the River Aire to the north and the A1(M) to the west. Analysis of the UK CHP Development map indicates an approximate average instantaneous demand of 22 MW for large and small industry along this corridor.

At this stage, provision of heat or steam from the Proposed Development to supply the identified potential heat load is not viable, taking into account the distributed nature of the loads, the distances to the identified opportunities, potential barriers and constraints to the installation of export pipework, and the fact that the Proposed Development will not be in commercial operation until 2021 at the earliest.

Based on the evaluation undertaken, at the current time it is considered that there is only likely to be demand for steam. This is considered to represent the highest grade of exportable heat and likely to be the most attractive to potential industrial users. This steam would likely be extracted from the steam turbine by the cold reheat line of the HP turbine. This method minimises efficiency impacts on the steam turbine and is considered preferable to direct bleeds.

A thermodynamic model of the Proposed Development has been developed in order to present an accurate representation of the Proposed Development, based on current understanding of the technology to be installed, in order to assess the impact of heat export on the electrical output and to produce the CHP envelope, which identifies the potential operational range of a new plant where it could be technically feasible to provide electrical power generation with heat generation for export. In accordance with the second BAT Test of the EA CHP Ready guidance, this assessment assumes that, given the uncertainty of future heat loads, the initial electrical efficiency of the CHP Ready Proposed Development is to be no less than that of the equivalent non-CHP-R plant.

To allow any identified and additional future CHP opportunities to be realised, the design (and final build) of the Proposed Development will be CHP Ready, and will therefore incorporate a number of defined features which will allow for the future implementation of CHP. It is considered that this is an appropriate solution given the current uncertainty (and thus absence of economic feasibility) surrounding the identified and future CHP opportunities.

This CHP assessment demonstrates that the Proposed Development meets the BAT tests outlined in the EA CHP Ready Guidance. It therefore will be designed and built as 'CHP Ready' to supply any identified viable heat load up to a potential maximum of 33MW and sufficient to meet the identified load of 21 MWth. This will allow for the future implementation of CHP as and when the identified heat loads become economically viable.

An assessment of potential for the Proposed Development to be CCR compliant and operate as CHP-R has also been undertaken, with the CHP envelope adjusted to take account of the anticipated heat and electrical demand of any future carbon capture equipment. No technical or economic barriers were identified and the Proposed Development is therefore considered to satisfy the requirements of CCR and be CHP-R.

The Applicant is committed to carrying out a periodic ongoing review of CHP potential, including:

- instigate an action plan as outlined in Appendix 2 of this report;
- maintaining a dialogue with key heat users as set out in the proposed action plan;
- carrying out regular reviews to determine if there have been sufficient changes in circumstances to warrant a new technical and financial assessment; and
- re-visiting the technical and economic assessments at least every 5 years or when a change in circumstances warrants.

These commitments will be secured through an appropriately worded requirement in Schedule 2 to the draft DCO (Application Document Ref. No. 2.1).

Through the above evaluations, assessment, and commitments, the Proposed Development meets the requirements of the three BAT Tests outlined in the EA CHP-Ready Guidance.

1.0 INTRODUCTION

1.1 This Combined Heat and Power ('CHP') assessment has been prepared on behalf of Eggborough Power Limited ('EPL' or the 'Applicant'). It forms part of the application (the 'Application') for a Development Consent Order (a 'DCO'), that has been submitted to the Secretary of State (the 'SoS') for Business, Energy and Industrial Strategy, under section 37 of 'The Planning Act 2008' (the 'PA 2008').

1.2 EPL is seeking development consent for the construction, operation and maintenance of a new gas-fired electricity generating station with a gross output capacity of up to 2,500 megawatts ('MW'), including electrical and water connections, a new gas supply pipeline and other associated development (the 'Project' or 'Proposed Development') on land at and in the vicinity of the existing Eggborough coal-fired power station, near Selby, North Yorkshire.

1.3 A DCO is required for the Proposed Development as it falls within the definition and thresholds for a 'Nationally Significant Infrastructure Project' (a 'NSIP') under sections 14 and 15(2) of the PA 2008.

1.4 The DCO, if made by the SoS, would be known as the 'Eggborough CCGT (Generating Station) Order' (the 'Order').

EPL

1.5 EPL owns and operates the existing Eggborough coal-fired power station (the 'existing coal-fired power station'), near Selby, including a significant proportion of the land required for the Proposed Development.

1.6 EPL was acquired by EP UK Investments Ltd (EP UK) in late 2014; a subsidiary of Energetický A Prumyslový Holding ('EPH'). EPH owns and operates energy generation assets in the Czech Republic, Slovak Republic, Germany, Italy, Hungary, Poland and the United Kingdom.

The Proposed Development Site

1.7 The Proposed Development Site (the 'Site' or the 'Order limits') is located at and in the vicinity of the existing coal-fired power station approximately 8 kilometres south of Selby.

1.8 The existing coal-fired power station is bound to the north by Wand Lane, with the River Aire located approximately 650 metres ('m') further to the north and the A19 Selby Road immediately to the west. Eggborough Village is located approximately 750 m to the south-west.

1.9 The entire Site lies within the administrative boundaries of Selby District Council ('SDC') and North Yorkshire County Council ('NYCC').

1.10 The existing coal-fired power station was officially opened in 1970 and comprises four coal-fired boilers units, which together are capable of generating up to 2,000 MW of electricity. The existing coal-fired power station also includes a turbine hall and boiler house, an emissions stack (chimney) of approximately 198 m in height, eight concrete cooling towers of approximately 115 m in height, an administration and control block, a coal stockyard and a dedicated rail line for the delivery of coal, in addition to ancillary buildings, structures and infrastructure and utility connections.

1.11 The Site itself extends to approximately 102 hectares and comprises land within the operational area of the existing coal-fired power station for the new gas-fired generating station and electrical and groundwater supply connections; corridors of land to the north of the existing coal-fired power station for the cooling water connections and gas supply pipeline; an area of land to the south-east of the main coal stockyard for surface water discharge connections; and corridors of land to the west and south of the operational area of the existing coal-fired power station for ground and towns water supply connections and access.

1.12 The land required for the generating station and electrical and groundwater connections is owned by EPL, as well as the majority of the land for the cooling and towns water and surface water discharge connections. The majority of the land required for the gas supply pipeline is not owned by EPL.

1.13 The area surrounding the Site is predominantly flat and for the most part comprises agricultural land interspersed with small settlements and farmsteads. The area is however crossed by transport infrastructure, notably the A19 and railway lines, including the East Coast Mainline, in addition to overhead electricity lines associated with the existing coal-fired power station and other power stations within the wider area.

1.14 A more detailed description of the Site is provided at Chapter 3 'Description of the Site' of the Environmental Statement ('ES') Volume I (Application Document Ref. 6.2).

The Proposed Development

1.15 The main components of the Proposed Development are summarised below:

- The **'Proposed Power Plant'** (Work No. 1) - an electricity generating station with a gross output capacity of up to 2,500 MW located on the main coal stockyard area of the existing coal-fired power station, comprising:
  - Work No. 1A - a combined cycle gas turbine ('CCGT') plant, comprising up to three CCGT units, including turbine hall and heat recovery steam generator buildings, emissions stacks and administration/control buildings;
  - Work No. 1B - a peaking plant and black start plant fuelled by natural gas with a combined gross output capacity of up to 299 MW, comprising a peaking plant consisting of up to two open cycle gas turbine units or up to ten reciprocating engines and a black start plant consisting of one open cycle gas turbine unit or up to three reciprocating gas engines, including turbine buildings, diesel generators and storage tanks for black start start-up prior to gas-firing and emissions stacks;
  - Work No. 1C - combined cycle gas turbine plant cooling infrastructure, comprising up to three banks of cooling towers, cooling water pump house buildings and cooling water dosing plant buildings; and
  - ancillary buildings, enclosures, plant, equipment and infrastructure connections and works.
- The **'Proposed Electricity Connection'** (Work No. 3) - electrical connection works, comprising:
  - Work No. 3A - up to 400 kilovolt ('kV') underground electrical cables to and from the existing National Grid ('NG') 400 kV substation;

  - Work No. 3B - works within the NG substation, including underground and over electrical cables, connection to busbars and upgraded or replacement equipment.

- The **'Proposed Cooling Water Connections'** (Work No. 4) - cooling water connection works, comprising works to the existing cooling water supply and discharge pipelines and intake and outfall structures within the River Aire, including, as necessary, upgraded or replacement pipelines, buildings, enclosures and structures, and underground electrical supply cables, transformers and control systems cables.
- The **'Proposed Ground and Towns Water Connections'** (Work No. 5) - ground and towns water supply connection works, comprising works to the existing groundwater boreholes and pipelines, existing towns water pipelines, replacement and new pipelines, plant, buildings, enclosures and structures, and underground electrical supply cables, transformers and control systems cables.
- The **'Proposed Access and Rail Works'** (Work No. 10) - rail infrastructure and access works, comprising alterations to or replacement of the existing private rail line serving the existing coal-fired power station site, including new rail lines, installation of replacement crossover points and ancillary equipment and vehicular and pedestrian access and facilities.
- The **'Proposed Surface Water Discharge Connection'** (Work No. 9) - surface water drainage connection works to Hensall Dyke to the south-east of the main coal stockyard, comprising works to install or upgrade drainage pipes and works to Hensall Dyke.
- The **'Proposed Gas Connection'** (Work No. 6) - gas supply pipeline connection works for the transport of natural gas to Work No. 1, comprising an underground high pressure steel pipeline of up to 1,000 millimetres (nominal bore) in diameter and approximately 4.6 kilometres in length, including cathodic protection posts, marker posts and underground electrical supply cables, transformers and control systems cables, running from Work No. 1 under the River Aire to a connection point with the National Transmission System ('NTS') for gas No. 29 Feeder pipeline west of Burn Village.
- The **'Proposed AGI'** (Work No. 7) - an Above Ground Installation ('AGI') west of Burn Village, connecting the gas supply pipeline (Work No. 6) to the NTS No. 29 Feeder pipeline, comprising:
  - Work No. 7A - a compound for National Grid's apparatus; and
  - Work No. 7B - a compound for EPL's apparatus.
- The **'Proposed Construction Laydown Area'** (Work No. 2A) - an area for temporary construction and laydown during the construction phase, including contractor compounds and facilities.
- The **'Proposed Carbon Capture Readiness ('CCR') Land'** (Work No. 2B) - an area of land to be reserved for carbon capture plant should such technology become viable in the future. It is proposed that this 'reserve' land is provided on part of the area to be used for temporary construction and laydown.
- The **'Proposed Retained Landscaping'** (Work No. 8) - encompassing the existing mature tree and shrub planting along the northern side of Wand Lane and to the eastern boundary of the existing coal-fired power station site, including that on the embankment around the eastern, southern and western boundaries of the main coal stockyard.

1.16 The 'associated development', for the purposes of section 115 of the PA 2008 comprises Work Nos. 2 to 10 of the Proposed Development.

