Connah’s Quay Low Carbon Power

Other Documents Volume VII
Combined Heat and Power (CHP) Readiness Assessment

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Executive Summary

1.1.1 Uniper UK Limited (the Applicant) is seeking a Development Consent Order (DCO) for the construction, operation and maintenance of a new low carbon Combined Cycle Gas Turbine (CCGT) Generating Station (the Proposed Development). The Proposed Development includes two natural gas-fired electricity generating plants with a combined net electrical output of up to 1,380 megawatts (MW) for both trains. Each station shall be provided with state-of-the art carbon capture technology, carbon dioxide (CO_2) export via pipeline, balance of plant including cooling water, electrical, gas and utility connections, construction laydown areas and other associated works. The provision of a post-combustion carbon capture facility will ensure that the Proposed Development operates with significantly reduced carbon emissions, capturing a substantial proportion of CO_2 that would otherwise be released into the atmosphere. As such, the Proposed Development will make a meaningful contribution toward the United Kingdom's (UK) Net Zero greenhouse gas emissions target by 2050.

1.1.2 The purpose of this document is to comply with Section 4.8 of the Overarching National Policy Statement for Energy (EN-1) (NPS 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) (NPS 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).

1.1.3 The assessment demonstrates that the Applicant has explored the potential for the plant to operate in CHP mode, i.e. exporting 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' (Natural Resources Wales, 2014 and Environment Agency, 2013) (the CHP-R Guidance).

1.1.4 Following an assessment of the feasibility for heat extraction, potential heat sources capable of producing hot water for district heating were identified. From these sources, there is approximately up to 41 Megawatt thermal (MWth) and 69 MWth from a single train and up to 81 MWth and 138 MWth of heat available (after heat requirements for the carbon capture plant are considered) from the Proposed Development running at minimum electrical power (part load) and maximum electrical power (full load) respectively for two trains. The calculated Primary Energy Savings are 6% and 5.9% for partial load and maximum load, respectively. This means any heat extraction to meet local heat demand within the CHP envelope is not expected to be economically viable. Therefore, CHP is 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 in the CHP-R Guidance.

1.1.5 While the total heat demand within a 15-kilometre (km) radius of the Proposed Development appears significant, particularly from large industrial users, which account for approximately 12,536,186 Megawatt hour (MWh) per annum, this figure reflects total site energy consumption, not the portion

that is necessarily compatible with district heating. Identified potential heat users include Essity's paper mill in Flint, with no evidence of an existing CHP system. Other industrial sites with possible heat demand include ICT UK, and BAE Systems at Broughton. While Tata Steel (Shotton) and Toyota (Deeside) are major employers, their suitability for heat integration is limited by location (across the River Dee) and process considerations.

1.1.6 It is important to note that much of this industrial demand may be met by high-temperature or process-specific systems (e.g. steam), which cannot be directly replaced or fully supplemented by a 90 °C district heating network. Therefore, the headline demand figures must be treated with caution. A more detailed, site-specific heat mapping and energy use assessment would be required to determine the actual serviceable load compatible with a district heating solution. Without this refinement, the identified loads cannot be reliably used to support a viable CHP-led heat network at this time.

1.1.7 CHP potential for the Proposed Development has been assessed using an assumption of 6,000 annual operating hours and based on a phased development approach. Phase-1 corresponds to the operation of a single train, while Phase-2 reflects the full build-out with both trains operational. The CHP envelope indicates that instantaneous heat available for export ranges from 40.7 MWth at minimum load (i.e., when only one train is running) to 69.2 MWth in Phase-1 and 138.4 MWth in Phase-2 at full load. This equates to an estimated potential annual heat availability of up to 415,200 MWh in Phase-1 and 830,400 MWh in Phase-2.

1.1.8 Maximum achievable CHP efficiency is calculated at 62.2%, with a Primary Energy Saving (PES) of 5.9% under full-load conditions. At minimum load, the CHP efficiency is 54.8%, with a PES of 6.0%. As these PES values fall below the 10% threshold required for classification as 'high-efficiency CHP' under the Energy Efficiency Directive, a cost-benefit analysis is not required at this stage. 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 - R in accordance with the BAT Tests of the CHP-R Guidance.

1. Introduction

1.1 Overview

1.1.1 This Combined Heat and Power Readiness Assessment has been prepared by AECOM Limited (AECOM) on behalf of the Applicant referred to as the Applicant. 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.

1.1.2 The Applicant is seeking development consent for the construction, operation (including maintenance) and decommissioning of a proposed low carbon Combined Cycle Gas Turbine (CCGT) Generating Station fitted with Carbon Capture Plant (CCP) (the Connah's Quay Low Carbon Power (CQLCP) Abated Generating Station) and associated supporting infrastructure (collectively the Proposed Development) on land at, and in the vicinity of, the existing Connah's Quay Power Station (Kelsterton Road, Connah's Quay, Flintshire, CH6 5SJ), North Wales (the Order limits)

1.1.3 The CQLCP Abated Generating Station would comprise up to two CCGT with CCP units (and supporting infrastructure) achieving a net electrical output capacity of more than 350 megawatts (MW; referred to as MWe for electrical output) and up to a likely maximum of 1,380 MWe (with CCP operational) onto the national electricity transmission network.

