The Keadby Next Generation Power Station Project

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The Keadby Next Generation Power Station Development Consent Order 2025

Land at, and in the vicinity of, the existing Keadby Power Station (Trentside, Keadby, Scunthorpe DN17 3EF)

Combined Heat and Power Assessment

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulations 5(2)(q)

Applicant: Keadby Next Generation Limited

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Glossary

Abbreviation	Description
BAT	Best Available Techniques - the available techniques which are the best for preventing or minimising emissions and impacts on the environment. BAT is required for operations involving the installation of a facility that carries out industrial processes. Techniques can include both the technology used and the way an installation is designed, built, maintained, operated and decommissioned.
BEIS	Department for Business, Energy and Industrial Strategy (now DESNZ)
CBA	Cost-benefit analysis - involves analysing the benefits of a course of action and comparing against the costs associated with it.
CCGT	Combined Cycle Gas Turbine – a highly efficient form of electricity generation technology. An assembly of heat engines work in tandem using the same source of heat to convert it into mechanical energy which drives electrical generators and consequently generates electricity.
CCP	Carbon Capture Plant – plant used to capture carbon dioxide (CO2) emissions produced from the use of fossil fuels in electricity generation and industrial processes.
CHP	Combined Heat and Power - process that captures and utilizes the heat that is a by-product of the electricity generation process

Abbreviation	Description
CHPQA	Combined Heat and Power Quality Assurance - a government initiative providing a practical, determinate method for assessing all types and sizes of Combined Heat and Power (CHP) schemes throughout the UK.
CHP-R	Combined Heat and Power – Ready – refers to a power generation station which is designed to be ready, with minimum modification, to supply heat in the future.
DCO	Development Consent Order – made by the relevant Secretary of State pursuant to The Planning Act 2008 to authorise a Nationally Significant Infrastructure Project. A DCO can incorporate or remove the need for a range of consents which would otherwise be required for a development. A DCO can also include rights of compulsory acquisition.
DECC	Department of Energy and Climate Change (now DESNZ)
DESNZ	Department for Energy Security and Net Zero
DTI	Department of Trade and Industry (now DESNZ)
HCA	Homes and Communities Agency - non-departmental public body that funded new affordable housing in England (now Homes England).
HP	High Pressure
HRSG	Heat Recovery Steam Generation - an energy recovery heat exchanger that recovers heat from a hot gas stream. It produces steam that can be used in a process (cogeneration) or used to drive a steam turbine (combined cycle).
IP	Intermediate Pressure
LEP	Local Enterprise Partnerships - business-led partnerships between local authorities and local private sector businesses.
LP	Low Pressure
MW	Megawatt – unit of power
MWth	Megawatts thermal – thermal power
NLC	North Lincolnshire Council

Abbreviation	Description
NSIP	Nationally Significant Infrastructure Project – defined by the Planning Act 2008 and cover projects relating to energy (including generating stations, electric lines and pipelines); transport (including trunk roads and motorways, airports, harbour facilities, railways and rail freight interchanges); water (dams and reservoirs, and the transfer of water resources); wastewater treatment plants and hazardous waste facilities. These projects are only defined as nationally significant if they satisfy a statutory threshold in terms of their scale or effect.
OEM	Original Equipment Manufacturer
PES	Primary Energy Saving – the reduction in non-converted energy available by implementing a combined heat and power scheme compared to the proposed development. It quantifies the energy efficiency gains by utilising waste heat from power generation, which would otherwise be lost, thereby lowering overall fuel use and emissions.
SoS	Secretary of State - title typically held by Cabinet Ministers in charge of Government Departments

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1. The Keadby Next Generation Power Station ('the Proposed Development') is a new CCGT electricity generating station with a capacity of up to 910MW electrical output. The CCGT electricity generating station will be designed to run on 100% hydrogen and able to run on 100% natural gas or a blend of natural gas and hydrogen and will be located on land to the west of Keadby 1 and Keadby 2 Power Stations.
2. The Proposed Development will also include associated infrastructure such as cooling water systems, electrical and gas (hydrogen and natural gas) connections, utility connections, construction laydown areas, and other supporting works, all located on land to the west of the existing Keadby 2 Power Station. By incorporating low-carbon fuel flexibility, the Proposed Development is expected to contribute toward the UK's target of achieving net zero electricity generation system by 2050.
3. The purpose of this document is to comply with Section 4.8 of the 'Overarching National Policy Statement for Energy (EN-1)' (Department for Energy Security & Net Zero), and Paragraph 1.6.2 of the 'National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)' (Department for Energy Security & Net Zero), which require developers promoting thermal generating stations to consider the opportunities for the implementation of Combined Heat and Power ('CHP').
4. The assessment demonstrates that the Applicant has explored the potential for the plant to operate in CHP mode, i.e. exporting waste heat to off-site users. In order to examine the CHP potential, the use of Best Available Techniques ('BAT') for the Proposed Development has been demonstrated by applying the three 'BAT Tests' outlined in the 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants' (Environment Agency, 2013) (the 'CHP-R Guidance').
5. Following an assessment of the feasibility for heat extraction, potential heat sources within the generating station capable of producing hot water for example for district heating were identified. From these sources, and assuming that the Proposed operates flexibly as a dispatchable plant at a theoretical 40% capacity factor, there is up to between 429,000 MWh and 773,000 MWh of heat available annually assuming a 10% primary energy saving from the Proposed Development at minimum electrical power and maximum electrical power respectively for offtake levels of between 123 MWth and 221 MWth.
6. The CHP assessment has indicated that there are a number of theoretical identified heat users within a 15km radius of the Proposed Site. Although there are large heat users which relate to domestic, small industrial and education uses within this search area, the domestic load is likely to be too dispersed, leaving likely non-domestic serviceable loads are of the order of 120,000 MWh or average of 34 MWth and this does not offer economically viable opportunities for a heat network at this time sitting at a relatively low primary energy saving opportunity, particularly given

the dispatchable nature of the Proposed Development and therefore the need to provide an alternative source of hot water when the plant is not running. The Proposed Development is anticipated to operate in dispatchable mode and as such may not be operating when required by potential heat users which presents a significant barrier to operation as a viable CHP installation. CHP is therefore, not proposed to be installed from the outset of commercial operation of the Proposed Development. However, the Proposed Development will be designed to be CHP - Ready in accordance with the BAT Tests of the CHP-R Guidance.

1. Introduction

1.1. Overview

1.1.1. This Combined Heat and Power Assessment (**Application Document Ref 5.9**) has been prepared by AECOM on behalf of Keadby Next Generation Limited ('the Applicant') which is a subsidiary of SSE plc. It forms part of the application for a Development Consent Order (DCO) ('the Application'), that has been submitted to the Secretary of State (SoS) for Energy Security and Net Zero under Section 37 of 'The Planning Act 2008' ('the 2008 Act').

1.1.2. The Applicant is seeking development consent for the construction, operation and maintenance of a new combined cycle gas turbine ('CCGT') electricity generating station on land at, and in the vicinity of, the existing Keadby Power Station, Trentside, Keadby, Scunthorpe DN17 3EF ('the Site').

1.1.3. The Keadby Next Generation Power Station ('the Proposed Development') is a new CCGT electricity generating station with a capacity of up to 910MW electrical output. The CCGT electricity generating station will be designed to run on 100% hydrogen and able to run on 100% natural gas or a blend of natural gas and hydrogen and will be located on land to the west of Keadby 1 and Keadby 2 Power Stations. The Proposed Development includes connections for cooling water, electricity, hydrogen and natural gas, and construction laydown areas and other associated development. It is described in full in Environmental Statement (ES) Volume I Chapter 4: The Proposed Development (Application Document Ref. 6.2.4).

1.1.4. The Proposed Development falls within the definition of a 'Nationally Significant Infrastructure Project' (NSIP) under Section 14(1)(a) and Sections 15(1) and (2) of the 2008 Act, as it is an onshore generating station in England that would have a generating capacity greater than 50MW electrical output (50MWe). As such, a DCO application is required to authorise the Proposed Development in accordance with Section 31 of the 2008 Act.

1.1.5. The DCO, if made by the SoS, would be known as 'The Keadby Next Generation Power Station Order' ('the Order').

1.2. The Applicant

1.2.1. The Applicant is a subsidiary of the FTSE-listed SSE plc, one of the UK's largest and broadest-based energy companies, and the country's leading developer of renewable energy. Over the last 20 years, the SSE Group has invested over £20 billion to deliver industry-leading offshore wind, onshore wind, CCGT, energy from waste, biomass, battery-storage, energy networks and gas storage projects. Related SSE companies own and operate the adjacent Keadby 1 and 2 Power Stations and have the benefit of the DCO for Keadby 3 CCS Power Station (herein referred to as the 'Keadby CCS Power Station').

1.2.2. The Proposed Development is being developed with Equinor, one of the country's leading energy providers, supplying natural gas, oil and electricity. Equinor is developing multiple low-carbon hydrogen and carbon capture projects in the Humber, working towards transforming the UK's most carbon intensive industrial cluster into a net zero region.

1.2.3. SSE Renewables Limited operates Keadby Windfarm, which lies to the north and south of the Site and generates renewable electricity from 34 turbines, with a total installed generation capacity of 68MW.

1.2.4. SSE plc has set out a clear commitment to investment in low carbon power infrastructure, working with government and other stakeholders to create a Net Zero power system by 2040. This includes investment in flexible sources of electricity generation and storage for times of low renewable output which will complement other renewable generating sources, either using low -carbon fuels and/ or capturing and storing carbon emissions.

1.2.5. The design of the Proposed Development demonstrates this commitment and the Proposed Development will be built with a clear route to decarbonisation, consistent with SSE's Net Zero Acceleration Programme Plus and net zero transition plan which committed to the development and progression of new low carbon flexible power including hydrogen-fuelled generation.

1.3. The Proposed Development

1.3.1. The Proposed Development would comprise a high efficiency gas fired power station with an electrical output capacity of up to 910MWe and associated buildings, structures and plant and other associated development defined in the Schedule 1 of the **Draft DCO** (**Application Document Ref. 3.1)** as Work Nos. 1-11 and shown on the **Works Plans** (**Application Document Ref. 2.3).**

1.3.2. The Proposed Development will include:

- a new-build CCGT electricity generating station fuelled by hydrogen and/or natural gas with a power output of up to 910MW (Work No. 1) including:

  - a CCGT plant;
  - cooling infrastructure;
  - natural gas and hydrogen blending equipment (for the Applicant's infrastructure);

- supporting facilities including administration and control buildings, workshops, storage buildings, effluent treatment facilities, fire water storage tank(s), demineralised water treatment plant including storage tank(s), and permanent laydown areas for operation and maintenance activities;
- a hydrogen supply pipeline, including a gas compound for the hydrogen supplier's apparatus and a hydrogen gas compound for the Applicant's apparatus (Work No. 2);
- a natural gas supply pipeline including a compound for the natural gas supplier's apparatus and a natural gas compound for the Applicant's apparatus (Work No. 3).
- electrical connection works for the export and import of electricity to and from the generating station and the existing 400kV National Grid Electricity Transmission (NGET) substation located adjacent to the Keadby Power Station site, including works within the substation (which would be undertaken by NGET) (Work No. 4);
- water supply connection works to provide cooling and make-up water to the generating station, including intake structures and an underground and/or overground water supply pipeline running between the generating station and the Stainforth and Keadby Canal (Work No. 5);
- connections to and use of an existing outfall and associated pipework for the discharge of used cooling water, surface water and treated effluent to the River Trent (Work No. 6);
- public water connection pipeline from a new connection on Chapel Lane to provide potable water to the generating station (Work No. 7);
- new permanent access to the generating station (Work No. 8), comprising:

  - maintenance and improvement of an existing private access road from the A18, including replacement of a private bridge (Mabey Bridge) (Work No. 8A);
  - installation of layby and gatehouse with barriers, enclosures, drainage and lighting north of the A18 junction (Work No. 8B) and associated utilities connections (Work No. 8C); and
  - emergency access route comprising the maintenance and improvement of an existing private track running between the

generating station and Chapel Lane and including new private bridge crossing (Work No. 8D);

- temporary construction and laydown areas (Work No. 9A);
- maintenance and improvement of the existing paved access routes running between the A18 and construction laydown areas (Work No. 9B); and between Skew Bridge adjacent to the A18 and a temporary construction laydown area associated with Mabey Bridge replacement (Work No. 9C);
- retention, maintenance and improvement and subsequent removal of existing temporary haul route from the Waterborne Transport Facility (Work No. 9D) and the inspection and repair of the existing wharf, and temporary placement of mobile cranes including the temporary oversailing of crane arms (Work No. 9E); and
- landscaping and biodiversity enhancement measures (Work No. 10);
- an allocation of land to meet the requirements of the Carbon Capture Readiness (Electricity Generating Stations) Regulations 2013 (Work No. 11).