1.17 It is anticipated that subject to the DCO having been made by the SoS (and a final investment decision by EPL), construction work on the Proposed Development would commence in early 2019. The overall construction programme is expected to last approximately three years, although the duration of the electrical and water connection and gas supply pipeline connection works would be significantly less. The construction phase is therefore anticipated to be completed in 2022 with the Proposed Development entering commercial operation later that year.

1.18 A more detailed description of the Proposed Development is provided at Schedule 1 'Authorised Development' of the draft DCO and Chapter 4 'The Proposed Development' of the ES Volume I (Application Document Ref. 6.2) and the areas within which each of the main components of the Proposed Development are to be built is shown by the coloured and hatched areas on the Works Plans (Application Document Ref. 4.4).

The Purpose and Structure of this document

1.19 The purpose of this document is to comply with Section 4.6 of the 'Overarching National Policy Statement for Energy (EN-1) (Ref. 1-2) and Section 2.33 of the 'National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2), which require developers advancing thermal generating stations to consider the opportunities for CHP. The assessment demonstrates that the Applicant has explored the potential for the plant to operate in CHP mode, exporting heat to off-site users. In order to examine the CHP potential, the use of Best Available Techniques (BAT) for the Proposed Development will be demonstrated by applying the three BAT Tests outlined in the CHP Ready Guidance for Combustion and Energy from Waste Power Plants (EA V1.0 February 2013) (Ref. 1-3).

1.20 A further revision of this CHP-R assessment will take place following completion of the detailed design of the Proposed Development, prior to its commissioning. The revised assessment will be based on potential heat loads agreed with the EA and the specific design of the plant.

1.21 This remainder of this report comprises the following:

- **Section 2** describes the policy context and methodology of the assessment;
- **Section 3** identifies potential heat users and determines a preferred option for potential heat export from the site;
- **Section 4** assesses the feasibility of heat extraction from the Proposed Development based on the current design;
- **Section 5** presents the assessment of the proposed development against the Best Available Techniques (BAT) tests described in the EA guidance, including an assessment of the ability of the plant to satisfy the requirements of CCR in conjunction with CHP-R; and
- **Section 6** presents the conclusions of this assessment.

2.0 CONTEXT AND METHODOLOGY

Context

National Policy Statements

2.1 CHP is the generation of electrical power and usable heat in a single process. This is also known as co-generation. CHP uses a greater proportion of the fuel energy, reducing the energy wasted as low-grade heat when generating electrical or mechanical power.

2.2 The National Policy Statements (NPSs) for energy infrastructure form the policy framework for applications for new generating stations of greater than 50 MW capacity in England and Wales. The NPS of most relevance to the Proposed Development are the Overarching National Policy Statement on Energy (EN-1) and the National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2).

2.3 Section 4.6 of EN-1 deals with the consideration of CHP. Paragraph 4.6.2 states that CHP is technically feasible for all types of thermal generating stations, including gas-fired, nuclear, energy from waste and biomass. Paragraph 4.6.3 goes on to state that the use of CHP reduces emissions and that the Government is therefore committed to promoting 'Good Quality CHP', which denotes CHP that has been certified as highly efficient under the CHP Quality Assurance programme.

2.4 Paragraph 4.6.5 of EN-1 recognises that to be economically viable as a CHP plant, a generating station needs to be located close to industrial or domestic customers with heat demands. The distance will vary according to the size of the generating station and the nature of the heat demand.

2.5 Paragraph 4.6.6 of EN-1 highlights that under guidelines issued by DECC (now BEIS) in 2006, any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must have either included CHP or contain evidence that possibilities for CHP had been fully explored to inform the Secretary of State's (SoS) consideration of the application. The paragraph goes on to confirm that the same principle now applies to any thermal generating station that is the subject of an application for development consent under the PA 2008 and that the SoS should have regard to the DECC guidance, or any successor to it, when considering the CHP aspects of application for thermal generating stations.

2.6 Paragraph 4.6.7 of EN-1 states that:

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

2.7 Paragraph 4.6.8 of EN-1 also states that to encourage proper consideration of CHP, substantial additional weight should be given by the SoS to applications incorporating CHP. If the proposal is for thermal generation without CHP, the applicant should:

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

2.8 Paragraph 4.6.10 of EN-1 states that if not satisfied with the evidence that has been provided, the SoS may wish to investigate this with one or more bodies such as the Homes & Communities Agency (HCA), Local Enterprise Partnerships (LEPs) and Local Authorities.

2.9 According to paragraph 4.6.11 of EN-1; should the SoS identify a potential heat customer that has not been explored, the applicant should be requested to pursue this. If agreement cannot be reached with the potential customer, the applicant should provide evidence demonstrating why this was not possible.

2.10 Paragraph 4.6.12 of EN-1 states that the SoS may wish to impose requirements within any DCO to ensure that the generating station is 'CHP Ready' to facilitate the potential future export of heat, should demand be identified. A Requirement is being proposed within the draft Order for this Proposed Development (see Schedule 2 to the draft Order, Document Ref. 2.1).

2.11 NPS EN-2 reiterates the requirements of EN-1, to either include CHP or present evidence in the application that the possibilities for CHP have been fully explored (paragraphs 2.3.2 - 3).

Department for Energy and Climate Change (DECC) CHP guidance

2.12 The requirements for the assessment of the feasibility of CHP in relation to thermal generating stations are set out in the DECC Guidance on Background Information to Accompany Notifications Under Section 14(1) of the Energy Act 1976 and Applications under Section 36 of the Electricity Act 1989 (December 2006). Paragraph 8 states that the Government expects developers to explore opportunities to use CHP fully, including community heating, when developing proposals for new thermal generating stations. However, it does recognise that in some cases CHP will not be an economic option.

2.13 Paragraph 12 of the Guidance lists what must be included with applications where CHP is not to be included. This includes:

- The basis for the developer's conclusion that it is not economically feasible to exploit existing regional heat markets;
- A description of potential future heat requirements in the area; and
- The provisions in the proposed scheme for exploiting any potential heat demand in the future.

2.14 Paragraphs 13 - 17 provide guidance on exploring opportunities for local users to make use of heat. Developers should fully explore opportunities for existing and likely local users of heat across a range of sectors, including industry, housing and community users. They should also engage with Government agencies, have regard to heat mapping and contact regional and local bodies to identify potential heat users.

2.15 Paragraph 19 stresses that where heat opportunities have been identified, developers should carry out detailed studies on the economic feasibility of these. Paragraphs 20-22 provide further guidance on economic feasibility.

EA CHP Ready Guidance - Combustion & Energy from Waste Plant

2.16 In 2013 The Environment Agency (EA) published detailed guidance on CHP Readiness Assessments as part of the Environmental Permitting regime.

2.17 The EA requires applications for Environmental Permits to demonstrate Best Available Techniques (BAT) for a number of criteria, including energy efficiency. One of the principal ways of improving energy efficiency is through the use of CHP.

2.18 The EA therefore requires developers to satisfy three BAT tests in relation to CHP. The first involves considering and identifying opportunities for the use of heat off-site. Where this is not technically or economically possible and there are no immediate opportunities, the second test involves ensuring that the plant is built to be 'CHP Ready'. The third test involves carrying out periodic reviews to see if the situation has changed and there are opportunities for heat use off site.

2.19 Where Development Consent is granted for a new plant without CHP, the associated application for an Environmental Permit should build on the conclusions of the CHP Assessment and contain sufficient information to demonstrate the new plant will be built 'CHP ready' (for the chosen location and design). The Environment Agency requires that:

> *"all applications for Environmental Permits for new installations regulated under the Environmental Permitting (England and Wales) Regulations 2010 demonstrate the use of BAT for a number of criteria, including energy efficiency. One of the principal ways in which energy efficiency can be improved is through the use of Combined Heat and Power (CHP). With respect to the use of CHP, there are three BAT tests which should be applied. These are as follows:*
>
> ***First BAT Test:***
>
> *The Environment Agency considers that BAT for energy efficiency for new combustion power plant or Energy from Waste (EfW) plant is the use of CHP in circumstances where there are technically and economically viable opportunities for the supply of heat from the outset.*
>
> *The term CHP in this context represents a plant which also provides a supply of heat from the electrical power generation process to either a district heating network or to an industrial / commercial building or process.*
> *However, it is recognised that opportunities for the supply of heat do not always exist from the outset (i.e. when a plant is first consented, constructed and commissioned).*
>
> ***Second BAT Test:***
>
> *In cases where there are no immediate opportunities for the supply of heat from the outset, the Environment Agency considers that BAT is to build the plant to be CHP-Ready (CHP-R) to a degree which is dictated by the likely future opportunities which are technically viable and which may, in time, also become economically viable.*
>
> *The term 'CHP-R' in this context represents a plant which is initially configured to generate electrical power only but which is designed to be ready, with minimum*

modification, to supply heat in the future. The term 'minimum modification' represents an ability to supply heat in the future without significant modification of the original plant / equipment. Given the uncertainty of future heat loads, 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.

Third BAT Test:

Once an Environmental Permit has been issued for a new CHP-R plant, the applicant/operator should carry out periodic reviews of opportunities for the supply of heat to realise CHP. Such opportunities may be created both by new heat loads being built in the vicinity of the plant, and / or be due to changes in policy and financial incentives which improve the economic viability of a heat distribution network for the plant being CHP. "

2.20 The EA guidance reiterates the need for applications for development consent involving generating stations to be supported by a CHP Assessment in line with Section 4.6 of EN-1, which contains details on:

- An explanation of their choice of location, including the potential viability of the site for CHP;
- A report on the exploration carried out to identify and consider the economic feasibility of local heat opportunities and how to maximise the benefits from CHP;
- The results of that exploration; and
- A list of organisations contacted.

If the proposal is for generation without CHP:

- The basis for the developer's conclusion that it is not economically feasible to exploit existing regional heat markets;
- A description of potential future heat requirements in the area; and
- The provisions in the proposed scheme for exploiting any potential heat demand in the future.

2.21 The CHP-R Guidance states that:

"The primary focus of this CHP-R Guidance is on the demonstrations required in an application for an Environmental Permit for new plants under the Environmental Permitting (England and Wales) Regulations 2010. However, the principles contained within this CHP-R Guidance may also have implications on consent applications (i.e. Planning Permission (under the Town and Country Planning Act 1990) or a DCO (under the Planning Act 2008)) for the new plant. Indeed, the Environment Agency will be consulted on these applications, as well as applications for extensions of / variations to existing plants."

2.22 The EA Document "Guidelines for Developments requiring Planning Permission and Environmental Permits" sets out the EA's role in the planning process and its approach to responding to applications for developments which will also require an Environmental Permit.

2.23 In particular, these Guidelines recognise that there may be some interdependencies between planning and permitting requirements. In the case of such interdependencies, the Guidelines recommend early engagement with the EA via their planning pre- application service and, in some cases, a "parallel- tracking" approach is recommended whereby the preparation and submission of the planning and permitting applications is carried out at the same time.

2.24 Therefore, it is recommended that this CHP-R Guidance (and the requirements for CHP-R) is considered prior to making a consent application for a new plant, in particular because the first and second BAT tests may affect the layout, space requirements and building design for the implementation of CHP.