1.1.4 Through a carbon dioxide (CO_2) pipeline, comprising existing and new elements, the Proposed Development would make use of CO_2 transport and storage networks owned and operated by Liverpool Bay CCS Limited, currently under development as part of the HyNet Carbon Dioxide Pipeline project (referred to as the HyNet CO_2 Pipeline Project), that will transport CO_2 captured from existing and new industries in North Wales and North West England, for offshore storage. The captured CO_2 will be permanently stored in depleted offshore gas reservoirs in Liverpool Bay.

1.1.5 For the purposes of the electrical connection, National Grid Electricity Transmission plc (NGET), which builds and maintains the electricity transmission network in England and Wales, is responsible for the operation and maintenance of the existing 400 kilovolt (kV) NGET Substation.

1.1.6 This along with **Chapter 4: The Proposed Development** of the **Environmental Statement** (**ES**) (**EN010166/APP/6.2.4**) provides further description of the Proposed Development. 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** (**EN010166/APP/2.4**).

1.1.7 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 that would have a generating capacity greater than 50 MW electrical output (50 MWe) in England and 350 MW (350 MWe) in Wales. As such, a DCO application is required to authorise the Proposed Development in accordance with Section 31 of the 2008 Act.

1.2 The Applicant

1.2.1 The Applicant is a UK-based company, wholly owned by Uniper SE (Uniper) through Uniper Holding GmbH. Uniper is a European energy company with global reach and activities in more than 40 countries. With around 7,500 employees, the company makes an important contribution to security of supply in Europe, particularly in its core markets of Germany, the UK, Sweden, and the Netherlands. In the UK, Uniper owns and operates a flexible generation portfolio of power stations, a fast-cycle gas storage facility and two high pressure gas pipelines, from Theddlethorpe to Killingholme and from Blyborough to Cottam.

1.2.2 Uniper is committed to investing around €8 billion (~£6.9 billion) in growth and transformation projects by the early 2030s and aims to be carbon-neutral by 2040. To achieve this, the company is transforming its power plants and facilities and investing in flexible, dispatchable power generation units. Uniper is one of Europe's largest operators of hydropower plants and is helping further expand solar and wind power, which are essential for a more sustainable and secure future. Uniper is gradually adding renewable and low-carbon gases such as biomethane to its gas portfolio and is developing a hydrogen portfolio with the aim of a long-term transition. The company plans to offset any remaining CO_2 emissions by high-quality CO_2-offsets.

1.3 What is Carbon Capture and Storage

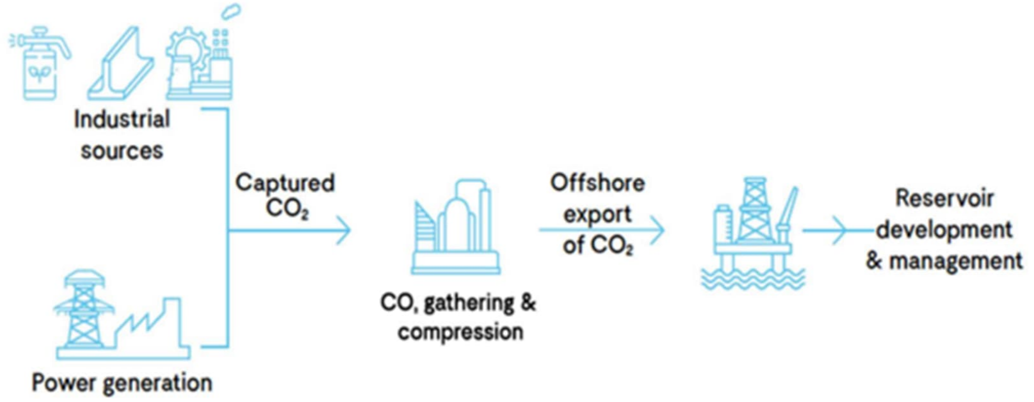
1.3.1 Carbon capture and storage (CCS) is a technique that reduces CO_2 emissions to the atmosphere. CCS typically involves a three-step process, involving:

- Step 1 - capturing the CO_2 emissions from industrial processes, such as power generation (the Proposed Development), steel and cement production, distilleries or oil refining;
- Step 2 – transporting the captured CO_2 emissions from where they were produced, for example via a pipeline or a vessel; and
- Step 3 – storing the captured CO_2 deep underground in geological formations.

1.3.2 Possible storage sites for carbon emissions include saline aquifers or depleted oil and gas reservoirs, which typically need to be 0.62 miles (1 kilometre (km)) or more below the ground where greater pressures exist.

1.3.3 **Plate 1** shows what is involved in the CCS process.

Plate 1: Illustration of the Carbon Capture, Usage and Storage (CCUS)



1.3.4 CCUS is crucial to reducing CO_2 emissions and combatting global warming. The United Kingdom (UK) Government has committed to achieving Net Zero in terms of greenhouse gas emissions by 2050. This is a legally binding target. UK Government policy further states that the 'deployment of power CCUS projects will play a key role in the decarbonisation of the electricity system at low cost' (Ref 1).

1.4 The Proposed Development

1.4.1 The design of the Proposed Development is subject to ongoing technical studies, to provide flexibility and to align with the current grid connection, but it is expected to comprise the development of up to two CCGT units achieving a net electrical output capacity of up to 1,380 megawatts (with CCP-Carbon Capture Plant- operational) onto the national electricity transmission network.