1.3.3. The Applicant will be responsible for the construction, operation (including maintenance) and eventual decommissioning of the Proposed Development including the on-site connections to electricity, cooling water, hydrogen and natural gas supplies.

1.3.4. The Proposed Development will be capable of operating 24 hours per day, 7 days per week with programmed offline periods for maintenance.

1.3.5. The route for the hydrogen supply pipeline to the Proposed Development has not yet been confirmed. The supply pipeline is not included in the Proposed Development and will be progressed by a third party under a separate consent. In line with Government policy, it is recognised that developments such as the Proposed Development are needed to stimulate investment in the development of hydrogen production and supply infrastructure.

1.3.6. Further detail on the components of the Proposed Development is provided in **ES Volume I Chapter 4**: The Proposed Development (**Application Document Ref. 6.2**). The areas within which each numbered Work (component) of the Proposed Development are to be built are defined by the coloured and hatched areas on the **Works Plans** (**Application Document Ref. 2.3**).

1.4. The Proposed Development Site

1.4.1. The Site is located within and near to the existing Keadby Power Station site near Scunthorpe, Lincolnshire and lies within the administrative boundary of North Lincolnshire Council (NLC). The majority of land is within the ownership or control of the Applicant (or SSE associated companies) and is centred on national grid reference 482351, 411796.

1.4.2. The existing Keadby Power Station site currently encompasses the operational Keadby 1 and Keadby 2 Power Station sites, including the Keadby 2 Power Station Carbon Capture and Readiness reserve space.

1.4.3. The Site encompasses an area of approximately 77.1 hectares (ha), of which approximately 26.7 ha of land is proposed for construction laydown.

1.4.4. Multiple proposed land uses together make up the Site, with the different areas described in turn below and shown on **ES Volume III Figure 3.3** Indicative Parts of the Site Plan (**Application Document Ref. 6.4).** These terms have been used to describe land use zones within the Site.

1.4.5. The Site is divided into the following areas of permanent and temporary land use (the proposed use is described in more detail in **ES Volume I Chapter 3:** Site and Surrounding Area (**Application Document Ref. 6.2**)):

- Main Site;
- Ancillary Facilities;
- Water Connections;
- Electricity Connections;
- Waterborne Transport Off-loading Area;
- Construction Laydown Areas;
- Access routes (emergency, permanent and construction);
- Connections to Keadby 1 and Keadby 2 power stations; and
- Additional areas for landscaping and biodiversity provision.

1.5. The DCO Process

1.5.1. The Proposed Development falls within the definition of a NSIP under Section 14(1)(a) and 15(2) of the 2008 Act as a ‘generating station exceeding 50 MW’.

1.5.2. As a NSIP project, the Applicant is required to seek a DCO to construct and operate the generating station, under Section 31 of the 2008 Act. Section 37 of the 2008 Act also governs the form, content and accompanying documents that are required as part of a DCO application.

The requirements are implemented through the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ('APFP Regulations') which state that an application must be accompanied by an ES, where a development is considered to be 'EIA development' under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) (as amended).

1.5.3. An application for development consent for the Proposed Development has been submitted to Planning Inspectorate (PINS) acting on behalf of the SoS. Subject to the application being accepted, PINS will then examine it and make a recommendation to the SoS who will then decide whether to grant a DCO. The acceptance, examination, recommendation and decision stages are subject to fixed timescales and the decision is therefore anticipated to fall in 2026.

1.5.4. A DCO, if granted, has the effect of providing deemed planning permission for a development, in addition to a number of other consents and authorisations where specified within the Order.

1.6. The Purpose of CHP

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

1.6.2. Inherent to the design of combined cycle combustion power plant is the efficient use of 'waste' heat within the combined cycle technology. The waste heat from the gas turbine is recovered by a heat recovery steam generator and steam at high, intermediate and low pressures used to generate electricity within the steam turbine. Steam can be extracted from the steam turbine to provide heat to offsite heat loads. Utilising high pressure steam for electricity generation is more efficient, as it maximises the extraction of useful energy by the steam turbine. Low pressure steam, which has already delivered much of its energy, is more suitably employed in CHP applications. Moreover, the temperature of low-pressure steam is more suited to typical heat demand profiles, making it a favourable option for CHP.

1.6.3. Where carbon capture readiness is also required as an alternative to hydrogen-fired operation as a decarbonisation approach the steam provision required in the CCP is obtained from the CCGT; this is primarily used to generate the heat necessary to separate the captured carbon dioxide from the rich amine within the carbon dioxide stripper.

1.7. The Purpose and Structure of this Document

1.7.1. The purpose of this document is to comply with Section 4.8 of the 'Overarching National Policy Statement for Energy (EN-1)' (DESNZ) and Paragraph 1.6.2 of the 'National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)' (DESNZ), which require developers promoting thermal generating stations to consider the opportunities for the implementation of CHP.

1.7.2. The document is structured as follows:

- Section 2 describes the policy context and assessment methodology;
- Section 3 assesses the feasibility of heat extraction from the Proposed Development based on the current design;
- Section 4 identifies potential heat users in the vicinity of the Proposed Development Site;
- Section 5 presents the assessment of the Proposed Development against the three Best Available Technique ('BAT') Tests described in the 'CHP Ready Guidance for Combustion and Energy from Waste Power Plants' (Environment Agency, 2013) (the 'CHP-R Guidance'); and
- Section 6 presents the conclusions of this CHP assessment.

2. Policy Context and Assessment Methodology

2.1. National Policy Statements

2.1.1. The National Policy Statements (NPS) for energy infrastructure form the policy framework for applications for new generating stations of greater than 50MW capacity in England and 350MW in Wales. The NPS of most relevance to the Proposed Development (and this CHP assessment) are EN-1 and EN-2.

2.1.2. Section 4.8 of EN-1 deals with the consideration of CHP. Paragraph 4.8.3 states that CHP is technically feasible for all types of thermal generating stations, including gas-fired, nuclear, energy from waste and biomass. Paragraph 4.8.4 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 ('CHPQA') programme.

2.1.3. Paragraph 4.8.6 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.

2.1.4. Paragraph 4.8.8 of EN-1 highlights that under guidelines issued by the Department of Trade and Industry (DTI) in 2006 (DTI4, 2006), any application to develop a thermal generating station under Section 36 of the Electricity Act 1989 must either include CHP or contain evidence that possibilities for CHP have been fully explored to inform the consideration of the application by the SoS. 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 2008 Act and that the SoS should have regard to the DTI guidance, or any successor to it, when considering the CHP aspects of applications for thermal generating stations.

2.1.5. Paragraph 4.8.9 and 4.8.10 of EN-1 state that:

'In developing proposals for new thermal generating stations, applicants should consider both the current and future opportunities for CHP from the start 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 Local Authorities, obtaining their advice on opportunities. Further advice is contained in the

2006 DTI guidance and applicants should also consider relevant information in regional and local energy and heat demand mapping.'

2.1.6. According to the Paragraph 4.8.12 of EN-1, the utilisation of useful heat that can replace conventional fossil-fuel based heat generation is encouraged, and the proposals include CHP will be given substantial weight. Applicants proposing thermal generation without CHP should ensure that they address the following points:

- explain why CHP is not economically or practically feasible;
- provide details of any potential future heat requirements in the area that have been considered and the reasons the station could not meet them;
- detail the provisions in the proposed scheme for ensuring any potential heat demand in the future can be exploited; and
- provide an audit trail of dialogue between the applicant, prospective customers, the local area energy team in local government and district heating energy supplies companies.

2.1.7. Paragraph 4.8.17 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 Local Authorities. According to paragraph 4.8.18 of EN-1, if the SoS identify a potential heat customer that has not been explored, the applicant should be requested to pursue this.

2.1.8. Paragraph 4.8.19 of EN-1 states that: 'The Secretary of State may also be aware of potential developments (for example from the applicant or a third party) which could utilise heat from the plant in the future, for example planned housing, and which is due to be built within a timeframe that would make the supply of heat cost-effective. Where it may be reasonably possible for the applicant to reach agreement with a potential heat customers during the lifetime of the station, the Secretary of State may wish to impose requirements to ensure that generating station is CHP-ready and designed in order to allow heat supply at a later date.'

2.1.9. 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 (paragraph 1.6.2).

2.2. CHP Guidance

2.2.1. The requirements for the assessment of the feasibility of CHP in relation to thermal generating stations are set out in the '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' (the 'CHP Guidance') (DTI, 2006). A driving principle behind the guidance

– and the broader philosophy of CHP – is the reduction of losses in the power generation process, associated improvements in efficiency and ultimately, therefore a reduction in CO2 emissions.

2.2.2. Paragraph 8 of the CHP Guidance states that the Government expects developers to explore opportunities to use CHP fully when developing proposals for new thermal generating stations and provide evidence to show the steps taken to assess the viability of CHP opportunities. However, it does recognise that in some cases CHP will not be an economic option.

2.2.3. Paragraph 12 of the CHP 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.

2.2.4. 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.

2.2.5. 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.

2.3. CHP-Ready Guidance

2.3.1. In 2013, the Environment Agency published detailed guidance on CHP assessments required for thermal generating stations (the ‘CHP-R Guidance’), to be used by developers and Environment Agency officers as part of the Environmental Permitting regime.

2.3.2. The Environment Agency requires applications for Environmental Permits to demonstrate BAT is implemented at any new 'installation'. BAT applies to a number of operational criteria, including energy efficiency.

2.3.3. In accordance with the CHP-R Guidance, the Environment Agency requires that developers 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.

2.3.4. 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' (‘CHP-R’) (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[5] 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 […]’.

2.3.5. The three BAT tests are summarised below:

First BAT Test:

2.3.6. ‘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.

2.3.7. 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.

2.3.8. 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:

2.3.9. 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.

2.3.10. 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:

2.3.11. 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.

2.3.12. The CHP-R 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. The CHP-R Guidance (Section 3.2) states that a CHP assessment should contain 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.'*

2.3.13. If the proposal is for generation without CHP, the CHP assessment should also contain:

- *'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.'*

2.3.14. The CHP-R Guidance states at Section 3.3 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'

2.3.15. The Environment Agency (2012) 'Guidelines for Developments requiring Planning Permission and Environmental Permits' set out the role of the Environment Agency in the planning process. The 2012 guidelines also set out the approach that the Environment Agency will take to responding to applications for developments which will also require an Environmental Permit. These Guidelines recognise that there may be some interdependencies between planning and permitting requirements and recommend early engagement with the Environment Agency via their planning pre-application service.