2.25 Accordingly, the EA recommends that the requirement for new plants to be CHP or CHP-R is discussed at the earliest possible stage, ideally during planning pre-application. In any case, where a DCO is required the applicant will have to make similar demonstrations under both the planning and permitting applications in terms of suitability of the location for CHP, potential opportunities for heat supply and CHP-R.

2.26 When consulted by the Planning Authorities on relevant consent applications for new plants, the EA will highlight the need for the plant to be CHP or CHP-R and will make reference to this CHP-R Guidance. Where a DCO is required, the Environment Agency will additionally comment on the results of the CHP Assessment.

2.27 The CHP-R guidance states that:

> *"The Environment Agency will not object to applications for new plants where they are located in areas where there are no opportunities for heat supply. However, where relevant, the Environment Agency will highlight the lack of opportunities to the Planning Authorities and this may influence the Planning Authority in its consideration of the suitability of the proposed location."*

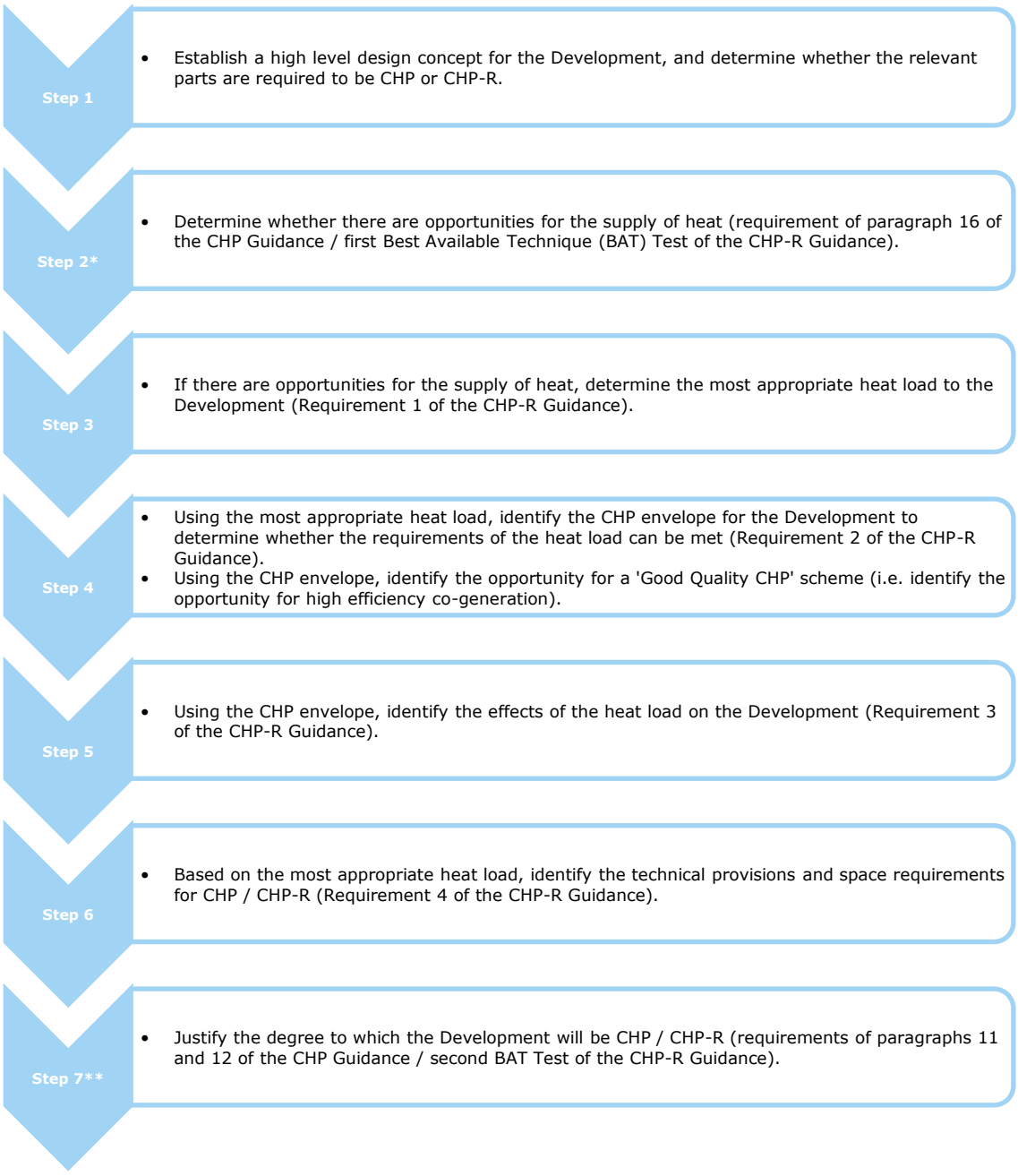
Note on the Implementation of the Energy Efficiency Directive

2.28 In addition to the requirements of the CHP-R Guidance, the Energy Efficiency Directive has been implemented in the UK through the Environmental Permitting (England and Wales) (Amendment) Regulations 2015 (SI 2015 No. 918). From 21 March 2015, these Regulations require operators of certain combustion installations to carry out a cost-benefit analysis (CBA) where opportunities for 'Good Quality CHP' schemes (or high efficiency co-generation) are identified. These schemes are those which achieve at least a 10 per cent saving in primary energy consumption.

Assessment Methodology

2.29 Based on the above, in developing the assessment methodology for this CHP-R Assessment, the requirements of the CHP Guidance and the CHP-R Guidance have been considered holistically and the separate assessment methodologies have been combined. Accordingly, the assessment methodology for this CHP-R Assessment is shown in Figure 2.1.

Figure 2.1: Assessment methodology



3.0 IDENTIFICATION OF POTENTIAL HEAT USERS

Introduction

3.1 A review of the potential heat demand within a 15 km radius of the Proposed Development has been undertaken to assess potential known or consented future developments that may require heat and to identify any existing major heat consumers; i.e. to identify potential heat loads. This enabled the initial design of proposed heat network options to be developed. The potential heat loads have been identified using a review of publicly available datasets on fuel use in the region - the UK CHP Development Map[1], DECC National Heat Map[2], DECC Public CHP Database, available OS data, satellite imagery and aerial photographs from Google Maps and Microsoft Bing Mapping.

3.2 A number of potential heat users exist within a 15 km radius of the Proposed Development, including private and public sector buildings. Following grant of the DCO and issue of the Environmental Permit, the Applicant would be able to prepare Heads of Terms for agreement with potential heat users, if economically viable to do so.

3.3 The technical suitability of connecting potential identified heat users to a district heating system has been considered on the basis of maximising carbon savings and delivering the highest Primary Energy Savings (PES). Larger heat users and those closer to the Proposed Development have been considered ahead of other users on the basis they are more likely to produce an economically viable solution.

3.4 The EA CHP Ready Guidance for Combustion and Energy from Waste Power Plants requires that the heat loads used in a CHP-R assessment be agreed with the Environment Agency. At this stage, due to the number of options under consideration, no consultation with the EA has taken place to date, but discussions with the EA will take place as part of the Environmental Permit application process.

Heat Load Estimation

3.5 The annual heat usage estimates have been based on the UK CHP Development Map, DECC National Heat Map and benchmark heat usage values mainly derived from standardised figures from the Chartered Institution of Building Service Engineers (CIBSE) Guide F (Energy Efficiency in Buildings).

3.6 In the CIBSE Guide, commercial, educational, recreational and other loads are expressed in terms of kWh (thermal) per square metre of floor space per year of fossil fuel use (natural gas is typically assumed). Based on estimates of floor areas and an assessment of the development type, it is possible to estimate annual energy usage. Converting natural gas use to actual heat loads (which might be provided by hot water distribution systems) requires an assumption of domestic gas-fired boiler efficiency. In this CHP assessment, an efficiency of 90% is assumed, based on industry norms. Floor areas for individual heat users have been estimated using dimensioning tools on aerial photographs.

[1] http://chp.decc.gov.uk/developmentmap/
[2] http://tools.decc.gov.uk/nationalheatmap/

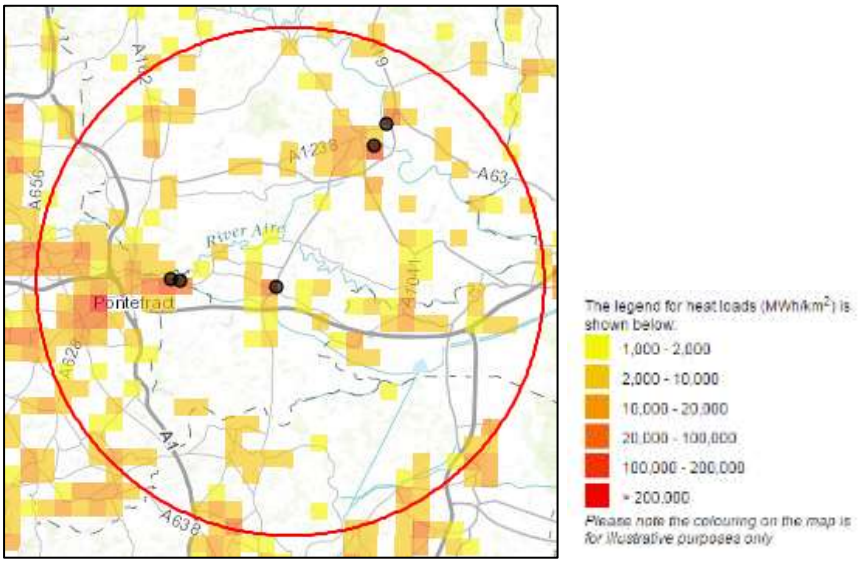
CHP Opportunities

3.7 The CHP Guidance required that CHP Assessments examine the information available on the Online Industrial Heat Map[3] to identify potential CHP opportunities. Since the publication of the CHP Guidance, the Online Industrial Heat Map has been replaced with the UK CHP Development Map[4].

3.8 The results from the examination of the UK CHP Development Map, covering a search area of 15 km centred on the Proposed Development (the CHP search area), are shown in Figure 3.1. The breakdown of the results from the examination of the UK CHP Development Map is shown in Table 3.1.

3.9 In addition a review of planning applications available through the online portals of Selby District Council and Wakefield District Councils was undertaken to determine potential heat users that may be in the planning system, the results of which are presented in the Constraints and Summary section below.