1.4.2 The proposed installation will generate electricity from combustion of natural gas within a CCGT, using hot exhaust gas from the combustion process to drive the gas turbine, and steam, generated from the heat of the exhaust gas, in the heat recovery steam generator (HRSG), which will be used to drive the steam-turbine. The exhaust gas will then pass through pre-treatment stages, including selective catalytic reduction (SCR, ammonia or urea-based) to reduce oxides of nitrogen (NO_x) in the gas and direct contact cooling of the gas using water, before passing to the Capture plant. The Capture plant will use an amine-based solvent to strip CO_2 from the exhaust gas within a packed column, via a weak acid-base reaction. The CO_2-depleted exhaust gas then passes through emissions abatement stages and is released to the atmosphere via a stack which is 150 m (metres) tall.

1.4.3 The CO_2 will be removed from the CO_2-rich solvent by heat, using steam taken from the HRSG. The solvent will be recirculated within the plant, whilst the CO_2 gas passes to the low-pressure compressor where it will be compressed and impurities (moisture, oxygen) will be removed before the CO_2 is exported off-site via pipeline. The solvent can accumulate impurities over time, and these will be removed via a solvent reclaiming process which may be a thermal or ion-exchange process, either continuously via a slipstream or as a batch process.

1.4.4 The main Capture plant stack emissions will be residual pollutants from the combustion and treatment processes, including NO_x, ammonia, carbon monoxide (CO) and residual CO_2 as the plant will be designed to optimise CO_2 capture (up to 95%) balanced against additional energy use. There may also be trace pollutants within the flue gas, including trace levels of solvent and solvent break-down products from within the process. Emissions will be monitored and minimised using several washing steps (which may include water and acid wash) on the final flue gas prior to release. In addition to the main Capture plant emission point, there are several other intermittent-use emission points, including a stack, up to 150 m height, serving the bypass stack. Emissions from the main Capture plant emissions stack, and bypass stack will meet the emission limits for Large Combustion Plants under the Industrial Emissions Directive (Directive 2010/75/EU of the European Parliament and of the Council) (Ref 10).

1.4.5 Other supporting infrastructure and plant to the proposed installation will include solvent and water-treatment chemicals storage, clean water treatment plant for generation of high-purity water for use in recirculated water circuits, potentially an auxiliary boiler (electric or gas-fired) for start-up support, emergency diesel generators for safe-shutdown during a power failure scenario, closed surface water drainage and appropriate treatment facilities, and infrastructure for natural gas import and conditioning and CO_2 conditioning and export.

1.4.6 The proposed installation will also be supported by natural gas supply, water abstraction and discharge, electrical connections, utilities, access works and CO_2 export connection.

1.4.7 It is expected that the proposed installation will make use of CO_2 transport and storage networks owned and operated by Liverpool Bay CCS Limited, currently under development as part of the HyNet CO_2 Pipeline Project, which will transport CO_2 captured from existing and new industries in North Wales and North West England, as well as from new hydrogen production facilities that are proposed as part of HyNet North West Project. The captured CO_2 will be stored in depleted offshore gas reservoirs in Liverpool Bay.

1.5 The Proposed Development Site

1.5.1 The Proposed Development site is located approximately 0.6 km north-west of the town of Connah's Quay in Flintshire, North East Wales. The site location is shown on the **Site Location Plan** (**EN010166/APP/2.1**).

1.5.2 The proposed installation is situated at grid reference SJ 27347 71374 and covers an area of approximately 56.46 hectares (ha), including operational parts of the existing Connah's Quay Power Station to the south-east and agricultural fields to the north-west.

1.6 The Development Consent Process

1.6.1 The Proposed Development falls within the definition of an NSIP under Section 14(1)(a) and 15(2) of the 2008 Act as a '*generating station exceeding 50 MW in England and 350 MW in Wales*'.

1.6.2 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 Environmental Impact Assessment (EIA) development under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) (as amended).

1.6.3 An application for development consent for the Proposed Development has been submitted to the Planning Inspectorate (PINS) acting on behalf of the Secretary of State (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 in 2026. A DCO, if granted, has the effect of providing planning consent for a development, in addition to a range of other consents and authorisations as specified within the Order.

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) (NPS EN-1) (Ref 2) and Paragraph 1.6.2 of the 'National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) (NPS EN-2) (Ref 3), which require developers promoting thermal generating stations to consider the opportunities for the implementation of Combined Heat and Power (CHP).

1.7.2 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. This document considers if there are additional opportunities for the implementation of CHP. The document is structured as follows:

- Section 2 presents general background to the overall project, summarises the purpose of the facility, and describes the legislative context of the development;
- Section 3 summarises the policy context and assessment methodology;
- Section 4 describes heat extraction options, CHP envelope and other considerations;

- Section 5 presents potential heat users and CHP viability assessment summary; and
- Section 6 summarises compliance with the relevant regulatory standards to demonstrate the proposed installation will comply with the relevant Best Available Techniques (BAT).

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 50 MW capacity in England and 350 MW in Wales. The NPS of most relevance to this CHP assessment are NPS EN-1 and NPS EN-2.

2.1.2 Section 4.8 of NPS 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. 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.

2.1.3 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) (Ref 4). Paragraph 4.8.8 of NPS EN-1 refers to the guidelines issued by the Department of Trade and Industry (DTI) in 2006 (Ref 4), which provide that 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 then confirms 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.