2.3.16. Therefore, it is recommended that the 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 (or CHP-R).

2.3.17. Accordingly, the Environment Agency recommend that the requirement for new plants to be CHP or CHP-R be discussed at the earliest possible stage, ideally during planning the pre-application period. 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. When consulted by the planning authorities on relevant consent applications for new plants, the Environment Agency will highlight the need for the plant to be CHP or CHP-R and will make reference to the CHP-R Guidance.

2.3.18. 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.'

2.4. Note on the Implementation of the Energy Efficiency Directive

2.4.1. In addition to the requirements of the CHP-R Guidance, the Energy Efficiency Directive has been implemented in the UK initially through the Environmental Permitting (England and Wales) (Amendment) Regulations 2015 (UK Gov., 2015). Since March 2015, these Regulations have required operators of certain combustion plants 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 ('primary energy saving' or 'PES').

2.5. Assessment Methodology

2.5.1. This CHP assessment has been undertaken in accordance with the methodology prescribed by the CHP-R Guidance, the stages of which are summarised below:

- identify whether the plant is required to provide CHP or be CHP-R;
- identify if there are opportunities for the supply of heat from the plant;
- where opportunities are identified, select the most appropriate heat loads for further consideration;
- determine the 'CHP envelope' to confirm if the plant is capable of serving the selected heat loads;
- identify the impacts on plant operation of supplying heat to the serviceable loads;
- identify the provisions required (e.g. on-site space) to supply heat to the serviceable loads; and
- undertake a CBA for the serviceable loads.

3. Heat Export Feasibility Study

3.1. Introduction

3.1.1. This section assesses the feasibility for heat extraction and export from the Proposed Development for comparison with the identified CHP heat load presented in Section 4. The Proposed Development includes a combined cycle gas turbine (CCGT) power station with electrical generating capacity up to 910 MW.

3.1.2. This analysis has been based on thermal modelling of the CCGT plant during part and full load scenarios as well as heat and material balance calculations from pre-FEED work. The largest gas turbine unit currently commercially available has been used as the power generation technology within the plant model to determine heat available from the Proposed Development.

3.1.3. The Proposed Development is intended to operate in dispatchable mode and as such may not be operating when required by potential heat users which presents a significant barrier to operation as a viable CHP installation.

3.1.4. Both part and full load scenarios have been considered within this study to produce a complete CHP envelope from minimum and maximum electrical power generation, respectively. It is difficult to predict the future operating regime of the Proposed Development. There may be significant periods where the Proposed Development is not operating at full load (or at all) under a flexible dispatchable regime; any heat made available for potential CHP is therefore likely to be intermittent, which does affect the viability of CHP provision.

3.2. Heat Extraction Options

3.2.1. The high efficiency observed in modern CCGTs, such as the model evaluated, is primarily achieved by minimising losses and maximising the integration of 'waste' heat within the plant itself. Useful heat is recovered from the gas turbine's exhaust gas through the Heat Recovery Steam Generator (HRSG). This heat is used to produce steam, at various pressures, which generates further power via a separate steam turbine.

3.2.2. The main heat extraction option considered is the extraction of steam from the electricity generating cycle. Within the scope of the Proposed Development, the utilisation of low pressure (LP) steam offtake from the CCGT has been assessed in the context of CHP. Utilisation of high pressure steam could also be considered but was discounted on an efficiency basis.

3.2.3. The exhaust gas exiting the HRSG through the main stack may still contain a certain amount of recoverable thermal energy and would not have a significant effect on the CCGT unit, however as a minimum level of temperature is required for dispersion, impacting material selection and air quality, this option is discounted. Therefore, only the LP steam CHP-R design has been evaluated further here.

3.2.4. In order to be designed as CHP-R, it is expected that the design of the CCGT unit would be identical to conventional CCGT units with the inclusion of the following additional items:

- Accessible tie-in location in low pressure (LP) steam turbine inlet
- A steam turbine condenser design that would allow for integration with a heat pump to supply a district heat network
- Control systems allow for future integration with the heat offtake connections. (i.e. capable of accommodating a future heat offtake module and providing sufficient inputs/outputs capacity.)

3.2.5. The existing CHP guidance does not address heat pump opportunities or the comparison between power plant integration schemes and localised conventional heat pump schemes for district heat network and so is not developed as part of this CHP-R assessment.

3.2.6. The CHP envelope is based on the largest, current commercially available gas turbine unit. However, it should be noted that, in recognising the evolution of gas turbine technology, there is potential for further efficiency and output improvements to be made prior to or during the detailed design of the Proposed Development. Therefore, the applications are seeking to allow and retain flexibility to adapt to future circumstances. In such circumstances, this could extend the boundaries of CHP envelopes.

3.3. Identification of the CHP Envelope

3.3.1. The following assumptions have been made to be used in the CHP envelope calculations.

- As the OEM has not yet been selected, a thermodynamic performance model representative of a generic H class machine has been used;
- It is assumed that standard LP turbine sizing with IP-LP crossover pressure control valve is used;
- LP delivery pressure is 4 bar(a) and temperature is 155°C;
- Condensate return temperature is 75°C;

- 25% of steam turbine exhaust flow from 100% load is considered the approximate limit to prevent LP last-stage blade buffeting;
- Thermal input LHV: 1387 MW for 100% load, 610 MW for min load;
- Thermodynamic performance on natural gas, hydrogen or natural gas - hydrogen blends are similar;
- For the purposes of assessing carbon capture impacts, a post combustion non-proprietary amine based solvent is assumed.

3.3.2. The following calculations have been performed to determine the CHP 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 – Maximum Electrical Power (100% Full Load) with Maximum Heat Extraction; and
- D – Maximum Electrical Power (100% Full Load) with No Heat Extraction.

3.3.3. The CHP efficiency (ηCHP) is defined as:

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

3.3.4. Based on the values of heat load and the expected electrical power output of the Proposed Development, the CHP envelope can be produced as shown in **Plate 1**.

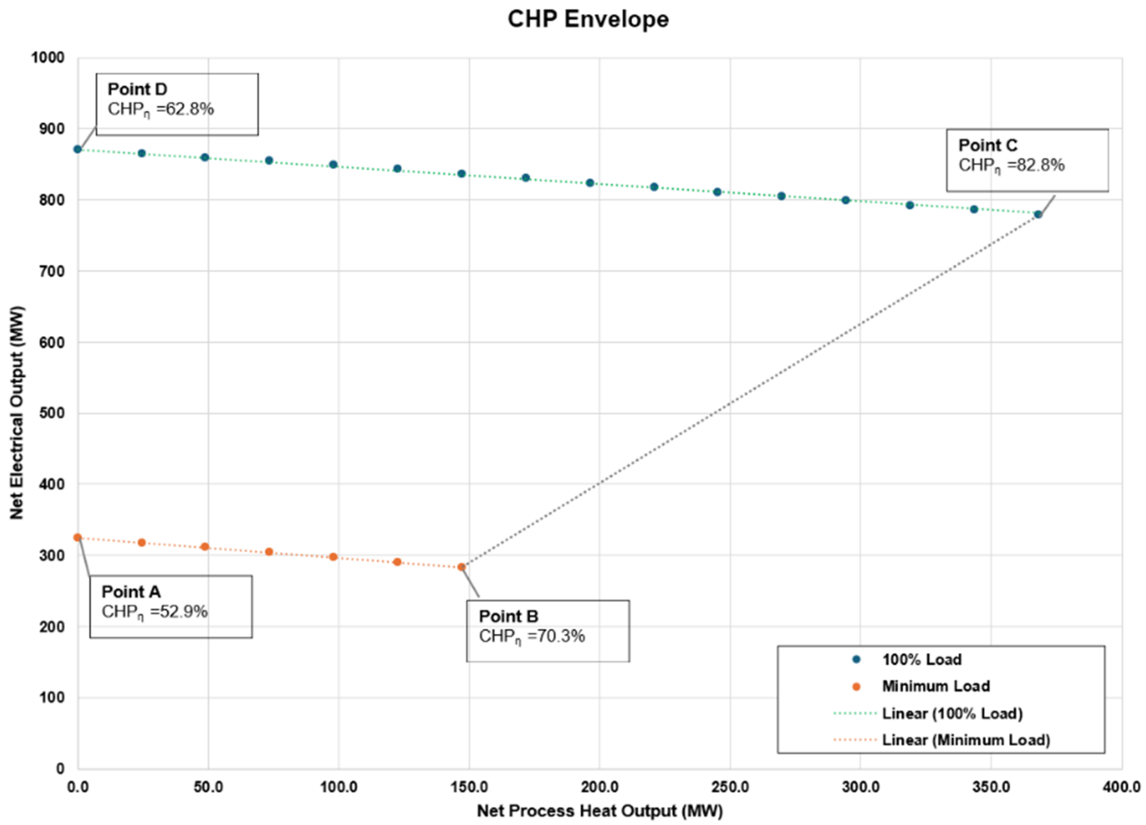

Plate 1: Indicative CHP Envelope (without CCP)

3.3.5. **Table 1** shows that the primary energy saving (PES) associated with the Proposed Development in CHP mode during full load would be approximately 16%, achieving a CHP efficiency of approximately 82.8%. During minimum load, the approximate primary saving, and CHP efficiency of the Proposed Development would be 12% and 70.3%, respectively.

Table 1: Indicative CHP Envelope (without CCP)

Description	Min. Elec. Power No Heat Load	Min. Elec. Power Max Heat Load	Max. Elec. Power Max Heat Load	Max. Elec. Power No Heat Load
Reference Point	A	B	C	D
Thermal Input, MWth	610	610	1387	1387
Net Power Output, MWe	323	281	780	870
Heat Load, MWth	0	147	368	0

Description	Min. Elec. Power No Heat Load	Min. Elec. Power Max Heat Load	Max. Elec. Power Max Heat Load	Max. Elec. Power No Heat Load
CHP Net Efficiency, %	52.9	70.3	82.8	62.8
Primary Energy Saving, %	0	**12**	**16**	0

3.3.6. The Proposed Development does not include a carbon capture plant; it is being designed to run on 100% hydrogen and able to run on 100% natural gas or a blend of natural gas and hydrogen therefore the decarbonisation route will be via hydrogen firing, when a commercially viable and reliable hydrogen supply becomes available to the Site. However, it is a requirement to demonstrate Carbon Capture Readiness, which is recorded in CHP-R Guidance and which, if installed would impact the heat available for CHP. In the event a carbon capture plant is installed and operational, the availability of steam energy for other offtakers is evaluated in **Table 2** below. Approximately 270 MWth of energy would be required for a future CCP in maximum load mode, and 123 MWth of energy would be required for the CCP in minimum load mode. Consequently, the energy yield from the steam cycle for the offtakers will be reduced. At maximum load, the energy available to offtakers after CCP would be 98 MWth, while this capacity reduces to 24 MWth at minimum load. In this case, the PES value is calculated as 4.5% for max load and 2% for min load. PES is lower at minimum load relative to maximum load because both heat and electrical efficiencies decline at reduced load. This efficiency drop is primarily caused by the steam cycle becoming increasingly sub-optimal as the load decreases.