Figure 3.1: Results from the Examination of the UK CHP Development Map



[3] This was available at: http://www.industrialheatmap.com
[4] This is available at: http://chptools.decc.gov.uk/developmentmap/

Table 3.1: Breakdown of the Results from the Examination of the UK CHP Development Map

Sector	% share of total load identified	Estimated instantaneous demand load Identified (MW_{th})
Communications and Transport	0.09	0.4
Commercial Offices	0.10	0.4
Domestic	25.95	122
Education	0.47	2.2
Government Buildings	0.03	0.2
Hotels	0.08	0.4
Large Industrial	69.78	327.9
Health	0.11	0.5
Other	0.02	0.1
Small Industrial	3.03	14.2
Retail	0.20	0.9
Sport and Leisure	0.05	0.3
Warehouses	0.10	0.5
Total heat load in area		**469.9**

3.10 From Table 3.1 it can be seen that the largest heat loads within the CHP search area were related to:

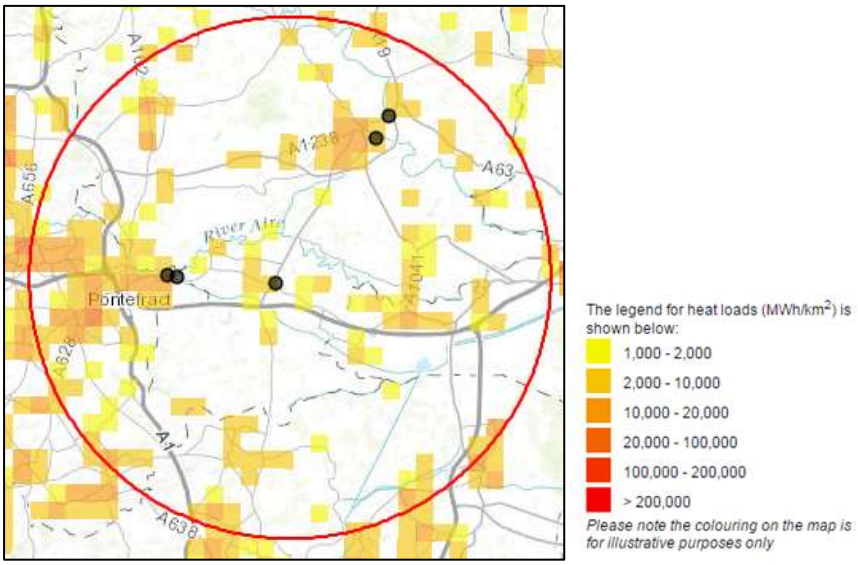
- Domestic;
- Large Industrial; and, to a lesser extent,
- Small Industrial.

Each of these are discussed in turn below.

Domestic

3.11 In terms of the domestic heat loads within the CHP search area, the results from the UK CHP Development Map are shown in Figure 3.2.

Figure 3.2: Domestic Heat Load Results from the Examination of the UK CHP Development Map



3.12 The CHP Development Map outputs results show that the domestic heat load within the CHP search area is 122 MW, approximately 26 per cent of the total heat load within the CHP search area. Based on Figure 3.2, this domestic heat load appears to be spread across the settlements that lie within the CHP search area, in particular at Pontefract to the west of the proposed Development site.

3.13 In combination with the domestic heat load spread, NPS EN-1 states (at paragraph 4.6.5) in terms of district heating networks that:

"*A 2009 Report for DECC[5] on district heating networks suggested that, for example, a district heating network using waste heat from a generating station would be cost-effective where there was a demand for 200 MW_{th} of heat within 15 km. Additionally, the provision of CHP is most likely to be cost-effective and practical where it is included as part of the initial design and is part of a mixed-use development. For example, retrofitting a district heating network to an existing housing estate may not be efficient*".

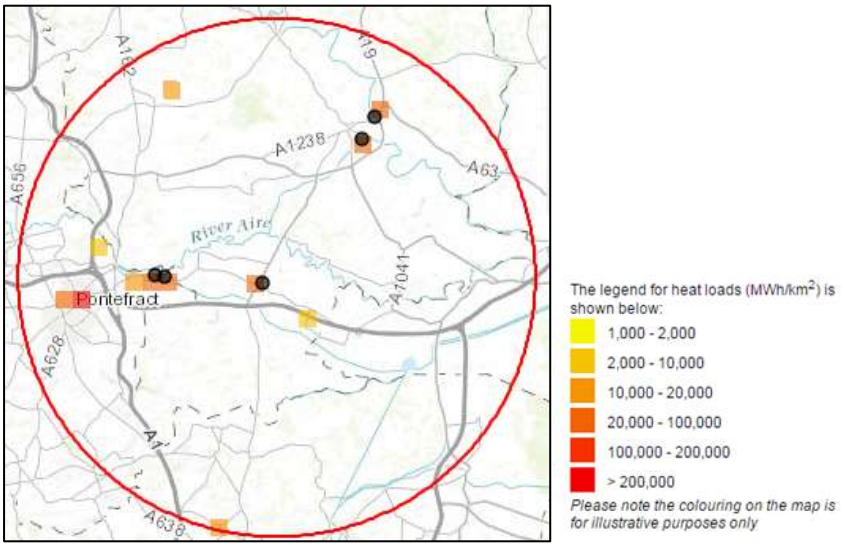
3.1 As the domestic heat load falls below the indicative 200 MW_{th} threshold and is spread across the CHP search area (i.e. is characterised by disparate, smaller settlements) and is not representative of a new heat load, the costs and practical benefits of including it as part of any initial design cannot be realised. Therefore, this domestic heat load is not considered to be a viable CHP opportunity. Further assessment of potential domestic heat loads has been considered through a review of planning applications. This is presented in the constraints and summary section below.

Large Industrial

3.2 In terms of the large industrial heat loads within the CHP search area, the results from the specific examination of the UK CHP Development Map are shown in Figure 3.3.

[5] 'The Potential and Costs of District Heating Networks', April 2009. Pöyry and Faber Maunsell

Figure 3.3: Large Industrial Heat Load Results from the Examination of the UK CHP Development Map



3.3 The results show that large industry represents the largest demand available in the CHP search area (322MW or nearly 70% of the total). This is comprised of large individual loads identified and a number of other industrial sites.

3.4 This very large figure appears to be due almost entirely (90%) to large industry within Pontefract (indicated by the red square in Figure 3.3). However, examination of industry within this area could not identify a demand of this size. A review of the CHP readiness report for the FM2 development at Ferrybridge Power Station (located in close proximity to this area) similarly did not identify a demand of this magnitude.

3.5 Five large heat loads were identified from examination of the UK CHP Development Map within the CHP search area; these are identified on Figure 3.3 above. From an interrogation of the Development Map and a review of other mapping sources, these have been identified as:

- Seldocol, Selby[6];
- Allied Glass Containers, Knottingley;
- Glencore Grocery;
- Tradebe, Knottingley;
- Ardagh Glass, Knottingley; and
- Saint Gobain Glass, Eggborough.

3.6 The estimated instantaneous heat demand associated with these sites (identified from the UK CHP Development Map) is shown in Table 3.2 below.

[6] It is not clear from the UK CHP map if this is the correct location. However, given that it is the largest industry within a 2km radius of the identified large heat load, it is assumed that the load refers to this business.

3.7 In addition to the large heat demands identified, a number of other potentially significant industrial heat demands were also identified in the following areas:

- To the west of the A1 within the town of Pontefract. This area is associated with a number of medium scale industrial operations including:
  - Tangerine Confectionery (food manufacture);
  - Cott Beverages (drink manufacture); and
  - Baileygate Industrial Estate.
- To the south-east of the site in the vicinity of the village of Great Heck. This may be associated with Plasmor (construction materials manufacture); and
- To the northwest of the site in the vicinity of the village of Sherburn-in-Elmet. This may be associated with the British Gypsum plasterboard manufacturing site.

3.8 The estimated heat demand associated with the identified large industrial users is shown in Table 3.2 below

Table 3.2: Identified large Industrial Heat Demand

Site	Nature of business	Distance from the proposed development	Estimated instantaneous Heat Demand (MW_{th})
Seldocol UK Ltd., Deniston Road, Selby	Grain Alcohol Distillers	9.4km	10.8[7]
Allied Glass Containers, Fernley Green Road, Knottingley	Glass Manufacture	6.9km	9.3[7]
Greencore Grocery Barlby Rd, Selby	Food Manufacture	10.8km	3.5[7]
Tradebe Solvent Recovery, Weeland Road, Knottingley	Waste Management	6.5km	2.8[7]
Saint Gobain Glass, Weeland Road, Eggborough	Glass Manufacture	0.8km	2.4[7]

[7] Derived from the UK CHP Development map

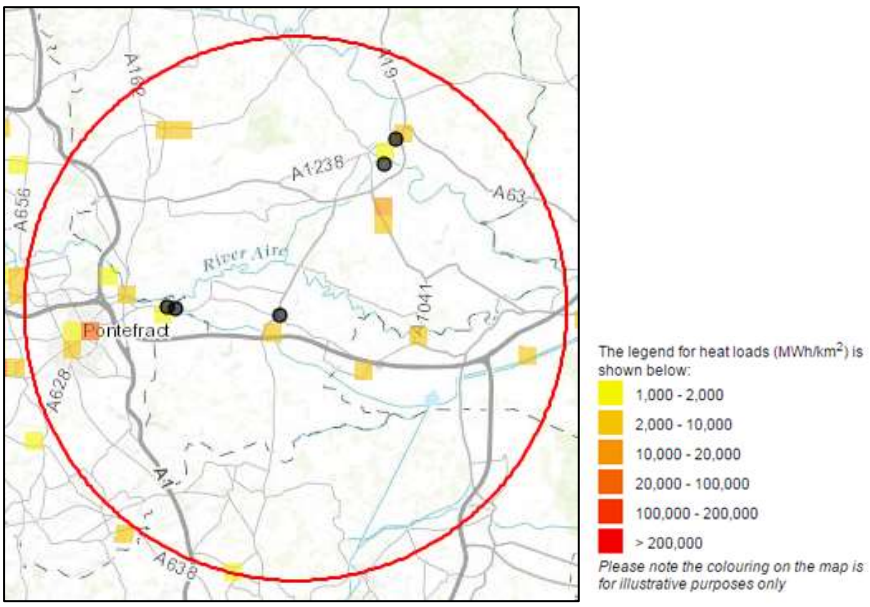
Site	Nature of business	Distance from the proposed development	Estimated instantaneous Heat Demand (MW_{th})
Tangerine confectionery, Cott Beverages and Baileygate industrial estate	Food and Drink manufacture, various light industry	11.4km	2.5
Plasmor, Green Lane, Great Heck	Concrete Product Manufacture	3.4km	0.6
Ardagh Glass, Spawn Bone Lane	Glass Manufacture	8.3km	0.6
British Gypsum, Fenton Ln, Sherburn in Elmet,	Plasterboard Manufacture	12.4km	0.5
Total			**33**

3.9 Three of the identified users are glassworks, which do not require low grade heat or steam as they rely on natural gas-fired high temperature furnaces, and also have extensive heat recovery systems installed on the furnaces, so while they are listed in Table 3.2, they are unlikely to provide realistic heat loads for the Proposed Development. Accordingly, they are not considered as viable demands and are not included as part of the demand making up the preferred option.

Small Industrial

3.10 In terms of the small industrial heat loads within the CHP search area, the results from the specific examination of the UK CHP Development Map are shown in Figure 3.4.

Figure 3.4: Small Industrial Heat Load Results from the Examination of the UK CHP Development Map



3.11 The smaller heat load opportunities identified are:

- Northside Industrial Park at Whitley Bridge;
- Small industry in at Snaith Road and Gowdall Lane, Pollington (Pet food manufacture);
- Small industry to the north of Snaith (timber merchant); and
- Croda Chemical works at Rawcliffe Bridge.

These are summarised in Table 3.3. No significant industry could be identified in the area south of Selby.