2.1.4 Paragraphs 4.8.9 and 4.8.10 of NPS EN-1 state that:

2.1.5 '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.

2.1.6 Given how important liaison with potential customers for heat is, applicants should not only consult those potential customers they have identified with 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.'*

2.1.7 Paragraph 4.8.12 of NPS EN-1 also states that to encourage proper consideration of CHP, substantial weight should be given by the SoS to applications incorporating CHP. If a proposal is for thermal generation without CHP, the applicant should:

- 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 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.

2.1.8 Paragraph 4.8.17 of NPS 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 NPS EN-1, if the SoS identify a potential heat customer that has not been explored, the applicant should be requested to pursue this.

2.1.9 Paragraph 4.8.19 NPS 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.*'

2.1.10 NPS EN-2 reiterates the requirements of NPS 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 A driving principle behind the CHP 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 CO_2 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 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, as follows:

- *'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-R Guidance

2.3.1 The Environmental Regulators published detailed guidance on CHP-readiness assessments required for thermal generating stations (the 'CHP-R Guidance') (Ref 7, Ref 8) to be used by developers and Environmental Regulator officers as part of the Environmental Permitting regime.

2.3.2 The Environmental Regulator 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 Environmental Regulator requires that developers satisfy three BAT tests in relation to CHP. The first BAT test 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 BAT test involves ensuring that the plant is built to be 'CHP - Ready'. The third BAT 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 - R' (for the chosen location and design). The Environmental Regulator requires that:

2.3.5 'all applications for Environmental Permits for new installations regulated under the Environmental Permitting (England and Wales) Regulations 2016 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 […]'.*

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 recognized 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 the BAT is to build the plant to be '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 accordance with Section 4.8 of NPS 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'*

'Guidance for developments requiring planning permission and environmental permits' (The Environmental Agency, 2012) (Ref 5), sets the Environmental Regulator's role in the planning process and its approach to responding to applications for developments which will also require an Environmental Permit. In particular, this guidance recognises that there may be some interdependencies between planning and permitting requirements. In the case of such interdependencies, the guidance recommends early engagement with the Environmental Regulator via their planning pre-application service.

The CHP-R Guidance states at Section 1.2 that: *'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. Accordingly, Natural Resources Wales recommends 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, Natural Resources Wales will highlight the need for the plant to be CHP or CHP-R and will make reference to the CHP-R Guidance.'*

2.3.15 The CHP-R Guidance states that: '*Natural Resources Wales 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, Directive 2012/27/EU of the European Parliament and of the Council (Energy Efficiency Directive) (Ref 9) has been implemented in the UK through the Environmental Permitting (England and Wales Regulations 2016 (Ref 6). 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 (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 5. The Proposed Development includes up to two CCGT power plants, each provided with a post-combustion CCP.

3.1.2 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 and in particular when it would be expected to change to dispatchable mode from baseload operation in the future power market. As a result, there may be significant periods where the Proposed Development is not operating at full load or not operating 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 of modern CCGTs such as the model evaluated results from 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 HRSG. This heat is used to produce steam, at various pressures, which generates further power via a separate steam turbine.

3.2.2 The carbon capture process uses steam from the steam turbine. Most of the steam provision required in the CCP is used to generate the heat necessary to separate the captured CO_2 from the rich amine within CO_2 stripper.

3.2.3 This results in a significant amount of heat from the CCGT already being utilised within the Proposed Development. This CHP-R Assessment takes into account the steam requirement for the CCP and its provision from the CCGT before any residual waste heat is then appraised for CHP purposes. It is not envisaged that the CCGT would routinely operate in isolation from the carbon capture plant, although there are circumstances that this could be necessary.

3.2.4 Extraction from the steam cycle represents a thermal energy source within the system, however, in order to minimise the loss in available power in abated mode, waste heat from the CCGT would be used as a priority within the CCP where feasible. As a consequence, the CHP readiness assessment appraises opportunities to use heat rejection at a suitable temperature from the CCP, rather than using direct low pressure (LP) steam offtake from the CCGT. It is noted that licensors will optimise heat recovery within the CCP to minimise parasitic loads, and this will be undertaken at the detailed design stage. As a consequence, available heat for CHP may be further reduced accordingly. However, two potential options for extracting heat from the

Proposed Development have been considered during full operation with both the CCGT and CCP running (i.e. abated operation). These comprise:

- extraction from the CO_2 stripper overhead stream (in some processes, an air-cooling system may be used to cool the CO_2 stripper overhead stream. In such cases, retrofitting may not be straightforward. It should be noted that this aspect will need to be evaluated during the subsequent design phases); and
- extraction from the LP condensate leaving the CO_2stripper reboiler. (It is worth noting that the use of LP steam is assumed for the CO_2 stripper case in this case. Where the condensate from the CO_2 stripper is used elsewhere in the plant, rather than returned to the power cycle, the available heat may be reduced. This will need to be evaluated during subsequent heat off take design).

3.2.5 It should be noted that another potential source of waste heat could be the CO_2 compression heating. The heat extracted by compressor intercooling could be recovered by changes to the compressor design, however, due to the need to investigate alternative arrangements potential impact to the non-CHP configuration this particular heat source is not investigated further within this report.