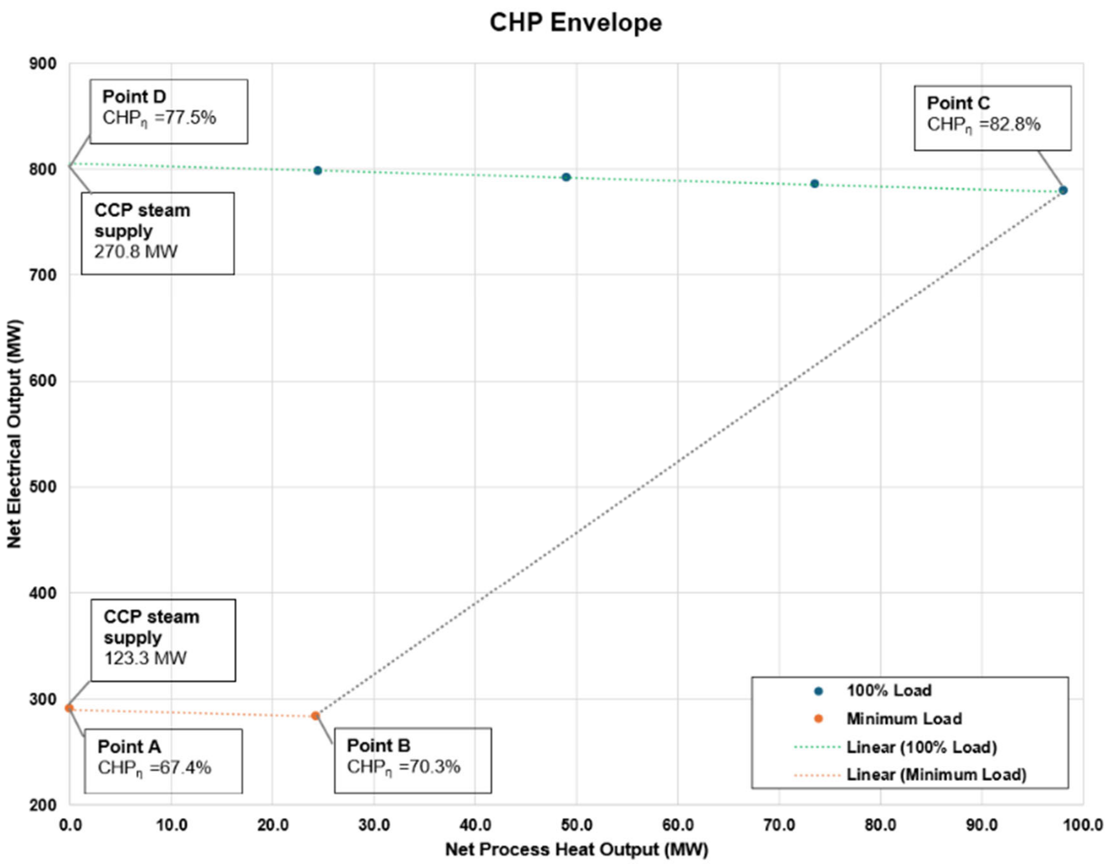

Plate 2: Indicative CHP Envelope (with CCP)

Table 2 Indicative CHP Envelope (with CCP)

Description	Min. Elec. Power No Heat Load for offtakers	Min. Elec. Power Max Heat Load for offtakers	Max. Elec. Power Max Heat Load for offtakers	Max. Elec. Power No Heat Load for offtakers
Reference Point	A	B	C	D
Thermal Input, MWth	610	610	1387	1387
Net Power Output, MWe	288	281	780	805
Heat Load for CCP, MWth	123	123	270	270
Heat Load for offtakers, MWth	0	24	98	0
CHP Net Efficiency, %	67.4	70.3	82.8	77.5
Primary Energy Saving, %	18.3	**2**	**4.5**	17.8

3.3.7. The performance of the Proposed Development (i.e. the indicative heat and power envelope data) is presented in Appendix A to this document, in the format defined by the CHP-R Guidance (Environmental Agency, 2013).

3.3.8. In the case of heat export from the CCGT to offtakers, as illustrated in **Plate 3**, while the produced net power decreases, plant CHP efficiency is enhanced, resulting in primary energy savings. Referring to the figure below, sourced from Environmental Agency's CHP Ready Guidance, the system's heat loss when the CCGT and a hypothetical standalone boiler individually meet power and heat demands is greater than the heat loss value of the CHP system. In this scenario, primary energy savings are achieved.

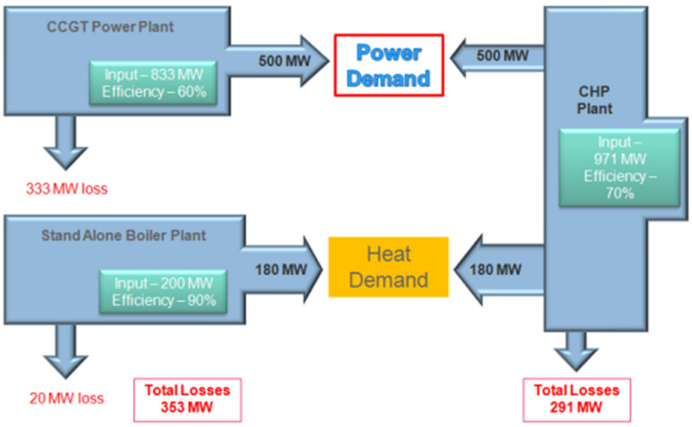

Plate 3: Generic Illustration of the Primary Energy Savings Resulting from the CHP

3.3.9. In the case presented in **Plate 3**, the key point to note is that the power supplied to the grid remains the same whether the CCGT and standalone boiler operate separately or as part of a CHP system. When heat extraction is carried out from the CCGT, the fuel input must be increased in order to maintain the same power output, which is not a possible scenario for the Keadby Next Generation Power Station discussed in this report as the base case is already based on 100% fuel input value. In this case, the reduction in power output due to the heat extraction must be balanced by increased generation from another equivalent CCGT operating on the grid. However, this report does not consider an assessment of the efficiency of such an external CCGT plant.

3.3.10. **Plate 4** and **Plate 5** respectively present the loss calculation used to determine the primary energy saving % under maximum and minimum load conditions of the Proposed Development. At maximum load with maximum heat extraction PES is calculated to be 16%; under minimum load with maximum heat extraction, PES is found to be 12%. As outlined in the Energy Efficiency Directive (Directive 2012/27/EU of the European Parliament and of the Council of 25 October), a CBA is only required where the CHP opportunity has the potential to be “high efficiency” that means where the PES achieves 10% or greater. However, the PES calculation must also be performed based on the heat demand selected within a 15 km radius, as this will determine whether an economic analysis is required. The details of calculation and results are provided in Section 4.

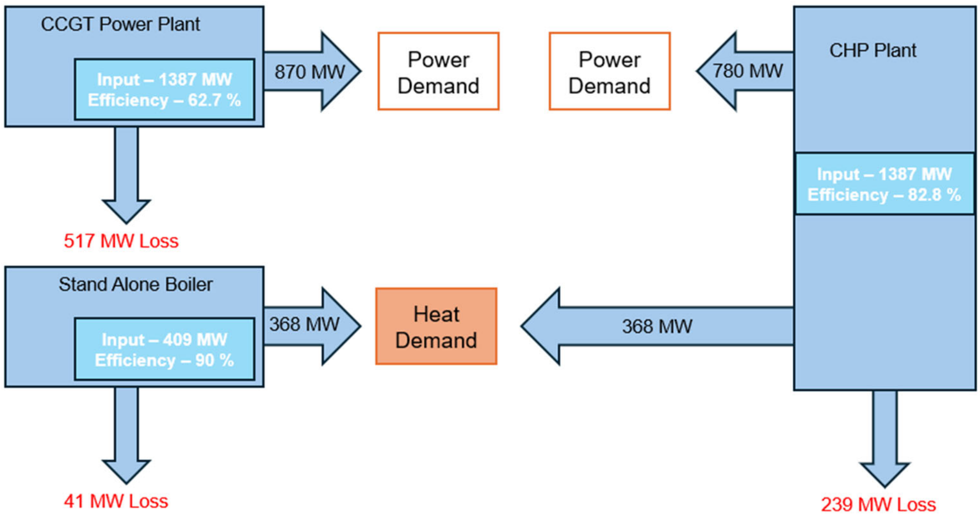

Plate 4: Illustration of the Primary Energy Savings Resulting from the CHP for power station Maximum Load

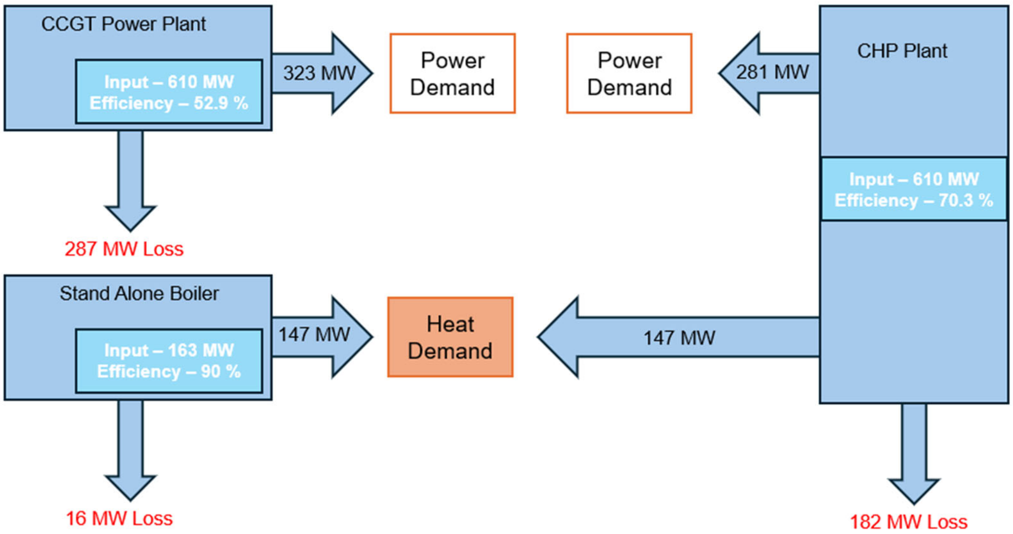

Plate 5: Illustration of the Primary Energy Savings Resulting from the CHP for power station Minimum Load

4. Identification of Potential Heat Users and Viability Assessment

4.1. Introduction

4.1.1. A review of the potential heat demand within a 15km radius of the centre of the Proposed CCGT Site 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.

4.1.2. Potential heat loads were identified using publicly available datasets, including regional fuel use data, the UK CHP Development Map, Ordnance Survey (OS) mapping, satellite imagery, and aerial photographs from Google Earth. (see Appendix B). The CHP-R Guidance states that heat loads used in the CHP-R assessment should be agreed with the Environment Agency. This will be carried out during the Environmental Permit determination period if any potentially viable CHP opportunities are identified.

4.2. CHP Opportunities

4.2.1. In line with the CHP Guidance, CHP assessments consider data from the UK CHP Development Map (BEIS, 2021). An assessment using this updated resource was conducted for a 15 km radius centred on the Proposed Site. The findings are presented in **Plate 6**.