Table 3.3: Identified Small Industrial Heat Demand

Site	Nature of business	Distance from the proposed development	Estimated instantaneous demand Identified (MW_{th})
Northside Industrial Park	Various light industrial / commercial	2.2km	0.2
Burgess Pet Care, Snaith Road, Pollington	Pet Food Manufacture	5.km	0.1
Screetons, Gowdall Lane, Snaith	Timber Merchant	6.5km	0.0

Site	Nature of business	Distance from the proposed development	Estimated instantaneous demand Identified (MW_{th})
Croda Chemical works	Chemical manufacture	12.8km	2.5
Total			**2.8**

Review of online planning portals

3.12 A review of the online planning portals of Selby District Council and Wakefield District Council identified the following applications that may represent future potential heat users (on the basis that planning permission is subsequently granted):

- 2016/1343/OUTM | Outline application for the construction of an employment park up to 1.45 million sqft. (135,500sqm) gross floor space comprising B2, B8 and ancillary B1 uses, ancillary non-residential institution (D1) and retail uses (A1- A5) and related ancillary infrastructure at the former Kellingley Colliery, Knottingley. Located approximately 5.2km from the Proposed Development Site. Depending on the type of premises ultimately constructed, this development could potentially present an estimated heat demand of 1.5-3MW_{th}[8]
- 2014/0659/FUL | Proposed development of 99 residential dwellings and associated access and landscaping works at land off Selby Road Eggborough Goole East Yorkshire. This was granted on 4 July 2014 and is believed to be under construction, accordingly there may be limited opportunity for connection except as retrofit. This development is estimated to represent an estimated heat demand of 0.26 MW_{th}.

3.13 In addition, a number of other energy developments have been identified in close proximity to these future heat loads which may offer preferential CHP provision to these options than this Proposed Development. They include:

- Southmoor Energy Centre (26MW Energy from Waste Plant), consented May 2014, immediately adjacent to the Kellingley redevelopment site;
- Knottingley Power Station (1500MW CCGT), consented March 2015, located 0.8 km from the Kellingley redevelopment site; and
- Ferrybridge Multifuel Plants 1&2 (158MW multifuel plants), fully consented October 2015, located 5 km from the Kellingley redevelopment site.

3.14 All of these plants or developments lie close to the potential future heat loads and may offer significant heat provision to meet the entire demand of these schemes. However, for the purpose of this report, these schemes are considered as part of the potential heat load. It should be noted that the Kellingley site is a planning application currently under consideration by the local

[8] Based on the energy benchmarks contained within CIBSE Guide F (Energy Efficiency in Buildings)

authority. It is not considered to be a current viable CHP opportunity at this time, as planning approval would be needed and further information on potential users of heat would be required.

Constraints and Summary

3.15 As can be seen there is substantial potential heat demand within the CHP search area, however, this demand is distributed over a wide area and predominantly more than 7 km from the Proposed Development Site. Out of the potential heat loads identified, industrial heat demand is considered to offer the most viable prospect for CHP from the Proposed Development based on current loads. This demand occurs in a number of locations associated (approximately) with the major conurbations within the CHP search area (Knottingley, Selby, Goole).

3.16 Although these locations occur within the CHP search area, there are a number of constraints that may impede connection to the Proposed Development. These include:

- Railway lines, including the East Coast Mainline, which runs north-south approximately 2km east of the Proposed Development Site and the Pontefract line which runs east-west approximately 1km south of the Site;
- Rivers including the River Aire which runs east-west, approximately 1km north of the Site; and;
- Motorways and major roads, including the M62 which runs east-west approximately 1.4km south of the Site and the A1 which runs north-south approximately 10km west of the Site.

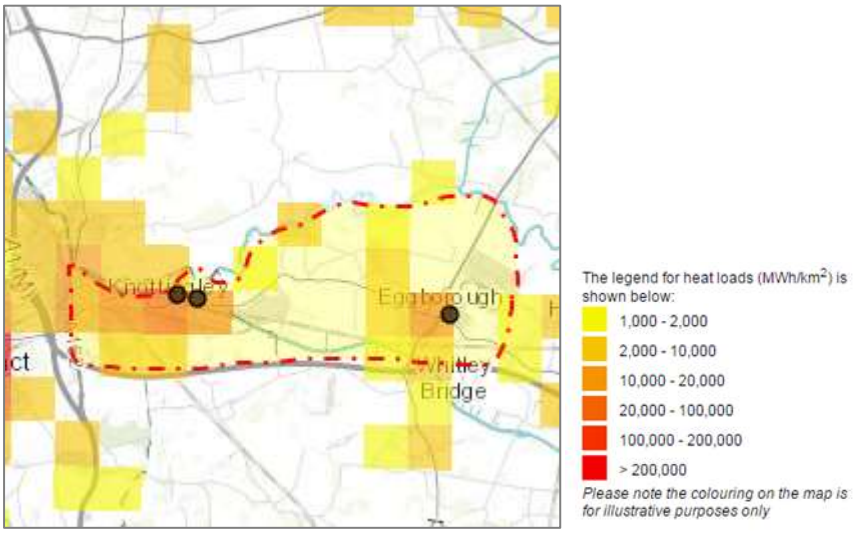
3.17 Although none of these constraints are considered insurmountable, they can pose engineering challenges and add considerably to the cost of installing the necessary pipework. These constraints, coupled with the large distances between the Proposed Development Site and the larger identified heat loads (typically greater than 7km) and the relatively low density demand in these areas means that they have been discounted as feasible options for the installation of CHP for the Proposed Development at this time.

Preferred Option

3.18 Taking these constraints into account, the most feasible potential CHP provision option is considered to relate to industrial demand along a corridor bounded by the M62 to the south, the River Aire to the north and the A1(M) to the west. Analysis of the UK CHP Development map indicates an approximate average instantaneous demand of 19MW_{th} for large and small industry along this corridor. This is therefore considered to be the largest potential heat load option for the purposes of this assessment.

3.19 This corridor is shown in Figure 3.5 below.

Figure 3.5: Total Heat Load Results from the Examination of the UK CHP Development Map – constraints corridor



3.20 This demand includes the identified demands of Tradebe, Plasmor and the Northside Industrial Estate. To this figure have been added the potential demands identified through the review of the planning portals making a maximum indicative instantaneous demand of 22.26MW_{th}.

4.0 HEAT EXPORT FEASIBILITY STUDY

Introduction

4.1 This Section assesses the feasibility for heat extraction and export from the Proposed Development for comparison with the identified CHP heat load from Section 3.3. The Proposed Development is a gas fired electricity generation comprising large combined cycle gas turbines (CCGTs) that are envisaged to operate for a period each day to help meet national electricity demand, with additional smaller intermittent or 'peaking' generation that is only expected to operate for up to 20% of the year. The peaking plant will be either reciprocating engines or Open Cycle Gas Turbines.

4.2 For the purposes of this assessment, only the CCGT units have been considered in determining the available heat load from the Proposed Development, as the peaking plant will only operate for a limited number of hours a year. In addition, the preferred option identified in this study consists primarily of industrial heat users, who are considered more likely to have a use for heat in the form of steam. Neither generation technology under consideration for the peaking plant includes for the production of steam, therefore the peaking plant is considered unlikely to be able to supply the heat as steam identified in the preferred option. The peaking plant is not considered a viable CHP provider in its own right and is considered unlikely to be able to provide backup heat.

Heat extraction

4.3 There a number of options for extracting heat from the CCGT units. These can be summarised as:

- Extraction from the Condenser;
- Extraction from the exhaust gas; and
- Extraction from the steam turbine.

The following sub-sections consider these in more detail.

Condenser

4.4 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. This is not likely to affect the power generation (apart from a small increase in the parasitic electrical load).

Exhaust gas

4.5 Exhaust gas from the outlet of the HRSG will contain water in vapour form. This flue gas is proposed to be discharged at a maximum temperature of around 75°C. It 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. Similarly to the heat available from the condenser, this does not affect the power generation from the plant apart from the increase in parasitic load.

4.6 Condensing the flue gas can be achieved in a wet scrubber. However, the scrubber temperature is typically no more than 80°C, which restricts the hot water temperature available for the customer. Alternatively a heat exchanger can be used. This can provide higher hot water

temperatures although corrosion of the tubes can be an issue unless specialist materials are used (such as PTFE tube bundles).

4.7 Additional cooling of the flue gas is likely to result in the frequent production of a visible plume from the stack. The water condensed from the flue gas could be recycled with other process effluent. However, if this is not possible it would need to be treated and then discharged.

Steam turbine

4.8 Steam extracted from the steam turbine can be used directly or to generate hot water. It is extracted from the turbine at low pressure to maximise the power generated from the steam. Extracting steam in this way reduces the electrical generation capacity of the generating station.

Conclusion

4.9 At this time, there would appear to be limited demand for low grade heat, with steam or hot water (75°C-115°C) likely to be of more use. Therefore, heat from the condenser or flue gas is not considered further; with steam extracted from the cold reheat line of the HP turbine selected as the preferred method of heat extraction. This method also offers the most flexibility for allowing heat to be supplied to future developments.

4.10 In accordance with the second BAT Test of the EA CHP Ready guidance, this assessment assumes that, given the uncertainty of future heat loads, the initial electrical efficiency of the CHP Ready Proposed Development is to be no less than that of the equivalent non-CHP-R plant. The amount of heat that could be extracted from a single steam turbine without reducing the efficiency below that of an equivalent non CHP-R plant, is considered to be approximately 33 MW_{th}

Identification of the CHP Envelope

4.11 Based on the assumption of extraction from the reheat cycle, the following calculations have been performed to determine the heat and power envelope. The envelope limits are defined as follows:

- A: Minimum Stable Load (with no Heat Extraction)
- B: Minimum Stable Load (with maximum Heat Extraction)
- C: 100 per cent Load (with maximum Heat Extraction)
- D: 100 per cent Load (with no Heat Extraction)

The CHP efficiency (η_{CHP}) is defined as:

$$\eta_{CHP} = \frac{\text{Net Process Heat Output + Net Power Output}}{\text{Fuel Input}}$$

4.12 Additionally the heat loads where 'Good Quality CHP' schemes would be feasible are also defined. This is shown as the Primary Energy Saving (PES) locus. Heat loads above the PES locus would mean that there would be a 10 per cent saving in primary energy consumption.

4.13 However, it should be noted that the heat and power envelopes should not be considered as definitive, and would ultimately depend on the required steam conditions and the steam turbine design of the CCGT unit.

4.14 The envelope is based on thermodynamic models developed for the envelope limits defined above.

4.15 The heat and power envelope for the CHP-R design is shown in Figure 4.1. The performance of the CCGT unit (i.e. the indicative heat and power envelope data) is summarised in Table 4.1. This information has been extracted from the thermodynamic models of an appropriate, efficient, single 'H' class single shaft unit.

4.16 Output from a single unit has been considered as the plant Load Factor is not expected to be baseload over the life of the Proposed Development; maximum output from all three units is therefore unrealistic. While it is likely that all units would operate at the same time during normal operation, extracting heat from a single unit would allow some – albeit limited - redundancy in the system during maintenance periods on a single unit.