3.2.6 During normal (abated) operation, the flue gases will enter the integrated CCP. However, during outages of the CCP, it will be possible to discharge exhaust gases through the bypass stacks above the HRSG buildings, which will be fitted with CEMS instrumentation. As the Proposed Development is expected to operate with the CCP for the majority of its design lifetime, the following sections and CHP-R Assessment Form (**Appendix A**) have only considered the CHP potential from the abated CCGT (operating with carbon capture).

Carbon Dioxide Stripper Overhead Stream

3.2.7 The CO_2 stripper overhead stream was identified as a potential source of heat extraction in the CCP. The CO_2 overhead hot stream exits the top of the CO_2 stripper column at a temperature of around 120°C, and it is transferred into the CO_2 stripper condenser to cool down with cooling water. Therefore, there is available waste heat. With the use of a suitable heat exchanger, heat from the CO_2 overhead stream can be extracted by reducing the temperature of this stream before the CO_2 stripper condenser.

Carbon Dioxide Stripper Reboiler Condensate Return

3.2.8 After supplying heat to the rich amine within the CO_2 stripper reboiler, LP steam condenses within the reboiler, leaving at a temperature that could be up to 144°C based on a generic design. This LP condensate may require further cooling before returning to the CCGT's condenser. Therefore, there is potential to utilise this available excess heat from the LP condensate to heat water for district heating using a water-water heat exchanger before the condensate cooler.

Summary

3.2.9 In this report, while calculating the head loads and the CHP envelope, the overall project has been considered as two phases of development. Phase-1 corresponds to the initial stage of the project with the construction of a single train. In Phase-2, the second train may be built. Accordingly, the minimum load for Phase-2 refers to the operational state in which only one train is running. As a result, the minimum and maximum heat loads values will differ between these two phases.

3.2.10 *Phase-1 (single train):* The total potential heat available in a form that could be suitable for district heating up to 69 MWth at full load, whereas at partial load up to 41 MWth.

3.2.11 *Phase-2 (both trains):* The total potential heat available in a form that could be suitable for district heating up to 138 MWth at full load, whereas at partial load up to 41 MWth.

3.3 Identification of the CHP Envelope

3.3.1 The following calculations have been performed to determine the heat and power envelope. The envelope limits are defined as follows:

- A - Minimum Stable Load with No Heat Extraction;
- B - Minimum Stable Load with Maximum Heat Extraction;
- C - Maximum Electrical Power (100% Full Load) with Maximum Heat Extraction; and
- D - Maximum Electrical Power (100% Full Load) with No Heat Extraction.

3.3.2 The CHP efficiency (ηCHP), where 'Net process heat' refers to the net heat available for export off-site, is defined as:

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

3.3.3 Based on the values of heat load presented in Section 3.2 above and the expected electrical power output of the Proposed Development, the CHP envelope can be produced as shown in **Plate 2** and **Plate 3** for Phase-1 and Phase-2, respectively.

Plate 2: Indicative CHP Envelope for Phase-1 (Single Train)

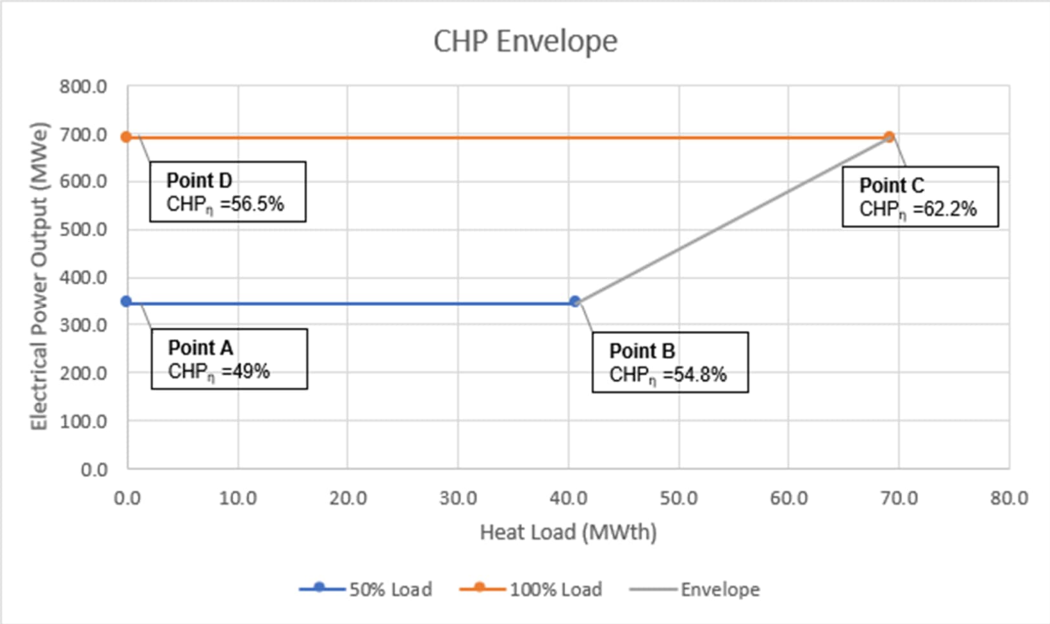
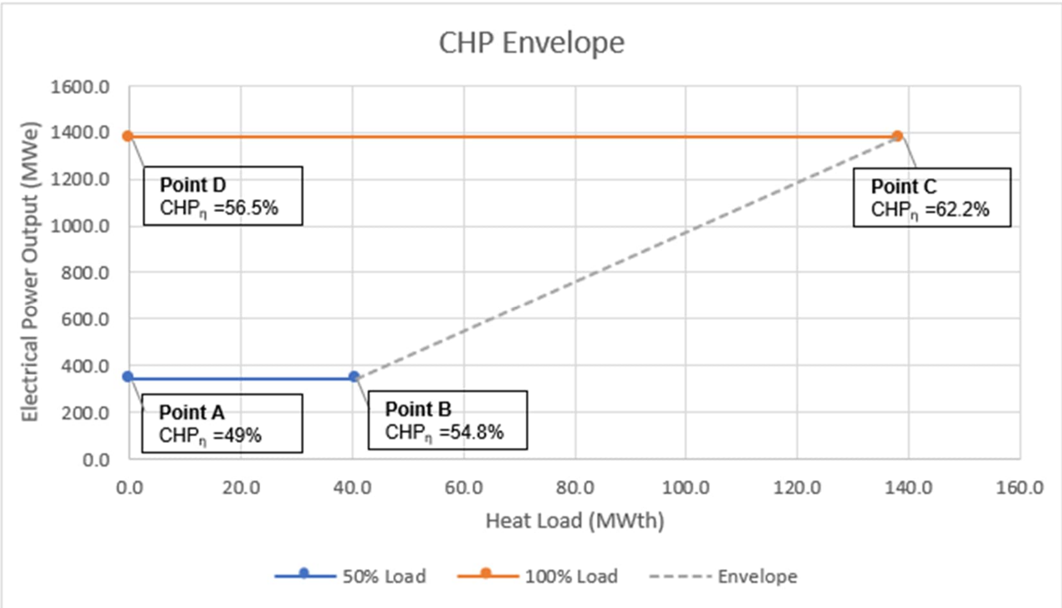