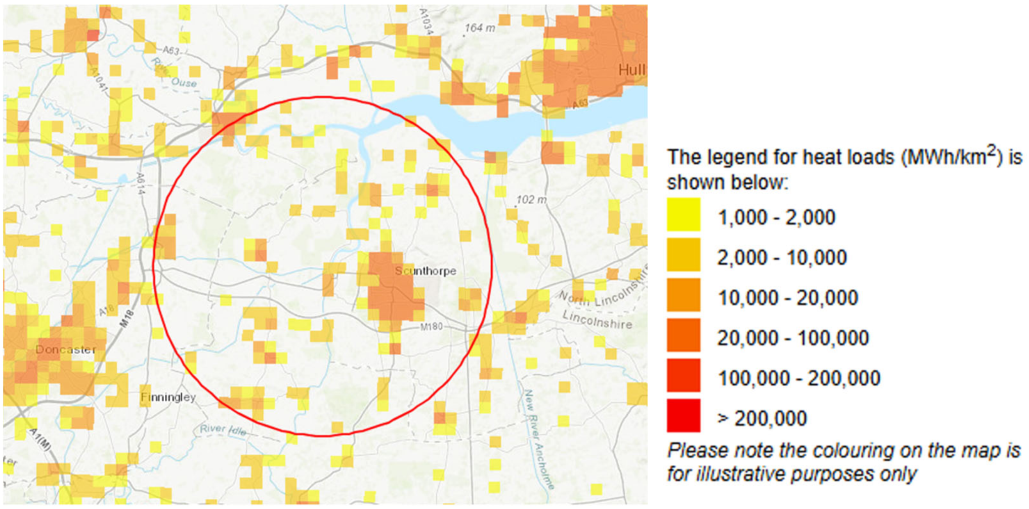

Plate 6: (Appendix B) Results from the examination of the UK CHP Development Map: Total heat demand map

4.3. CHP Viability

4.3.1. **Plate 6** indicates that the area of highest heat demand within the study boundary is Scunthorpe, approximately 8-11km away from the site. This presents a potential opportunity for the deployment of a district heating network. Developing a heat network to serve such a wide area would involve substantial logistical and economic challenges, especially given the predominance of low-density, detached and semi-detached housing in the area. A single district heating main extending from the Keadby Power Station to Scunthorpe would therefore represent the most technically and economically feasible option, as constructing multiple pipelines in different directions would substantially increase capital expenditure (CAPEX) and reduce overall viability.

4.3.2. Based on the operational cases and CCGT modelling, two heat extraction threshold values have been identified at which the PES exceeds 10%. It has been calculated that if the heat demand within the 15 km radius surpasses these thresholds, the PES value will exceed 10%. The heat extraction amounts capable of exceeding the 10% of PES threshold at both minimum and maximum gas turbine loads are provided below:

- Gas Turbine at Maximum Load: At 221 MWth heat offtake, the PES > 10%.
- Gas Turbine at Minimum Load: At 123 MWth heat offtake, the PES also > 10%.

4.3.3. Using a plant utilisation factor of around 40% of the year, total annual heat energy available ranges between 429,000 MWh and 773,000 MWh.

Comparing these heat quantities with the totals shown in Appendix B, these are greater than the total heat demand for all non-domestic buildings within a 15km radius. The non-domestic buildings have a calculated load of 120,000 MWh/yr which falls below 10% PES scenarios.

4.3.4. For the 10% PES to be exceeded all non-domestic buildings in the 15km radius and approximately 21 % of the domestic buildings that are scattered within 15km radius would need to be connected to the network. If only the non-domestic load of 120,000 MWh/yr was to be accounted for maximum and minimum gas turbine load scenarios this would have PES value of 2% for minimum and 4.5% for maximum.

4.3.5. A potential district heating network would serve only non-commercial buildings in this initial assessment. This is due to the comparatively simpler and less complex connection process for non-commercial users, making them more suitable for early-phase evaluations. Based on this limited scope, the heat load estimated does not result in a Primary Energy Saving (PES) greater than 10%. According to the Energy Efficiency Directive (Directive 2012/27/EU of the European Parliament and of the Council of 25 October), cost-benefit analysis is required for high-efficiency cogeneration installations that exceeds PES of 10%. Therefore, since the PES does not exceed this threshold, no further detailed financial modelling has been conducted at this stage. However, the heat load potential in Scunthorpe (the areas of highest heat demand identified), particularly if extended to commercial buildings or future developments might warrant further investigation in future.

4.3.6. Developing a heat network to serve a wide area comprising thousands of buildings, including individual homes, presents substantial logistical and economic challenges. District heating becomes financially viable primarily in high-density residential areas (e.g. flats or terraced housing). In contrast, most dwellings in the vicinity are semi-detached or detached, making decentralised options like individual air source heat pumps more economically attractive for these users.

4.3.7. However, this could change in the future, as, recent Heat network zoning regulation (Department for Energy Security & Net Zero, 2024) concerning district heating schemes require new buildings, non-domestic buildings above an agreed size and energy use threshold and buildings that are already communally heated within a defined proximity of a heat network to connect, where feasible. According to the Heat network zoning regulation, to identify potential heat network zones in towns and cities, a methodology is being developing, and the proposed methodology is being tested in the pilot projects now. Then, national standards will be set. Once the pilot studies are concluded and the necessary standards are formally established under this regulation, it is expected that heat demand in Scunthorpe could increase accordingly.

4.4. Economic Assessment

4.4.1. The Economic Assessment is a requirement when the calculated Primary Energy Saving (PES) exceeds 10%. In this case, while the technical assessment identified potential maximum heat loads, the serviceable (or realistically usable) heat load is significantly lower due to local demand constraints. As a result, the calculated PES falls below the 10% threshold, and a full Economic Assessment has not been prepared. As the Proposed Development is intended to operate in dispatchable mode it may not be operating when required by potential heat users and additional heat generating equipment such as standalone boilers might be required to address this.

4.5. Further Consideration and Potential Challenges of CHP

4.5.1. Within the defined CHP envelope and based on the selected heat demand value of 120,000 MWh within a 15 km radius, the calculated PES does not exceed 10%. As outlined in Section 4.4, under such circumstances a CBA is not required. However, should the heat demand or the plant's operational profile change in the future, the CHP scheme may become economically viable. In such a case, it is essential that the plant, being CHP-R, is capable of supplying heat with minimal modifications. Therefore, the system must be designed to be compatible with the potential future implementation of CHP infrastructure. This includes, but not limited to, provisions such as accessible tie-in locations, control system requirements, as summarized in paragraph 3.2.4.

5. BAT Assessment

5.1. Introduction

5.1.1. The CHP-R Guidance states that the Environment Agency require applications for Environmental Permits to demonstrate 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 Environment Agency therefore requires developers to satisfy three BAT tests in relation to CHP.

5.1.2. 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.

5.1.3. The CHP-R Guidance BAT requirements have been fulfilled for the Proposed Development, as outlined in this section.

5.2. Plant Description

5.2.1. As detailed within Section 1, the Proposed Development consists of a CCGT plant.

5.2.2. Details of the plant energy production and potential heat loads are identified in Sections 3 and 4 respectively and summarised within the CHP-R Assessment Form presented in Appendix A.

5.3. BAT Tests

5.3.1. The following section describes how the Proposed Development addresses the three BAT Tests identified within Section 2.3.

First BAT Test

5.3.2. As illustrated in Section 3 and summarised in the CHP-R Assessment Form in Appendix A, the Proposed Development has up to 368 MWth and 147 MWth of heat available for supplying to heat off-takers at full and part load respectively. This is illustrated in the CHP envelope identified in Section 3 and demonstrates that the Proposed Development has the capacity to produce a significant quantity of hot water should there be demand for local district heating.

5.3.3. The Proposed Development is in excess of the 300MWe threshold identified in the Environment Agency's CHP-R Guidance (2013) and is expected to operate primarily as a dispatchable plant over its 25-year design life. As such the operating profile of the Proposed Development may not be operating when required by potential heat users and as such is not well suited to the local heat demands from potential offtakers.

5.3.4. The assessment undertaken in Section 3 has identified that the maximum theoretical heat output for the plant represents a PES of approximately 12% for minimum load and 16% for maximum load which are above the 10% threshold identified by the Energy Efficiency Directive for high efficiency co-generation.

5.3.5. The heat demand within a 15km radius of the plant has been identified and is considered technically feasible. Section 5 above discusses the potential heat users within this area. The total selected non-domestic heat demand has been estimated at 120,000 MWh. Based on this evaluation, the resulting Primary Energy Saving (PES) has been determined to below 10%, indicating that it is not economically viable. As such, a CBA has not been prepared due to the limited serviceable demand and the dispatchable nature of the plant, which means that the theoretical heat is unlikely to be consistently available in practice for the expected operating profile of the Proposed Development.

Second BAT Test

5.3.6. Whilst no current heat demand has been identified that is economically viable, there is the potential for a number of neighbouring opportunities to be developed that could provide a viable heat demand. To this extent, the extraction option from the steam cycle has been evaluated. In the case of Carbon Capture Plant integration, potential heat extraction options within the CCP could also be considered.

5.3.7. The Proposed Development, in accordance with Second BAT Test, will be built to be 'CHP Ready'. To account for the possibility that future heat loads may become economically viable, the detailed design phase will include an assessment of potential design provisions that could allow for the implementation of the required infrastructure.

5.3.8. In accordance with the second BAT Test of the Environment Agency's CHP-R Guidance (2013), this assessment assumes that, given the uncertainty of future heat loads and the fact that it is not technically or economically feasible to install CHP from Commercial Operation Date, the initial electrical efficiency of the 'CHP Ready' Proposed Development is no less than that of the equivalent non-CHP Ready plant. This may impact the extent of "CHP-Readiness" of the installation.

5.3.9. The Proposed Development will be built to be CHP-Ready, incorporating the necessary provisions summarized in paragraph 3.2.4, in addition to the features of a conventional CCGT unit.

Third BAT Test

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

- carrying out regular reviews to determine if there have been sufficient changes in circumstances (e.g. due to changes in policy and/ or financial incentives that make it more economically viable) to warrant new technical and economic assessments; and
- carrying out regular review of operating profile of the power plant and impact on technical and economic viability
- re-visiting the technical and economic assessments within 12 months of the Commercial Operation Date and at least every 5 years thereafter or when a change in circumstances warrant.

6. Conclusions

6.1.1. In line with the requirements of NPS EN-1 and EN-2 (DECC, 2011a and 2011b) and the CHP-R Guidance (Environment Agency, 2013), this CHP assessment has been undertaken to support the application for a DCO and meet the BAT requirements of the CHP-R Guidance.

6.1.2. The Proposed Development is intended to operate in dispatchable mode and as such may not be operating when required by potential heat users which presents a significant barrier to operation as a viable CHP installation.

6.1.3. The CHP assessment has indicated that there are a number of theoretical identified heat users within a 15km radius of the Proposed Development Site. Although there are large heat loads which relate to domestic, small industrial and education within this search area, none of these offer economically viable opportunities for a heat network.

6.1.4. CHP is therefore not proposed to be installed from the outset; however, the Proposed Development will be CHP-Ready with sufficient space allocated for future retrofit of a heat offtake within the Proposed Development Site should that be required. This is considered to be BAT for plant such as the Proposed Development.

6.1.5. Under maximum CHP operation (i.e. full load), the plant achieves an electrical output of approximately 780 MWe while extracting up to 368 MWth of heat. In this mode, the CHP net efficiency is estimated at ~82.8%, resulting in a Primary Energy Saving (PES) of approximately 16%. At minimum stable generation, the plant operates at around 281 MWe with approximately 147 MWth of heat extraction. In this condition, the CHP net efficiency is ~70.3%, and the corresponding PES is estimated at 12%. Both operating scenarios exceed the 10% PES threshold defined in the Energy Efficiency Directive, which means that an economic analysis would normally be required under the Directive. However, as explained in Section 4.3, in order for the PES value to exceed 10%, the heat extraction must reach approximately 221 MWth at maximum load and exceed 123 MWth at minimum load. However, the current analysis has identified the non-domestic heat demand within 15 km to be 120,000 MWh annually. Assuming 3,500 hours of operation per year, the CHP system would need to extract 773,000 MWh at full load and 429,000 MWh at partial load, both of which significantly exceed the current demand (120,000 MWh). Consequently, the PES target of 10% cannot be met under current conditions. Therefore, there is not required to conduct economic analysis. To achieve PES > %10, all non-domestic users plus approximately 21 percent of domestic buildings would need to connect. However, local housing density (predominantly semi-detached/detached) makes individual air-source heat pumps more viable than a district heating network at present.