4.17 The identified potential heat load (22.26MW) is shown in red.

Figure 4.1: CHP Envelope for the CHP-R design (one unit)

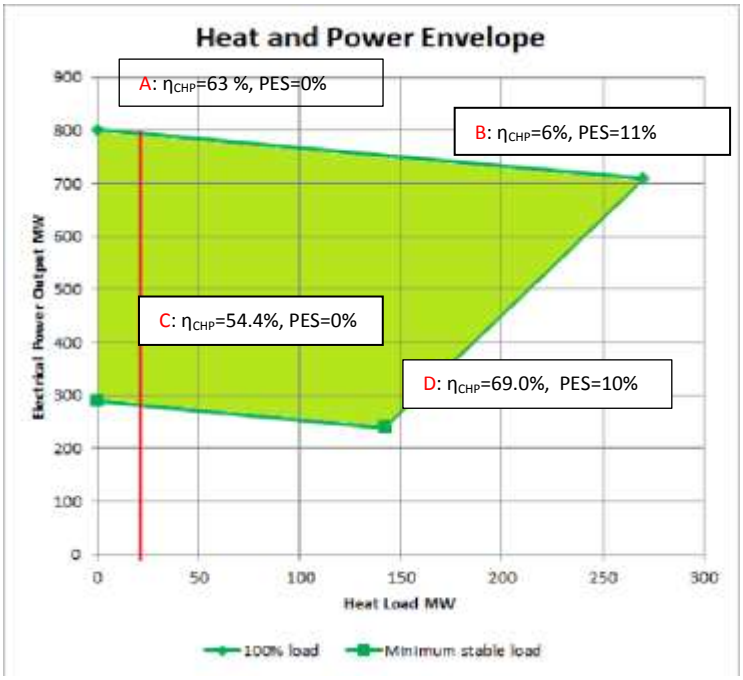


Table 4.1: Indicative CHP Envelope (one unit)

		No Heat Extraction	Maximum Heat Extraction
100 Per Cent Load		**A**	**B**
Fuel Input*	MW	1282	1282
Net Process Heat Output	MW	0	270
Net Electrical Power Output	MW	801	710
Total Heat and Power Output	MW	801	980
CHP Efficiency	%	62.5	76.4
Minimum Stable Load (MSL)		**D**	**C**
Fuel Input*	MW	567	568

		No Heat Extraction	Maximum Heat Extraction
Net Process Heat Output	MW	0	142
Net Electrical Power Output	MW	289	239
Total Heat and Power Output	MW	289	381
CHP Efficiency	%	51	67

*Based on the LHV value

Summary

4.18 Figure 4.1 and Table 4.1 indicate that a CCGT unit could meet the identified demand without exceeding the maximum identified heat extraction of 33MW_{th}.

4.19 The PES calculations show that any 'Good Quality CHP' schemes may lie within the identified heat and power envelopes. It should be noted that the PES calculations do not take into account heat transmission losses. Given the length of pipework required, these losses may be significant and may therefore require a bespoke steam cycle design.

Further Consideration of CHP

4.20 To allow the identified (and any additional future) potential CHP opportunities to be realised, should it be economic to do so, the design and final build of the Proposed Development will incorporate a number of appropriate provisions which will allow for the future implementation of CHP. At this stage, as no immediately viable CHP opportunities have been identified, the design of the CCGT units would be identical to conventional CCGT units with the inclusion of an accessible tie-in location at the HP steam turbine exhaust (from the cold re-heat line).

4.21 Accordingly, the CCGT units will be designed and built to be CHP-Ready in accordance with EA second BAT Test.

Potential Challenges of Operating as a CHP System

4.22 Whilst the CCGT units will be designed and built CHP-R, the ultimate implementation of CHP at the Proposed Development would be dependent on a number of factors. These factors include:

- Compatibility of the running regime of the CCGT units with the requirements of the heat load. The anticipated role of the Proposed Development is to provide flexible capacity to the National Grid National Electricity Transmission System to compensate for the intermittency of renewables. Therefore, the running regime and load of the CCGT units is likely to be variable. The plant will certainly be designed to run as a 'two-shifting' plant to be run up to its maximum load twice a day to meet peak grid demand, and potentially switched off in between. In contrast, a primary requirement of a viable and effective CHP scheme is that it should be capable of meeting the requirements of the identified heat load that is likely to be steady and consistent over the majority of the year, particularly for district heating schemes or steady state industrial processes. As a result, the ultimate running regime and load of the CCGT units may not coincide with the requirements of the identified heat load, and this incompatibility may affect the viability and effectiveness implementing any CHP scheme. As outlined previously, while there are up to three proposed CCGT units at the Proposed Development, and theoretically one unit could provide redundancy for another, it is not possible to say with any certainty whether the

units will be operated in isolation and the current expectation is for all three units to operate at the same time, subject to maintenance regimes. Therefore, the level of redundancy in the system is expected to be low;

- Technical challenges of a routing network for steam/ heat pipes, especially with the distances involved here. A detailed assessment of routing options would be required to determine the technical feasibility of heat export to the identified demand; and
- Timing of heat availability. Given that the lead in time to beneficial operation of the CCGT is around 4 years, and the availability of heat for export, the demand identified in this report may have changed.

Economic Assessment

4.23 Although at this stage no viable opportunity has been identified and a detailed financial assessment is not possible, a high level economic appraisal has been undertaken, with costs estimated based on previous experience with other schemes. This appraisal takes into account the following:

- Estimated capital costs;
- Estimated operational and maintenance costs for the heat network;
- Estimated revenues from the sale of heat; and
- The estimated reduction in electricity revenue due to the reduction in electricity produced by the Proposed Development as a result of exporting heat.

4.24 No other running costs or administrative costs associated with operation of the Proposed Development are considered.

Financial Assumptions

4.25 This economic assessment is based on revenue from heat sales only. The financial parameters considered are detailed below.

- Assumed lost power value: £38/MWh_e (2017)
- Assumed gas price: £14.86/MWh_{th} (2017)
- Assumed heat price: £17.48/MWh_{th} (2017)

4.26 The heat and lost power price has been derived from the current commercial gas and electricity prices based on DECC's data[9]. The gas price has been converted to an output energy unit price, to provide a benchmark competitive price for the energy supplied. The unit gas price for district heating users has been estimated at £14.86/MWh_{th}. If a reasonable boiler efficiency of 85 % is applied, the output energy unit price will be £16.51/MWh_{th}.

[9] Data was taken from https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2016 and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254831/Annex-m-growthassumptions and prices.xls

4.27 A 10 year project life in the financial model was assumed for this CHP assessment. This is based on the premise that it will be difficult to secure heat supply contacts in excess of 10 years and that the energy market could change significantly over that period. It is assumed that heat supply contracts will either be renewed or replaced and that the heat load will remain constant over a longer period, but that the commercial terms would almost certainly change. There is no guarantee that the assumed level of market penetration can be sustained over a term longer than 10 years.

Capital Cost

4.28 The capital cost of any heat network would depend on several factors, the main ones being the type, length and size of the pipe work required and physical barriers or constraints to be overcome in the network route. These factors have been considered at a high level to estimate the capital cost of the network, but this costing can only be indicative at this stage and would need to be reviewed as more detailed information becomes available. The market has not been approached at this stage to validate any of the estimated costs, so there is a risk that the actual prices may be higher than the estimated prices. Wherever possible, capital costs have been based on information from similar projects. For the purpose of this assessment, an indicative figure of £750,000 per km has been used with a total pipework length of 12 km.

4.29 Other capital cost items including the installation of primary and secondary heat stations and back-up systems totalling a cost of £3M, making total estimated capital cost of £12M.

Operational and maintenance cost

4.30 Operational costs are assumed to include the costs of inspection and basic maintenance of the infrastructure plus costs associated with treatment chemicals and the running costs of pumps and of the backup system. This is estimated to be £400,000 per year including staff wages.

Results

4.31 Under these assumptions, the potentially identified scheme does not represent an economically viable solution; however, this is recognised to be marginal, with a 10% reduction in capital costs potentially producing a positive rate of return. A summary of the output of the financial model is shown in table below.

Table 5.1: Financial Model Outputs

	Output: £12m capital cost	Output: £11m capital cost
Capital cost	£12,000,000	£11,000,000
Capital repayments (assuming 2% APR)	£1,335,918	£1,224,592
Annual operational cost	£400,000	£400,000
Annual Profit/loss (10 year window)	-£107,050	£4,280
NPV	-£890,280	£35,580
IRR (pre-tax)	-0.4%	0.02%

4.32 This assessment is only intended as a rough guide and is not intended to replace a full financial appraisal.

5.0 BAT ASSESSMENT SUMMARY

5.1 The EA CHP Guidance states that the EA requires applications for Environmental Permits to demonstrate Best Available Technology (BAT) for a number of criteria, including energy efficiency. Aside from the selection of efficient turbines, one of the principal ways of improving energy efficiency is through the use of CHP. The EA therefore requires developers to satisfy three BAT tests in relation to CHP. The first involves considering and identifying opportunities for the use of heat off-site. Where this is not technically or economically possible and there are no immediate opportunities, the second test involves ensuring that the plant is built to be 'CHP Ready'. The third test involves carrying out periodic reviews to see if the situation has changed and there are opportunities for heat use off site.

5.2 The EA CHP Guidance BAT Requirements have been fulfilled for the Proposed Development as outlined in this section.

First BAT test

5.3 The Proposed Development will not be operated as a CHP plant at the outset of commercial operation as no economically viable opportunities for the supply of heat have been identified to date. Uncertainties in terms of the design and running regime mean that a clear offer to potential heat users cannot be made at the present time and no defined heat loads in close proximity to the Site that require committed heat provision from 2021 onwards have been identified

Second BAT test

5.4 The Proposed Development will be built to be 'CHP Ready' for the identified loads. The final heat export capacity provided will be determined at detailed design stage and will reflect the load potential available at that time. This will ensure that the Proposed Development is designed and built to allow for the future implementation of CHP if the identified or potential future heat loads become economically viable. It is likely that the heat load available from the Proposed Development would be the load from a single CCGT unit without modification or oversizing of the steam turbine; the other two CCGT units and / or the peaking plant could potentially be used to improve redundancy in the system but predicted Load Factors preclude the committed use of heat from all units simultaneously.

5.5 In accordance with the second BAT Test of the EA CHP Ready guidance, this assessment assumes that, given the uncertainty of future heat loads, the initial electrical efficiency of the CHP Ready Proposed Development is no less than that of the equivalent non-CHP-R plant. Therefore, the concept design of the plant assumes heat will be extracted through the cold-reheat line of the HP turbine. To install direct steam extraction from the turbine may significantly reduce the electrical efficiency of the Proposed Development and would increase its capital cost and is therefore not considered to represent BAT at this time.

5.6 The "CHP Envelope" for the Proposed Development has been identified to demonstrate that it will meet the identified heat loads within its likely operational profile. The CHP Envelope demonstrates that the annual average heat loads of currently identified heat network options are theoretically within the operational ranges of the Proposed Development, however the current density of heat requirements, distances from the Site and the fact that the Proposed Development will not be operational until 2021 at the earliest, mean that commercially viable opportunities for the use of off-site CHP have not been identified.