Plate 3: Indicative CHP Envelope for Phase-2 (Two Trains)



3.3.4 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 (Ref 7; Ref 8).

3.3.5 While creating the CHP envelope, the values provided by the Applicant were used. Additionally, for parameters that were not specified by the Applicant, estimates were made by comparison with similar H CCGT units at Pre-FEED stage. A more accurate CHP envelope can be developed once more detailed Heat and Material Balances (H&MB) are available.

3.3.6 **Table 1** and **Table 2** show that the primary energy saving associated with operating the Proposed Development in CHP mode during full load would be approximately 5.9%, achieving a CHP efficiency of approximately 62.2% for both phases. During part load, the approximate primary saving, and CHP efficiency of the Proposed Development would be 6% and 54.8% respectively.

Table 1: Indicative CHP Envelope during Abated Operation – For Phase-1 (Single Train)

Description	Min. Stable Load with No Heat Extraction	Min. Stable Load with Max Heat Extraction	Max. Elect. Power with Max Heat Extraction	Max. Elec. Power with No Heat Extraction
Reference Point	**A**	**B**	**C**	**D**
Thermal Input, MWth	703	703	1,221	1,221
Net Power Output, MWe	345	345	690	690
Heat Load, MWth	0	40.7	69.2	0
CHP Net Efficiency, %	49	54.8	62.2	56.5
Primary Energy Saving, %	0	6	5.9	0

Table 2: Indicative CHP Envelope during Abated Operation – For Phase-2 (Two Trains)

Description	Min. Stable Load with No Heat Extraction	Min. Stable Load with Max Heat Extraction	Max. Elec. Power With Max Heat Extraction	Max. Elec. Power with No Heat Extraction
Reference Point	**A**	**B**	**C**	**D**
Thermal Input, MWth	703	703	2,443	2,443
Net Power Output, MWe	345	345	1,380	1,380
Heat Load, MWth	0	40.7	138.4	0
CHP Net Efficiency, %	49	54.8	62.2	56.5

Description	Min. Stable Load with No Heat Extraction	Min. Stable Load with Max Heat Extraction	Max. Elec. Power With Max Heat Extraction	Max. Elec. Power with No Heat Extraction
Primary Energy Saving, %	0	6	5.9	0

3.4 Further Consideration and Potential Challenges of CHP

3.4.1 To allow the identified (and any additional future) potential CHP opportunities to be realised, should it be economic to do so, modifications to the Proposed Development would be needed to incorporate a number of appropriate provisions to allow for the future implementation of CHP.

3.4.2 It would be necessary to install the equipment required for the CHP opportunity identified. This would include the necessary heat exchangers for the CO_2 stripper overhead stream, LP condensate stream as well as the required pipework and connections to export heat from the Proposed Development Site to the user.

3.4.3 If the quantity of process heat output from one or more of the two heat extraction locations is deemed economically viable and will be of use off-site, the detailed design (yet to be undertaken) will be developed to demonstrate that the heat exchangers can be installed in the required positions. This will also include an assessment of the routing options to determine the technical feasibility of heat export to the identified demand.

3.4.4 Other potential challenges may result from the operating regime not being compatible with the requirements of the heat load. It is difficult to predict the future operating regime of the Proposed Development at this stage but is expected to be run in dispatchable mode to match the anticipated intermittency of renewable power in the future power market. This is likely to result in the plant periodically not operating in response to the grid demands as well as maintenance requirements. In contrast, a primary requirement of a viable and effective CHP scheme is that it should be capable of meeting the requirements of the identified heat load that is likely to be steady and consistent over the majority of the year, particularly for district heating schemes or steady state industrial processes. As a result, the running regime and load of the Proposed Development may not coincide with the requirements of the identified heat load(s), and this incompatibility may affect the viability and effectiveness of implementing the CHP opportunity.