6.1.6. If a Carbon Capture Plant (CCP) were to be installed on the CCGT, available heat offtake drops to ~98 MWth (full load) and ~24 MWth (minimum load), yielding PES well below 10 %. In this operating mode, while the non-domestic heat demand can still be met at maximum load, it cannot be fully satisfied during minimum load operation.

6.1.7. The PES assessments conducted for operation with CCP are based on the assumption that heat will be extracted from the steam cycle. Other potential heat extraction points within the potential CCP may also exist and could warrant further evaluation.

6.1.8. The applicant is committed to carrying out a periodic ongoing review of CHP potential. This commitment will be secured through an appropriately worded requirement in Schedule 2 to the draft DCO.

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13. Department for Energy Security & Net Zero (DESNZ) (2024) Heat network zoning Available online: https://assets.publishing.service.gov.uk/media/65a1488b3308d2000d1fbf50/heat-network-zoning-overview.pdf [Accessed 15 July 2025].

Appendix A

A.1 CHP-R Assessment Form

#	Description	Units	Notes/Instructions
Requirement 1: Plant, Plant Location and Potential Heat Loads			
1.1	Plant Name		Keadby Next Generation Power Station
1.2	Plant description		A combined cycle gas turbine (CCGT) power station with a gross capacity of approximately 910 megawatts (MWe). The power station will be designed to run on 100% hydrogen and able to run on 100% natural gas or blend of natural gas and hydrogen. The CCGT will comprise an H-class gas turbine, heat recovery steam generator and steam turbine. Site cooling will be supplied through hybrid cooling technology and operation will be at UK ambient conditions.
1.3	Plant Location (Postcode / Grid Ref)		Keadby, Scunthorpe (DN17 3EF / SE820120)
1.4	Factors influencing selection of plant location		Ongoing development of an existing power generation site (Keadby 1 and 2) and close to a proposed Humber Cluster
1.5	Operation of plant		
a)	Proposed operational plant load	%	100 Single train design (one gas turbine, one HRSG and one steam turbine)
b)	Thermal input at proposed operational plant load	MW	1,387

c)	Net electrical output at proposed operational plant load	MW	870
d)	Net electrical efficiency at proposed operational plant load	%	62.7
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	1,387
g)	Net electrical output at maximum plant load	MW	870
h)	Net electrical efficiency at maximum plant load	%	62.7
i)	Minimum stable plant load	%	37
j)	Thermal input at minimum stable plant load	MW	610
k)	Net electrical output at minimum stable plant load	MW	335
l)	Net electrical efficiency at minimum stable plant load	%	52.9
1.6	Identified Potential Heat Loads		See details presented in Section 4.
1.7	Selected Heat Loads		
a)	Category (e.g. industrial / district heating)		Non-domestic
b)	Maximum heat load extraction required		120,000 GWh (assuming 3500 hours annual) 34 MWth
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		LP steam extraction
b)	Description of heat load profile		Intermittent flow (depending on seasonal heat demand)

c)	Export pressure	bar a	Not available (tbd in the subsequent project phase)
d)	Export temperature	°C	Not available (tbd in the subsequent project phase)
e)	Export flow	t/h	Not available (tbd in the subsequent project phase)
f)	Return pressure	bar a	Not available (tbd in the subsequent project phase)
g)	Return temperature	°C	Not available (tbd in the subsequent project phase)
h)	Return flow	t/h	Not available (tbd in the subsequent project phase)
Requirement 2: Identification of CHP Envelope			
2.0	Comparative efficiency of a standalone boiler for supplying the heat load	90 % LHV	90
2.1	Heat extraction at 100% plant load		
a)	Maximum heat load extraction at 100% plant load	MW	368
b)	Maximum heat extraction export flow at 100% plant load	t/h	540
c)	CHP mode net electrical output at 100% plant load	MW	780
d)	CHP mode net electrical efficiency at 100% plant load	%	56.2
e)	CHP mode net CHP efficiency at 100% plant load	%	82.8
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	16
2.2 Heat extraction at minimum stable plant load			

a)	Maximum heat load extraction at minimum stable plant load	MW	147
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	216
c)	CHP mode net electrical output at minimum stable plant load	MW	281
d)	CHP mode net electrical efficiency at minimum stable plant load	%	46
e)	CHP mode net CHP efficiency at minimum stable plant load	%	70.3
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	12
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 (120,000 GWh /34 MW)			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	863
b)	CHP mode net electrical efficiency at proposed operational plant load	%	62
c)	CHP mode net CHP efficiency at proposed operational plant load	%	65%

d)	Reduction in net electrical output for CHP mode at proposed operational plant load	%	0.8
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%pts	0.7
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	1.8
g)	Z ratio		4.9
Requirement 4: Technical provision and space requirements			
4.1	Description of likely suitable extraction points		Extraction of LP steam from steam turbine inlet.
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
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		Future costs of the CHP technology could be minimised by implementing the necessary connections to the appropriate heat extraction point during the installation phase, in order to avoid any disruption to power plant operations at a later stage. This includes conducting detailed engineering analyses and installing the required equipment in advance.
4.4	Provision of site layout of the plant, indicating available space which could be made available for CHP-R		Suitable provision will be included in the detailed design of the plant.

Requirement 5: Integration of CHP and carbon capture			
5.1	Is the plant required to be CCR?		Yes – because electrical power output is greater than 300 MW.
5.2	Export and return requirements identified for carbon capture		
	<u>100% plant load</u>		
a)	Heat load extraction for carbon capture at 100% plant load	MW	271
b)	Description of heat export (e.g. steam / hot water)		Low Pressure (LP) Steam
c)	Export pressure	bar a	4
d)	Export temperature	°C	155
e)	Export flow	t/h	396
f)	Return pressure	bar a	Pressure loss will be calculated in detailed design phase.
g)	Return temperature	°C	75
h)	Return flow	t/h	396
i)	Likely suitable extraction points		LP/ Intermediate Pressure (IP) crossover
	<u>Minimum stable plant load</u>		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	123
k)	Description of heat export (e.g. steam / hot water)		Low Pressure (LP) Steam
l)	Export pressure	bar a	4
m)	Export temperature	°C	155
n)	Export flow	t/h	180
o)	Return pressure	bar a	Pressure loss will be calculated in detailed design phase.
p)	Return temperature	°C	75
q)	Return flow	t/h	180

r)	Likely suitable extraction points		LP/ Intermediate Pressure (IP) crossover
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	1,387
c)	Carbon capture mode net electrical output at 100% plant load	MW	805
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	58
e)	Minimum stable plant load with CCS	%	37
f)	Carbon capture mode thermal input at minimum stable plant load	MW	610
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	288
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	47
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	MW	98
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	144
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	780

d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	56.2
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	63.2
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	4.5
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	24
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	36
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	281
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	46
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	50
f)	Reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	2
5.6	Can the plant with carbon capture supply the selected identified potential heat load		No, available heat extraction capacity is 24 MW, selected load is 34 MW.

	(i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		
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		Not available
Requirement 6: Economics of CHP-R			
6.1	Economic assessment of CHP-R		Not considered economically viable to develop a district heat network as the primary energy saving does not meet the 10%.
BAT Assessment			
Is the new plant a CHP plant at the outset (i.e. are there economically viable CHP opportunities at the outset)?			No – selected load is not economically viable.
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

Appendix B

B.1 Review of CHP Development Map

B.1.1 The CHP Guidance requires that CHP assessments examine the information available on the Online Industrial Heat Map 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 (Department for Business, Energy & Industrial Strategy (BEIS), 2021). The results from the examination of the UK CHP Development Map, covering a search area of 15km centred on the Proposed Keadby Next Generation Power Station site, are shown in **Plate B.1**.

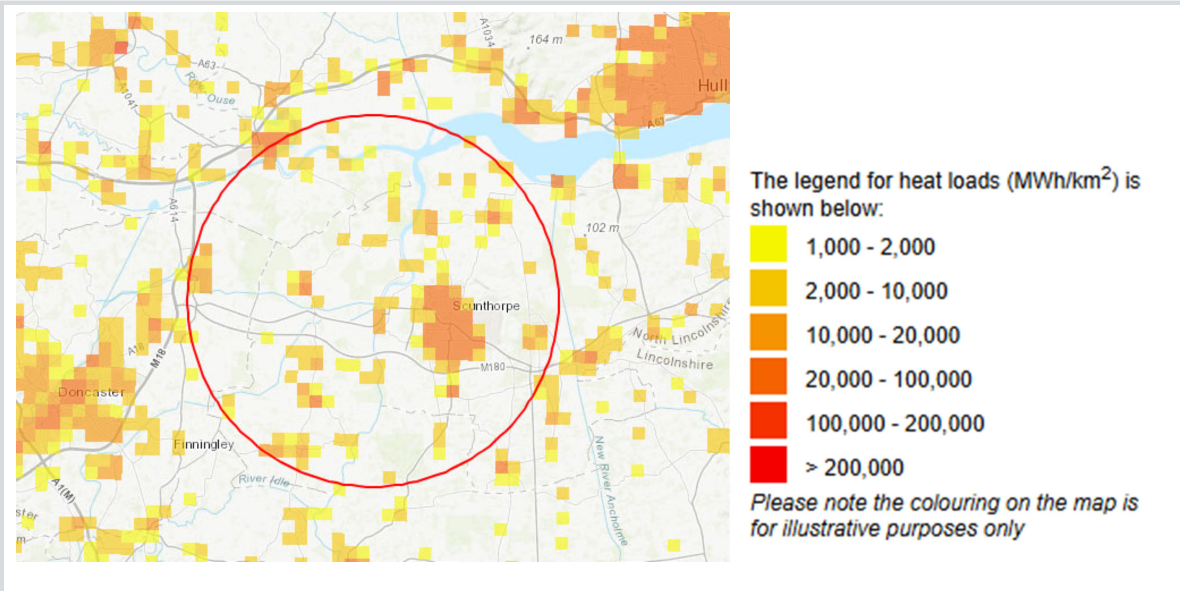

Plate B1: Results from the examination of the UK CHP Development Map: Total heat demand map

B.1.2 The breakdown of the results from the review of the UK CHP Development Map across the full 15km radius is shown in **Table B.1.** Results from the examination of the UK CHP Development Map: Heat demand by sector

Table B.1: Results from the examination of the UK CHP Development Map: Heat demand by sector

Sector	% share of total load identified	Total heat load (MWh)
Communications and Transport	0.04%	708
Commercial Offices	0.27%	4,256
Domestic	93.26%	1,488,307

Sector	% share of total load identified	Total heat load (MWh)
Education	1.54%	24,644
Government Buildings	0.28%	4,423
Hotels	0.22%	3,572
Large Industrial	0.00%	0
Health	0.33%	5,220
Other	0.07%	1,135
Small Industrial	3.23%	51,545
Prisons	0.00%	0
Retail	0.53%	8,536
Sport and Leisure	0.15%	2,365
Warehouses	0.08%	1,225
District Heating	0.00%	0
Total potential heat load within 15 km of proposed Keadby Next Generation Power Station		1,595,937

B.1.3 From **Table B.1**, the largest potential heat loads within the CHP search area (15 km radius from Proposed Keadby Next Generation Power Station), relate to:

- Domestic (93.3%),
- Small industrial (3.2%), and
- Education (1.5%).

B.1.4 The following figures illustrate these heat loads within the CHP search area.