5.7 Operation of the Proposed Development in CHP mode with the method of heat extraction identified, at an identified heat load of circa 20MW, is not considered to significantly affect the electrical efficiency of the plant. This is due to the method of heat extraction and the small relative proportion of heat extraction in comparison with the overall generation capacity. It is recognised that a high proportion of heat extracted would result in a drop in electrical efficiency that may not pass this BAT test.

5.8 Sufficient space will be allocated for future retrofit of a heat offtake within the Proposed Development footprint, should that be required. Potential routes for water or steam pipelines to the boundary of the Site would be feasible and will be maintained within the plant design, although since no specific CHP opportunity has been identified, no route corridor has been determined.

Third BAT test

5.9 Once the Proposed Development is operating as a CHP Ready plant, the Applicant will also carry out an ongoing review of CHP potential, including:

- Instigate an action plan as outlined in Appendix 2 of this report;
- Maintaining a dialogue with key heat users as set out in the proposed action plan ;
- Carrying out regular reviews to determine if there have been sufficient changes in circumstances to warrant a new technical and financial assessment; and
- Re-visiting the technical and economic assessments at least every 5 years or when a change in circumstances warrants.

CHP and Carbon Capture

5.10 As the CCGT component of the Proposed Development has an output in excess of 300MW, the Carbon Capture Readiness (Electricity Generating Stations) Regulations 2013 apply to the CCGT, which must therefore be designed to be Carbon Capture Ready (CCR). The EA CHP-R Guidance then requires that consideration should be given to the ability of the plant to satisfy the requirements of CCR in conjunction with CHP-R.

5.11 This consideration allows for the identification of a 'CHP and Carbon Capture Envelope'. The CHP and Carbon Capture Envelope represents the likely range for the operation of the new plant with carbon capture where it could be technically feasible to operate electrical power generation with carbon capture and heat generation at a later date.

5.12 In determining the CHP and Carbon Capture Envelope for the Proposed Development, the effect on the operation of the generation units as a result of the carbon capture plant has to be considered. In this instance, the retro-fitting of the Carbon Capture equipment would result in an additional steam demand and parasitical electrical load[10]. This additional load comprises an estimated 115MW of steam and 130MW additional parasitic electrical load.

[10] See Carbon Capture Readiness assessment for Eggborough CCGT

5.13 For the purposes of calculating a CHP and Carbon Capture envelope, this steam demand is assumed to be taken directly from that available for CHP - there are differences in the steam requirements for the carbon capture plant and that being made available for CHP and the 115MW refers to an overall drop in the steam turbine electrical output. However, it is considered a reasonable figure for the purposes of the envelope calculations. The parasitic load is accounted for in the drop in electrical energy available as output from the station. This has a direct result on the overall plant efficiency.

5.14 It is acknowledged that the energy and steam requirements for the carbon capture plant may vary depending on the running mode of the plant. i.e. operating under minimum stable load may require less steam and electricity to run the carbon capture plant than under 100% load. However, it is not considered that the steam and electricity demand is likely to be directly proportional to the load. For the purposes of calculating the envelope, it is assumed to be unchanged.

5.15 The projected steam and electrical demand of the carbon capture plant coupled with the identified CHP heat demand exceeds the capacity of a single CCGT unit operating under minimum stable load conditions. Therefore, for the purpose of this assessment, heat and electricity are assumed to be extracted from a combination of all three CCGT units for the CCS provision.

5.16 As with the CHP heat export feasibility assessment above, the largest potential H Class CCGT units have been considered. This is the same assumption as was used in the CCR readiness assessment.

5.17 The heat and power envelope for the CHP-R design plus carbon capture is shown in Figure 5.1. The performance of the CCGT unit (i.e. the indicative heat and power envelope data) is summarised in Table 5.2.

Figure 5.1: CHP Envelope for the CHP-R design (three units) including Carbon Capture

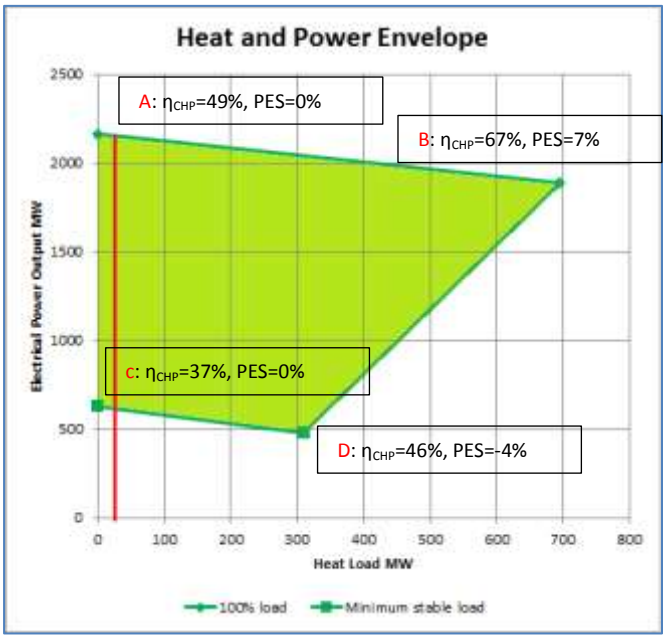


Table 5.2: Indicative CHP and Carbon Capture Envelope (three units)

		No Heat Extraction	Maximum Heat Extraction
100 Per Cent Load		**A**	**B**
Fuel Input*	MW	3845	3845
Net Process Heat Output	MW	0	695
Net Electrical Power Output	MW	2273	1997
Total Heat and Power Output	MW	2273	2692
CHP Efficiency	%	59	70
Minimum Stable Load (MSL)		**D**	**C**
Fuel Input*	MW	1701	1701
Net Process Heat Output	MW	0	426
Net Electrical Power Output	MW	737	587
Total Heat and Power Output	MW	737	1013
CHP Efficiency	%	42	59.6

*Based on the LHV value

5.18 As shown in Figure 5.1 and Table 5.1 above, the identified potential heat loads of circa 21MW lie within the theoretical operating envelope of the plant with the addition of carbon capture. The steam extraction for the purposes of the carbon capture plant is anticipated to be from the CCGT IP/ LP crossover as opposed to the cold reheat line of the HP turbine for CHP-R purposes. This is not anticipated to represent a technical barrier in terms of operating the plant with both CHP and Carbon Capture.

5.19 The Proposed Development is therefore considered to satisfy the requirements of CCR and be CHP-R.

6.0 CONCLUSIONS

6.1 In line with the requirements of NPS EN-1 and EN-2 and the EA CHP Ready Guidance, this CHP Assessment has been undertaken to support the application for a DCO and meet the BAT requirements of the CHP Ready Guidance.

6.2 In accordance with the second BAT Test of the EA CHP Ready guidance, this assessment assumes that, given the uncertainty of future heat loads, the initial electrical efficiency of the CHP Ready Proposed Development is to be no less than that of the equivalent non-CHP-R plant.

6.3 This CHP assessment demonstrates that the Proposed Development meets the BAT tests outlined in the EA CHP Ready Guidance. It therefore will be designed and built as 'CHP Ready' to supply any identified viable heat load up to a potential maximum of 33MW and sufficient to meet the identified load of 21 MW_{th}. This will allow for the future implementation of CHP as and when the identified heat loads become economically viable.

6.4 The CHP Assessment has indicated that there are a number of theoretical identified heat users within a 15 km radius of the Proposed Development. These include:

- A total domestic annual average heat load of approximately 122 MW_{th} across the whole search area;
- A total small industrial annual average heat load of approximately 14.2 MW_{th} across the whole search area;
- A total large industrial annual average heat load of approximately 327.9[11] MW_{th} across the whole search area.

6.5 In addition, there is one potential future CHP opportunity identified through a review of projects currently in the planning system, and future CHP opportunities could potentially be identified during the period in which the Proposed Development is consented and moves towards construction and operation.

6.6 It is considered that the most feasible option relates to meeting industrial heat demand along a corridor bounded by the M62 to the south, the River Aire to the north and the A1(M) to the west. Analysis of the UK CHP Development map indicates an approximate average instantaneous demand of 22MW for large and small industry along this corridor.

6.7 A review of existing generating stations and the information on the online planning portals of Selby District and Wakefield District Councils indicated several other energy supply sources and proposed developments in closer proximity to the identified potential heat demand. These developments may offer preferential access for these heat users owing to the closer proximity and the potential timescale to operation.

[11] This very large figure appears to be due almost entirely (90%) to large industry within Pontefract. However, examination of industry within this area could not identify a demand of this size within that area.

6.8 At this stage, provision of heat or steam from the Proposed Development to supply the identified potential heat load is not viable, taking into account the distributed nature of the loads, the distances to the identified opportunities, potential barriers and constraints to the installation of export pipework, and the fact that the Proposed Development will not be in commercial operation until 2021 at the earliest. CHP is therefore not proposed to be installed at this time.

6.9 To allow any identified and additional future CHP opportunities to be realised, the design (and final build) of the Proposed Development will be CHP Ready, and will therefore incorporate a number of defined features which will allow for the future implementation of CHP. It is considered that this is an appropriate solution given the current uncertainty (and thus absence of economic feasibility) surrounding the identified and future CHP opportunities.

6.10 Based on the evaluation undertaken, at the current time it is considered that there is only likely to be demand for steam. This is considered to be represent the highest grade of exportable heat and likely to be the most attractive to potential industrial users. This steam would likely be extracted from the steam turbine by the cold reheat line of the HP turbine. This method minimises efficiency impacts on the steam turbine and is considered preferable to direct bleeds.

6.11 A thermodynamic model of the Proposed Development has been developed in order to present an accurate representation of the Proposed Development, based on current understanding of the technology to be installed, in order to assess the impact of heat export on the electrical output and to produce the CHP envelope, which identifies the potential operational range of a new plant where it could be technically feasible to provide electrical power generation with heat generation for export.

6.12 An assessment of potential for the Proposed Development to be CCR compliant and operate as CHP-R has also been undertaken, with the CHP envelope adjusted to take account of the anticipated heat and electrical demand of any future carbon capture equipment. No technical or economic barriers were identified and the Proposed Development is therefore considered to satisfy the requirements of CCR and be CHP-R.

6.13 The Applicant is committed to carrying out a periodic ongoing review of CHP potential, including:

- Instigate an action plan as outlined in Appendix 2 of this report;
- Maintaining a dialogue with key heat users as set out in the proposed action plan ;
- Carrying out regular reviews to determine if there have been sufficient changes in circumstances to warrant a new technical and financial assessment; and
- Re-visiting the technical and economic assessments at least every 5 years or when a change in circumstances warrants.

These commitments will be secured through an appropriately worded requirement in Schedule 2 to the draft DCO (Application Ref. 2.1).

6.14 Through the above evaluations, assessment, and commitments, the Proposed Development meets the requirements of the three BAT Tests outlined in the EA CHP-Ready Guidance.