3.5 Economic Assessment

3.5.1 As outlined in the Energy Efficiency Directive, a CBA is only required where the CHP opportunity has the potential to be 'high efficiency' (i.e. achieve a PES of 10% or greater). No such opportunities have been identified.

3.5.2 Where opportunities arise with PES values exceeding 10% are identified in the future (through the periodic review of this CHP assessment, anticipated as a condition to the Environmental Permit for the Proposed Development), the relevant sections of the document will be updated accordingly, and a dedicated economic analysis document could also be developed to support the evaluation.

4. Identification of Potential Heat Users

4.1 Introduction

4.1.1 A review of the potential heat demand within a 15 km radius of the centre of the Proposed Development 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. The CHP-R Guidance stipulates that heat loads used in a CHP-R assessment must be agreed with the Environmental Regulator. At this stage, no formal consultation with the Environmental Regulator has taken place regarding CHP considerations (see **Appendix B**).

4.2 CHP Opportunities

4.2.1 In line with the CHP Guidance, CHP assessments consider data from the UK CHP Development Map (Ref 1). An assessment using this updated resource was conducted for a 15 km radius centred on the Proposed Development Site. The findings are presented in **Table 3**.

Table 3: Results from the examination of the UK CHP Development Heat Map: Total heat demand

Sector	Total Heat Load (MWh)
Large Industrial	12,536,186
Healthcare	78,572
Future Developments	72,897
Small Industrial	654,443
Total Current Demand	**13,269,201**

4.2.2 The identified potential heat offtake industrial clients within the 15 km of the Proposed Development:

- Tata Steel – Connah's Quay (location and process constraints may limit CHP suitability)
- Essity Paper Mill – Flint (unknow heat demand)

- Toyota Motor Manufacturing – Deeside (location and process constraints may limit CHP suitability)
- BAE Systems – Broughton (significant thermal energy demand typical of aerospace manufacturing; potential candidate for CHP pending detailed assessment)
- Capenhurst Nuclear Services (primarily electricity-driven nuclear fuel enrichment with minimal recoverable heat; unlikely suitable for CHP integration).

4.2.3 However, it is important to note that much of this industrial demand may be met by high-temperature or process-specific systems (e.g. steam), which cannot be directly replaced or fully supplemented by a 90 °C district heating network. Additionally, not all of the identified industrial heat users are located along a feasible district heating connection route. The listed loads represent a summary of potential heat demands within a 15 km radius of the proposed development, not necessarily those accessible from a single linear heat network alignment. Therefore, the headline demand figures must be treated with caution. A more detailed, site-specific heat mapping and energy use assessment—factoring in both technical compatibility and spatial connection viability—would be required to determine the actual serviceable load.

4.3 CHP Viability

4.3.1 To remain conservative, an annual operating time of 3,500 hours has been assumed for the initial assessment. However, this figure could potentially increase to 6,000 hours, depending on the specific load profile and operational strategy. This will be subject to further, more detailed investigation.

4.3.2 The instantaneous heat output from Connah's Quay Power Station is inherently variable, as it is influenced by fluctuations in electricity grid supply and demand. The power plant is being developed in two phases. Phase-1 will be a single line; Phase-2 would add a second line to the plant (thus doubling its output). **Table 4** and **Table 5** show the differing heat recovery capacities under these two potential scenarios, reflecting the power station's ability to supply heat to a district heating network based on 6,000 operational hours.

Table 4: Connah's Quay Power Station heat availability potential from Scenario 1 – Phase-1 (one train)

Connah's Quay operating capacity mode	Instantaneous heat availability (MW)	Potential heat availability (MWh)
Minimum load	40.7	244,200
Maximum load	69.2	415,200

4.3.3 **Table 4** shows the initial calculated heat availability potential ranges between 40.7 MW and 69.2 MW.

Table 5: Connah's Quay Power Station heat availability potential from Scenario 2 – Phase-2 (two trains)

Connah's Quay operating capacity mode	Instantaneous heat availability (MW)	Potential heat availability (MWh)
Minimum load	40.7	244,200
Maximum load	138.4	830,400

4.3.4 **Table 5** shows the initial calculated heat availability potential ranges between 40.7 MW and 138.42 MW when Scenario 2 – Phase-2 is implemented.

Phase-1 - Healthcare Sector and Future Development

4.3.5 Phase-1 focuses exclusively on the healthcare sector and future development heat demand within the 15 km search area. Based on combined outputs from the UK CHP Development Map and supplementary datasets, the total estimated healthcare sector and future development heat load is approximately 151,469 MWh/year – assuming 6,000 hours of annual operating time. This includes major facilities such as Arrowe Park Hospital (35,391 MWh/year), alongside a network of smaller healthcare centres spread across towns such as Mold, Holywell, Chester, Ellesmere Port, and future developments in Deeside and the North Gateway.