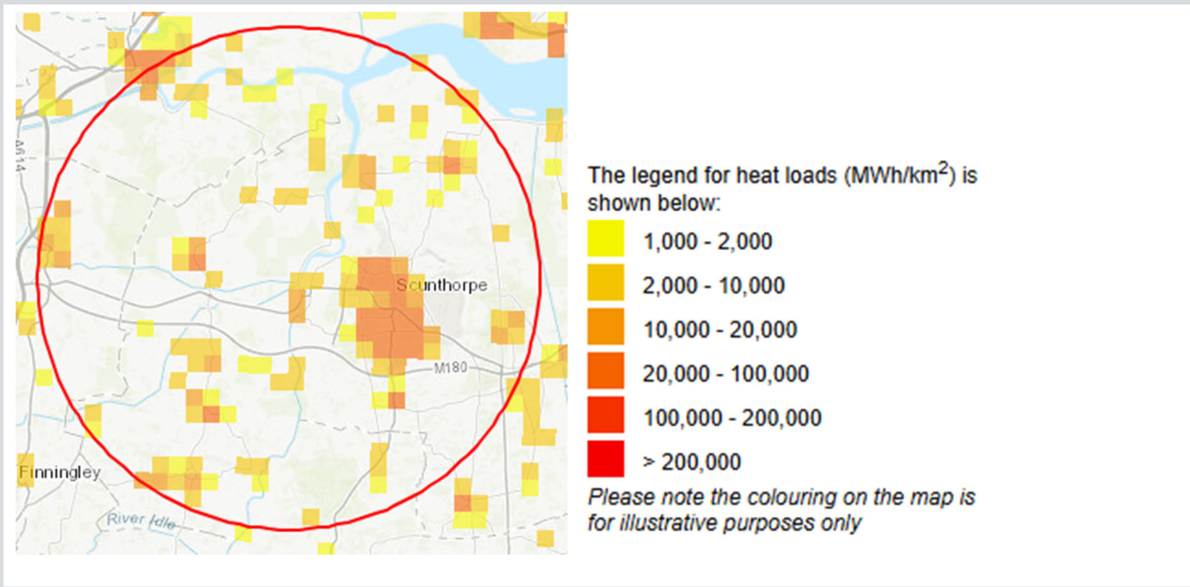

Plate B.2: Results from the examination of the UK CHP Development Map: Domestic heat loads

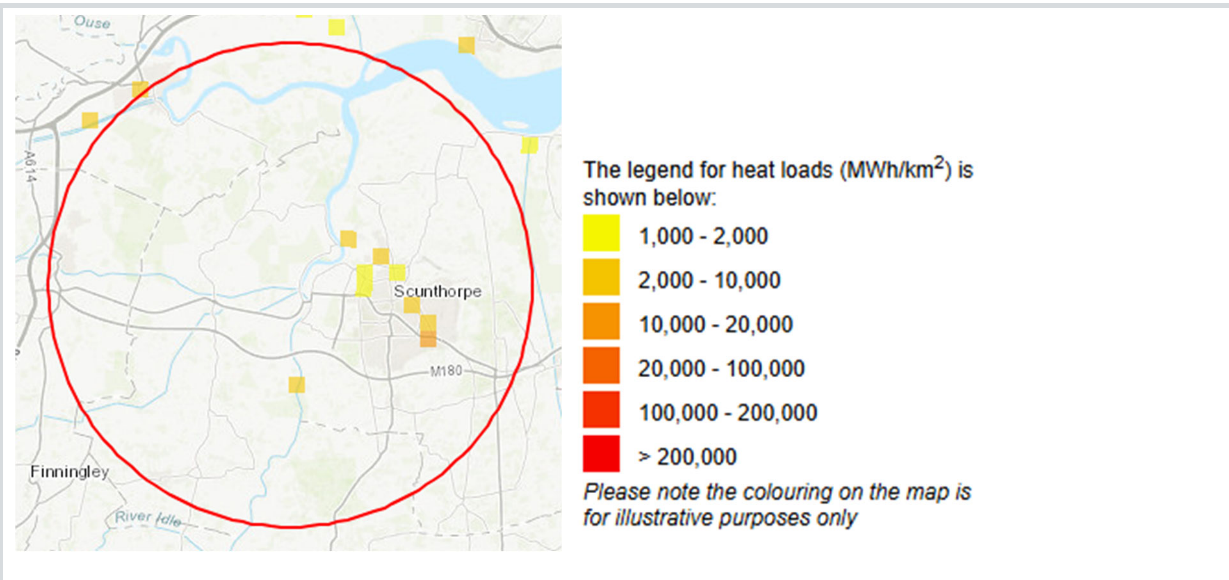

Plate B.3 Results from the examination of the UK CHP Development Map: Small industrial heat loads

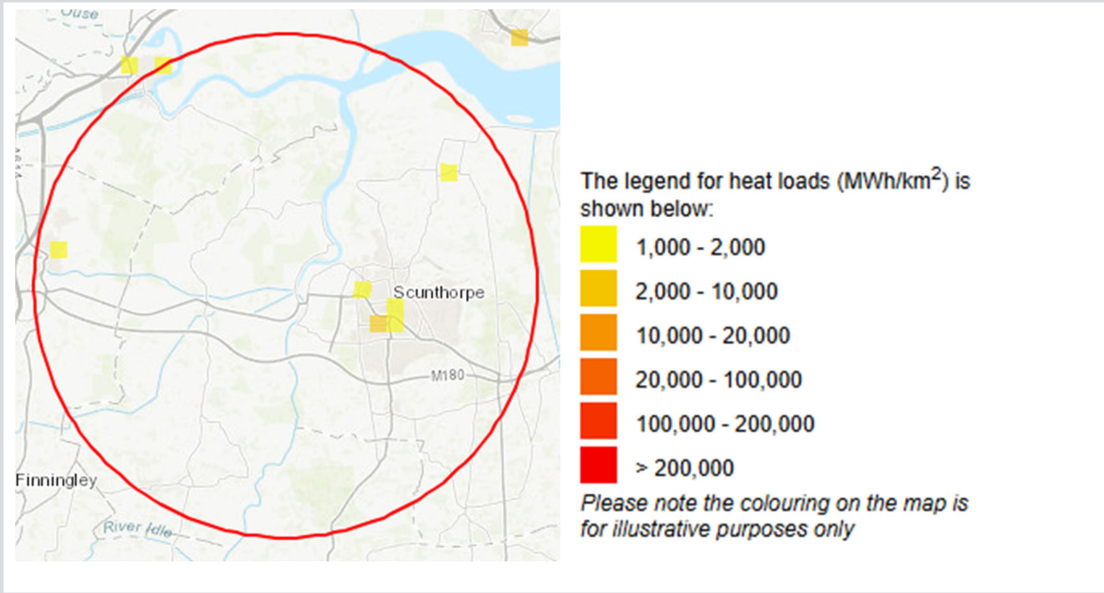

Plate B.4 Results from the examination of the UK CHP Development Map: Education heat loads

B.2 Review of Healthcare data

B.2.1 NHS England publish the cost of "providing and maintaining the NHS Estate including buildings, maintaining and equipping hospitals, the provision of services e.g. laundry and food, and the costs and consumption of utilities" in the Estates Return Information Collection (ERIC).

B.2.2 The ERIC summary results for 2023/24 have been reviewed to identify the healthcare heat loads within a 15 km radius of the Proposed Keadby Next Generation Power Station, as summarised in **Table B.2**.

B.2.3 ERIC data for healthcare sites within a 15 km radius of Proposed Keadby Next Generation Power Station

Table B.2 ERIC data for healthcare sites within a 15 km radius of Proposed Keadby Next Generation Power Station

Site Name	Post Code	Gross internal floor area (m²)	Distance from Keadby Next Generation Power Station (km) [1]	Gas consumed (kWh)	Oil consumed (kWh)
New Beacon House	DN17 1BS	1,805	5.4	Not Applicable	Not Applicable

Site Name	Post Code	Gross internal floor area (m²)	Distance from Keadby Next Generation Power Station (km) [1]	Gas consumed (kWh)	Oil consumed (kWh)
Global House (North Lincolnshire College)	DN17 1AJ	1,145	5.7	Not Applicable	Not Applicable
Scunthorpe General Hospital	DN15 7BH	64,434	5.3	19,129,429	36,760
Ironstone Centre	DN15 6HX	1,005	6.3	Not Applicable	Not Applicable
St. Nicholas House, Scunthorpe	DN15 6NU	734	6.4	116,174	0
Great Oaks Inpatient Unit	DN16 2JX	3,003	7.9	713,328	0
Nth Lincs - Talking Shop	DN15 6SS	503	6.8	53,699	0

[1] Distance measured as the crow flies.

Source: Estates Returns Information Collection, Summary page and dataset for ERIC 2023/24

B.2.4 Seven NHS sites within 15 km, as the crow flies, from the Proposed Keadby Next Generation Power Station have been identified, as listed in Table B.2. Three of these sites (New Beacon House, Global House and Ironstone Centre) do not have consumption data recorded within the ERIC data; therefore, the Display Energy Certificate (DEC) online database has been reviewed to obtain any additional information for these sites; summarised below in **Table B.3**.

Table B.3 DEC energy data for selected healthcare sites within a 15 km radius of Proposed Keadby Next Generation Power Station

Site Name	Post Code	Gross internal floor area (m²)	Distance from Keadby Next Generation Power Station (km) [1]	Gas consumed (kWh)	Oil consumed (kWh)
New Beacon House	DN17 1BS	1,805	5.4	Not available	Not available
Global House (North Lincolnshire College)	DN17 1AJ	1,145	5.7	278,246	Not applicable
Ironstone Centre	DN15 6HX	1,005	6.3	326,509	Not applicable

[1] Distance measured as the crow flies.

Source: Display Energy Certificate database, https://www.gov.uk/find-energy-certificate

1.1.1 The last site, New Beacon House, does not have consumption data recorded within the ERIC dataset or have a valid DEC available online. The online CIBSE Benchmarking Tool has been used to estimate the building's gas consumption.

Table B.4 Benchmarked energy data for selected healthcare sites within a 15 km radius of Proposed Keadby Next Generation Power Station

Site Name	Post Code	Gross internal floor area (m²)	Distance from Keadby Next Generation Power Station (km) [1]	Gas consumed (kWh)	Oil consumed (kWh)
New Beacon House	DN17 1BS	1,805	5.4	267,140 [2]	Not applicable

[1] Distance measured as the crow flies.

[2] Benchmarked energy consumption using CIBSE Energy Benchmarking Dashboard, for typical practice fossil fuel consumption for health centres.

Source: CIBSE Energy Benchmarking Dashboard, https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/energy-benchmarking-dashboard/

B.2.5 The above noted gas consumption data has been converted into heat demand by accounting for an assumed boiler efficiency of 85%, representative of existing boiler performance. **Table B.5** records the heat demands from the identified healthcare buildings.

Table B.5 Total potential healthcare heat load

Site Name	Total fossil fuel consumption (kWh)	Total heat demand (kWh)	Total heat demand (MWh)
New Beacon House	267,140	227,069	227.1
Global House (North Lincolnshire College)	278,246	236,509	236.5
Scunthorpe General Hospital	19,166,189	16,291,261	16,291.3
Ironstone Centre	326,509	277,533	277.5
St. Nicholas House, Scunthorpe	116,174	98,748	98.7
Great Oaks Inpatient Unit	713,328	606,329	606.3
Nth Lincs - Talking Shop	53,699	45,644	45.6
Total potential healthcare heat load within 15 km radius of proposed Keadby Next Generation Power Station		17,783,092	17,783.1

B.3 Review of proposed future developments

B.3.1 A high-level desktop review of significant potential future developments in the vicinity of the Keadby Next Generation Power Station has been undertaken; with the proposed Lincolnshire Lakes development presenting the greatest opportunity.