APPENDIX 1: CHP-R FORM

#	Description	Units	Notes / Instructions
Requirement 1: Plant, Plant Location and Potential Heat Loads			
1.1	**Plant Name**		Eggborough CCGT Power Station
1.2	**Plant Description**		The Proposed Development comprises the construction and operation of a CCGT power station with a capacity of around 2.5 GW, comprising up to three high efficiency combined cycle gas turbines and associated steam turbines, plus up to two 'fast response' open cycle gas turbines (OCGT) or reciprocating gas engines to be installed in the same area. For the purposes of the CHP assessment only the CCGT element of the proposed development has been considered.
1.3	**Plant Location (Postcode / Grid Ref)**		The Proposed Development Site consists of land owned by EPL within the Eggborough Power Station, Eggborough, Goole DN14 0BS, UK, centred on Grid Reference SE 576 243.
1.4	**Factors Influencing Selection of Plant Location**		The Eggborough Power Station site has been selected by the Applicant for the development of a CCGT generating station, as opposed to other potentially available sites for the following reasons: • the site has a long history of power generation; • the existing coal-fired power station is facing closure and future redevelopment of the Power Station site would potentially allow retention of some of the existing workforce in similar employment; • the site has excellent grid, water and transport links and is a brownfield site which is considered more attractive to redevelop than a greenfield one for large scale power generation; and • the site is largely in the freehold ownership of the Applicant.

1.5	**Operation of Plant**		
a)	Proposed Operational Plant Load	%	100
b)	Thermal Input at Proposed Operational Plant Load	MW	1282 single unit based on H Class technology as a worst case
c)	Net Electrical Output at Proposed Operational Plant Load	MW	801 (Best case assumed for maximum CHP benefit)
d)	Net Electrical Efficiency at Proposed Operational Plant Load	%	62.5 (Best case assumed for maximum CHP benefit)
e)	Maximum Plant Load	%	100
f)	Thermal Input at Maximum Plant Load	MW	1281
g)	Net Electrical Output at Maximum Plant Load	MW	801
h)	Net Electrical Efficiency at Maximum Plant Load	%	62.5
i)	Minimum Stable Plant Load	%	36
j)	Thermal Input at Minimum Stable Plant Load	MW	567
k)	Net Electrical Output at Minimum Stable Plant Load	MW	289
l)	Net Electrical Efficiency at Minimum Stable Plant Load	%	51
1.6	**Identified Potential Heat Loads**		Details of identified heat loads can be found in section 3 of this report.

1.7	**Selected Heat Load(s)**		
a)	Category (e.g. Industrial / District Heating)		Industrial
b)	Maximum Heat Load Extraction Required	MW	211
1.8	**Export and Return Requirements of Heat Load**		
a)	Description of Heat Load Extraction		Steam
b)	Description of Heat Load Profile		Detailed heat load profiles can be found in section 3 of this report.
c)	Export Pressure	bar a	14
d)	Export Temperature	°C	220
e)	Export Flow	t/h	25 (estimated)
f)	Return Pressure	bar a	6 (estimated)
g)	Return Temperature	°C	75 (estimated)
h)	Return Flow	t/h	25

Requirement 2: Identification of CHP Envelope			
2.0	**Comparative Efficiency of a Standalone Boiler for supplying the Heat Load**	% LHV	90
2.1	**Heat Extraction at 100% Plant Load**		
a)	Maximum Heat Load Extraction at 100% Plant Load	MW	270
b)	Maximum Heat Extraction Export Flow at 100% Plant Load	t/h	380
c)	CHP Mode Net Electrical Output at 100% Plant Load	MW	710
d)	CHP Mode Net Electrical Efficiency at 100% Plant Load	%	55.3
e)	CHP Mode Net CHP Efficiency at 100% Plant Load	%	76.4
f)	Reduction in Primary Energy Usage for CHP Mode at 100% Plant Load	%	10.7
2.2	**Heat Extraction at Minimum Stable Plant Load**		
a)	Maximum Heat Load Extraction at Minimum Stable Plant Load	MW	142
b)	Maximum Heat Extraction Export Flow at Minimum Stable Plant Load	t/h	200
c)	CHP Mode Net Electrical Output at Minimum Stable Plant Load	MW	239
d)	CHP Mode Net Electrical Efficiency at Minimum Stable Plant Load	%	42.1
e)	CHP Mode Net CHP Efficiency at Minimum Stable Plant Load	%	67.1
f)	Reduction in Primary Energy Usage for CHP Mode at Minimum Stable Plant Load	%	9.5
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

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	794
b)	CHP Mode Net Electrical Efficiency at Proposed Operational Plant Load	%	62
c)	CHP Mode Net CHP Efficiency at Proposed Operational Plant Load	%	63.6
d)	Reduction in Net Electrical Output for CHP Mode at Proposed Operational Plant Load	MW	7
e)	Reduction in Net Electrical Efficiency for CHP Mode at Proposed Operational Plant Load	%	1%
f)	Reduction in Primary Energy Usage for CHP Mode at Proposed Operational Plant Load	%	1.9%
g)	Z Ratio		3.2
Requirement 4: Technical Provisions and Space Requirements			
4.1	Description of Likely Suitable Extraction Points		Via the cold reheat line on the HP turbine
4.2	Description of Potential Options which could be incorporated in the Plant, should a CHP Opportunity be realised outside the 'CHP Envelope'		N / A - 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		Allocation for CHP equipment within the turbine hall to avoid the cost of building a dedicated heat station at a later date.

4.4	Provision of Site Layout of the Plant, indicating Available Space which could be made available for CHP-R		

Requirement 5: Integration of CHP and Carbon Capture			
5.1	**Is the Plant required to be CCR?**		Yes
5.2	**Export and Return Requirements Identified for Carbon Capture**		
	100% Plant Load		
a)	Heat Load Extraction for Carbon Capture at 100% Plant Load	MW	115
b)	Description of Heat Export (e.g. Steam / Hot Water)		Steam
c)	Export Pressure	bar a	3.5
d)	Export Temperature	°C	250
e)	Export Flow	t/h	972
f)	Return Pressure	bar a	Not known
g)	Return Temperature	°C	Not known
h)	Return Flow	t/h	Not known
i)	Likely Suitable Extraction Points		IP/LP crossover on the steam turbine
	Minimum Stable Plant Load		
j)	Heat Load Extraction for Carbon Capture at Minimum Stable Plant Load	MW	115
k)	Description of Heat Export (e.g. Steam / Hot Water)		Steam
l)	Export Pressure	bar a	3.5
m)	Export Temperature	°C	250
n)	Export Flow	t/h	972
o)	Return Pressure	bar a	Not known
p)	Return Temperature	°C	Not known
q)	Return Flow	t/h	Not known
r)	Likely Suitable Extraction Points		IP/LP crossover on the steam turbine
5.3	**Operation of Plant with Carbon Capture (without CHP)**		
a)	Maximum Plant Load with Carbon Capture	%	100
b)	Carbon Capture Mode Thermal Input at Maximum Plant Load	MW	3843
c)	Carbon Capture Mode Net Electrical Output at Maximum Plant Load	MW	2164
d)	Carbon Capture Mode Net Electrical Efficiency at Maximum Plant Load	%	56

e)	Minimum Stable Plant Load with CCS	%	36
f)	Carbon Capture Mode CCS Thermal Input at Minimum Stable Plant Load	MW	1700
g)	Carbon Capture Mode Net Electrical Output at Minimum Stable Plant Load	MW	628
h)	Carbon Capture Mode Net Electrical Efficiency at Minimum Stable Plant Load	%	37
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	478
b)	Maximum Heat Extraction Export Flow at 100% Plant Load with Carbon Capture	t/h	380
c)	Carbon Capture and CHP Mode Net Electrical Output at 100% Plant Load	MW	1888
d)	Carbon Capture and CHP Mode Net Electrical Efficiency at 100% Plant Load	%	49
e)	Carbon Capture and CHP Mode Net CHP Efficiency at 100% Plant Load	%	67
f)	Reduction in Primary Energy Usage for Carbon Capture and CHP Mode at 100% Plant Load	%	7%
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	311
b)	Maximum Heat Extraction Export Flow at Minimum Stable Plant Load with Carbon Capture	t/h	200
c)	Carbon Capture and CHP Mode Net Electrical Output at Minimum Stable Plant Load	MW	478
d)	Carbon Capture and CHP Mode Net Electrical Efficiency at Minimum Stable Plant Load	%	37
e)	Carbon Capture and CHP Mode Net CHP Efficiency at Minimum Stable Plant Load	%	46

f)	Reduction in Primary Energy Usage for Carbon Capture and CHP Mode at Minimum Stable Plant Load	%	-4
5.6	**Can the Plant with Carbon Capture supply the Selected Identified Potential Heat Load (i.e. is the Identified Potential Heat Load within the 'CHP and Carbon Capture Envelope')?**		Yes
5.7	**Description of Potential Options which could be incorporated in the Plant for useful integration of any realised CHP System and Carbon Capture System**		A full assessment of the potential for heat recovery of the carbon capture plant itself will be undertaken at design stage. Rather than two steam takeoffs from the steam turbine, the potential for steam for the carbon capture plant and the CHP to be supplied through a single take off will be investigated through the detailed design of any carbon capture plant.
Requirement 6: Economics of CHP-R			
6.1	Economic Assessment of CHP-R		Designing the plant as CHP-R is considered to be economically feasible.
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
	Once the new plant is CHP-R, is it BAT?		Yes Periodic reviews of opportunities for heat supply will be carried out once the plant becomes operational. An action plan will be implemented as outlined in Appendix 2 of this CHP Assessment.

APPENDIX 2: ACTION PLAN

Although it is technically feasible to deliver heat to the area surrounding the Proposed Development, a full economic assessment including detailed discussions with potential heat users is necessary to determine its viability. Therefore, in order to preserve the opportunity to realise CHP potential from the Proposed Development it is recommended that this action plan is put in place. The outcome of this action plan will be a regular updating of the potential to export heat with a view to making the Proposed Development a CHP facility when economically and commercially viable to do so.

The key steps to be implemented under this Action Plan are:

(1) Maintain dialogue with identified key heat users and the Local Authority;

At the appropriate times meetings would be held with potential heat users to ensure heat sales opportunities are maintained. An annual meeting will also be held with Local Authority representatives to discuss and identify potential CHP opportunities.

(2) Maintain database of other potential heat users;

A database of potential customers will be collated and maintained, with new and proposed developments added to it when identified through reviews of local planning applications.

(3) Carry out ongoing reviews of potential heat load and scheme costs;

Carry out reviews of potential opportunities every 2 years.

(4) Produce regular CHP Review reports

A CHP Review report will be provided to the Local Authority for review 12 months after the authorised development has been taken into commercial operation. It will demonstrate that appropriate connection and space for the later provision of heat pass-out for off-site users of heat has been provided.

The CHP review will consider the opportunities that reasonably exist for the export of heat from the authorised development at the time of submission of the CHP Review and will include a list of actions (if any) the undertaker can reasonably undertake (without material additional cost to the undertaker) to increase the potential for the export of heat from the authorised development.
The CHP Review will be revised and re-submitted by the undertaker to the planning authority on the date that is five years after the date of its previous submission to the planning authority throughout the lifetime of the authorised development and any actions specified in the subsequent CHP Review will be carried out by the undertaker in accordance with the timescales specified in the re-submitted CHP Review.