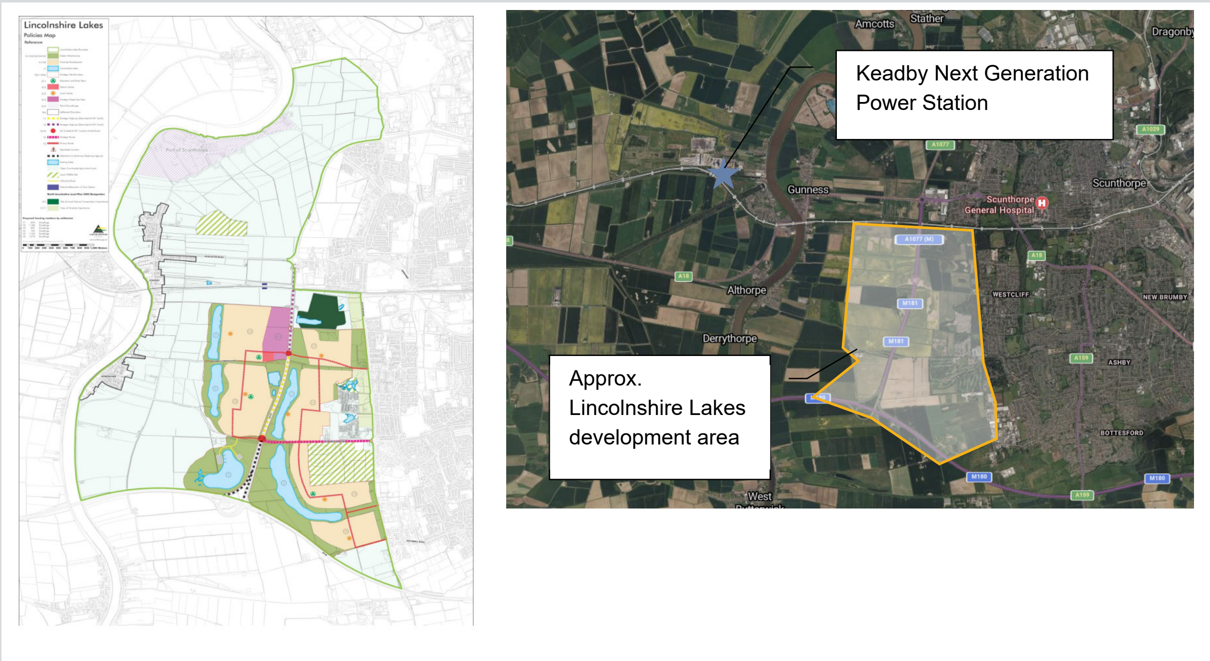

Plate B.5 Lincolnshire Lakes development

Source: Lincolnshire Lakes Strategic Design Guide PART A: Analysis and Framework Plans, August 2016[1] and Aerial image from bing.com

Table B.6 Strategic Site Allocations taken from the Lincolnshire Lakes Area Action Plan

Reference	Summary description of relevant features
SSA1	Mixed use area and district centre, including: • 23 ha strategic mixed-use area • 2.15 ha district centre
SSA2	Villages 1 and 2, and Lake 1 • Village 1: approximately 690 dwellings, with 300 m² local centre (shopping) • Village 2: approximately 1,188 dwellings, with 500 m² local centre (shopping)
SSA3	Villages 3 and 4, and Lake 2 • Village 3: approximately 987 dwellings, with 400 m² local centre (shopping) and primary school • Village 4: approximately 769 dwellings, with 300 m² local centre (shopping)

[1] https://democracy.northlincs.gov.uk/wp-content/uploads/2017/03/Lincolnshire-Lakes-Strategic-Design-Guide1.pdf

SSA4	Lake 5 and surrounding area
SSA5	Village 5 and Lake 3 • Village 5: approximately 1,100 dwellings, with 300 m² local centre (shopping) and primary school
SSA6	Village 6 and Lake 4 • Village 6: approximately 1,570 dwellings, with 500 m² local centre (shopping) and primary school

Source: Lincolnshire Lakes Area Action Plan, Adopted May 2016[2]

B.3.2 Benchmarks have been used to calculate the overall heat demand that the Lincolnshire Lakes development may present, as illustrated below in **Table B.7**.

Table B.7 Potential heat demands from Lincolnshire Lakes development

Sector	% share of load identified	Potential future heat load (MWh)
Communications and Transport	0.00%	-
Commercial Offices	0.00%	-
Domestic	73.91%	24,295
Education	0.63%	208
Government Buildings	0.00%	-
Hotels	0.00%	-
Large Industrial	0.00%	-
Health	0.00%	-
Other	0.00%	-
Small Industrial	0.00%	-
Prisons	0.00%	-
Retail	25.46%	8,369

[2] https://m.northlincs.gov.uk/public/planningreports/LincolnshireLakes/Adoption/Lincolnshire_Lakes_AAP_2016.pdf

Sector	% share of load identified	Potential future heat load (MWh)
Sport and Leisure	0.00%	-
Warehouses	0.00%	-
District Heating	0.00%	-
Total potential heat load within Lincolnshire Lakes development		32,872

Appendix C

C.1 CHP viability study

Domestic loads

C.1.1 The CHP Development Map outputs within **Plate B.2** indicate that the existing domestic heat load within the search area is 1,488,306 MWh (approximately 93% of the total heat load within the search area). As indicated by **Plate B.2**, the heat load is spread across the CHP search area with the highest heat loads located within the settlements of Scunthorpe and Bottesford.

C.1.2 This may be further increased by the Lincolnshire Lakes development, which at its maximum extent may have a domestic heat load of 24,295 MWh. At the time of writing (March 2025), there are five projects within the Lincolnshire Lakes development within the planning process; but the anticipated timelines for construction are not known.

C.1.3 Reporting undertaken historically for DECC (Pöyry and Faber Maunsell, 2009) suggests that a district heating network using waste heat from a generating station would potentially be cost-effective where heat demand exceeds 200MWth within 15km. Notwithstanding, NPS EN-1 (at paragraph 4.6.5) recognises the challenges associated with retrofitting CHP:

"[…] 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 […]"

C.1.4 Whilst the domestic heat loads present within the CHP search area are in excess of 200 MWth, the overall load comprises numerous individual loads associated with individual disparate settlements.

C.1.5 The largest domestic heat loads are to the east of the River Trent which would therefore necessitate the construction of pipework crossing the river to connect the Proposed Power Station to any network.

C.1.6 Owing to the technical complexities and engineering challenges of multiple export networks, as well as the lack of any clear and stable revenue stream, the costs and benefits of including it as part of any initial design cannot be realised.

C.1.7 On this basis, the domestic heat load is not considered to be a viable CHP opportunity.

Small industrial loads

C.1.8 The CHP Development Map outputs within **Plate B.3** indicate that the small industrial heat load within the search area is 51,545 MWh (approximately 3% of the total heat load within the search area). As indicated by **Plate B.3**, the heat loads are broadly split between industrial facilities surrounding Scunthorpe and some limited industrial activity at West Butterwick. Notable small industrial facilities locally include Queensway Industrial Estate, Grange Lane Industrial Estate, Midland Road Industrial Estate, Sawcliffe Industrial Estate, Foxhills Industrial Estate and Flixborough Industrial Estate.

C.1.9 However, it should be noted that industrial heat demands are particularly difficult to benchmark accurately because the use (and therefore the heat demand) of industrial units varies widely. A relatively high proportion of industrial units are not heated or heated to low temperatures (frost protection). Conversely some industrial processes require large quantities of heat. Therefore, the benchmarked heat demand for this category of building is particularly uncertain and should be validated with site-specific data prior to further development of heat network design.

C.1.10 Although the individual small industrial sites could potentially present some heat loads, all of the small industrial users are located on the eastern side of the River Trent which presents challenges in terms of transporting any potential waste heat to industrial users. In addition, there is no single small industrial load and instead, there are a number of multiple disparate users. As well as leading to increased cost and technical complexity in installing a network for export of heat, balancing multiple (variable) loads is predicted to be prohibitive against the context of the Proposed Development which itself would have a highly variable output in dispatchable mode.

C.1.11 Furthermore, as there is no single heat load, there would be greatly increased legal and financial complexity – and ultimately risk – associated with establishing contracts for supply of ‘waste’ heat to multiple users. This is a specific issue highlighted within reporting undertaken for DECC in 2009 which notes that *“[…] achieving a satisfactory base load heat demand will be risky if it relies on securing commitments from a large number of private sector users […]”.*

C.1.12 Owing to the factors discussed above, the small industrial heat loads are not considered to be a viable CHP opportunity.

Education loads

C.1.13 The CHP Development Map outputs within **Plate B.4** indicates that the existing education heat load within the search area is 24,644 MWh (approximately 1.5% of the total heat load within the search area). As indicated by **Plate B.4**, the heat loads are split between Scunthorpe and two separate locations at Thorne (to the west) and Winerton (to the north-east).

C.1.14 This load may be further increased by the construction of the Lincolnshire Lakes development which may add a further 208 MWh of education heat load.

C.1.15 The barriers associated with education are as per those discussed above for small industrial heat loads and on this basis, education is not considered to be a viable CHP opportunity.

Healthcare loads

C.1.16 The CHP Development Map outputs indicates that the healthcare heat load within the search area is 5,220MWh (approximately 0.3% of the total heat load within the search area).

C.1.17 A subsequent review of the ERIC dataset indicates that the healthcare heat load is approximately 17,780 MWh, within which the largest heat load is Scunthorpe General Hospital with a total heat demand of 16,291MWh. The other healthcare heat loads are distributed across Scunthorpe and are generally associated with smaller primary healthcare settings.

C.1.18 The barriers associated with healthcare are as per those discussed above for small industrial heat loads and on this basis, education is not considered to be a viable CHP opportunity.

Heat demand summary

C.1.19 **Table C.1** shows a summary of the calculated heat demands as described in the previous sections. These show a total annual heat demand of circa 1.63 million MWh per year. Non-domestic heat demands total annual heat demand is around 120,400 MWh per year.

Table C.1 Summary of calculated heat demand within 15km of proposed power plant

Head Demand Category	Calculated Heat Demand (GWh/yr)	Data source
Domestic existing	1,488	CHP Development Map
Domestic future development	24	Planning application & Benchmark
Small Industrial existing	52	CHP Development Map
Education existing	25	CHP Development Map

Head Demand Category	Calculated Heat Demand (GWh/yr)	Data source
Education future development	0.2	Planning application & Benchmark
Healthcare existing	18	CHP Development Map
Other	26	CHP Development Map
Total	1,634	
Non-domestic total	120	

Supply & demand balance

C.1.20 Analysis of the proposed power plant has been undertaken to assess the calculated Primary Energy Saving (PES) from the potential heat off-take. This has established that the PES is less than 10% when the heat offtake is low. The minimum heat offtake at which a 10% PES is achieved has been calculated to be 123MWth when the plant is operating at minimum electrical output and 221MWth when the plant is operating at maximum output.

C.1.21 Taking account of these minimum thresholds the heat demand analysis, summarised in the previous sections, has been reviewed to establish what scale of heat network might be needed to use this minimum quantum of heat.

C.1.22 The projected annual run-time for the plant is understood to be 3,500 hours per year. This equates to around 40% of the year. Taking account of this utilisation factor, total annual heat available ranges between 429,000 MWh and 773,000 MWh. Comparing these heat quantities with the totals shown in **Table C.1** , these are greater than the total heat demand for all non-domestic buildings within a 15km radius, including future developments, but lower than the total including all dwellings (existing and future development).

C.1.23 Developing a heat network to serve a large area, with many thousands of buildings including a large number of individual dwellings, would be extremely challenging in many ways. The economics of supplying individual houses via DHNs typically only becomes viable when the dwelling density is high (e.g. terraced housing or flats). However, most dwellings in the area are either semi-detached or detached and so supplying heat in this way is likely to be less economically viable, for a heat network developer, than supplying them with individual air source heat pumps.