4.3.6 However, the healthcare loads are geographically dispersed and located on the opposite side of the River Dee from the power station. These spatial limitations, combined with the relatively low density of healthcare demand when considered in isolation, mean that heat network serving just healthcare loads would be unlikely to be viable. However, although the Northern Gateway is also located on the opposite side of the River Dee, its concentrated load profile and proximity to the power station offer improved prospects for economies of scale and network efficiency, enhancing the overall viability of a CHP-led heat network. This approach is subject to further validation through detailed route planning, cost analysis, and engagement with potential heat users.

Phase-2 – Healthcare Sector, Future Development and Small Industrial

4.3.7 Phase-2 expands upon Phase-1 by incorporating projected heat demand from small industrial. Small industrial requires an additional 654,443 MWh/year. Connah's Quay at maximum operation, when Phase-2 is fully operational, could provide 830,400 MWh per year. This is sufficient to supply all the small industrial, health care and future development sites identified; a combined heat demand of 805,912 MWh per year.

4.3.8 The small industrial heat demand is widely dispersed and highly uncertain as the heat demand for this sector varies a lot depending on the nature of the industry. Moreover, many industrial buildings use direct gas-fired radiant heating systems that are not compatible with district heating. For this reason, this type of demand would require substantial validation before building a case for a district heat network to serve these small industrial buildings. On the other hand, some of the large industrial processes discussed previously may be readily compatible with heat supplied from the power plant.

5. BAT Assessment

5.1 Introduction

5.1.1 The CHP-R Guidance requires that applications for Environmental Permits are able to demonstrate the application of 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 Environmental Regulator therefore requires developers to satisfy three BAT tests in relation to CHP. The detailed explanations of these three BAT tests are provided under Section 2.3.

5.1.2 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, CCP and associated auxiliary equipment.

5.2.2 Details of the plant energy production and potential heat loads are identified in Section 3 and this Section 5 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 the Proposed Development is expected to have an availability in excess of 90% of its 25-year design life, it theoretically has the potential to supply baseload heat capacity in the event that there is a significant demand for heat, recognising that its primary role is expected to be as a dispatchable plant.

5.3.3 As illustrated in Section 3 and summarised in the CHP-R Assessment Form in **Appendix A**, the Proposed Development has up to 69 MWth and 41 MWth of heat available for supplying to heat off-takers at full and part load respectively for Phase-1 (a single train). 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.

5.3.4 As the CCGT plant is in excess of the 300 MWe threshold identified in the Natural Resources Wales's CHP-R Guidance (2014) and the Environment Agency's CHP-R Guidance (2013) heat demand within a 15 km radius of the plant is considered technically feasible. Section 5 above discusses the potential heat users within this location and concludes that, whilst there are potentially large heat loads for major industrial facilities with significant uncertainty, the commercial and domestic demands are low, and none of these currently offer economically viable opportunities for a heat network.

5.3.5 The assessment undertaken in Section 3 has identified that the PES would be approximately 6% which is below the 10% threshold identified by the Energy Efficiency Directive for high efficiency co-generation. As the PES does not meet the 10% threshold, a CBA is not required by the Energy Efficiency Directive.

5.3.6 Based on the above discussion, the Proposed Development will not be operated as a CHP plant at the outset of commercial operation as there is no current heat demand within the technically feasible radius that is considered economically viable.

Second BAT Test

5.3.7 Whilst no current commercial or domestic heat demand has been identified that is economically viable, there is the potential for a number of neighbouring industrial opportunities to be developed that could provide a viable heat demand, although the level of heat offtake available from the plant represents a level of primary energy savings below the general PES threshold of 10%. To this extent, an assessment of heat extraction options from the Proposed Development has been undertaken that has identified two potential sources:

- extraction from the CO_2 stripper overhead stream; and
- extraction from the LP condensate leaving the CO_2 stripper reboiler.

5.3.8 For the period that the Proposed Development does operate as a dispatchable plant or that the variable heat demand could be supplemented by other nearby proposed heat sources at the time of development, the Proposed Development will be built to be CHP-R. The final heat export capacity provided will be determined at detailed design stage and will reflect the load potential available at that time. The Proposed Development will be designed and built to allow for the future implementation of CHP if the identified or potential future heat loads become economically viable.

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

5.3.10 Sufficient space will be allocated for future retrofit of a heat offtake within the Proposed Development Site, should that be required. Potential routes for water or steam pipelines to the boundary of the Proposed Development Site would be feasible.

Third BAT Test

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

- instigating an action plan;

- maintaining a dialogue with key heat users as set out in the proposed action plan;
- carrying out regular reviews to determine if there have been sufficient changes in circumstances (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
- re-visiting the technical and economic assessments at least every 5 years or when a change in circumstances warrants.

6. Conclusions

6.1.1 This Heat Export Feasibility Study has assessed the potential for CHP readiness at CQLCP Project, in line with the requirements of the Environmental Regulator's CHP-R Guidance. The assessment considered both technical and operational aspects of heat recovery from the proposed CCGT and post-combustion CCP, including part- and full-load operation scenarios.

6.1.2 Two technically feasible heat extraction options were identified from the carbon capture process:

- heat recovery from the CO_2 stripper overhead stream; and
- heat recovery from the low pressure (LP) condensate return from the CO_2 stripper reboiler.

6.1.3 In this report, while calculating the head loads and drawing the CHP envelope, the overall project has been considered as two phases development. Phase-1 corresponds to the initial stage of the project, during which the construction of a single train is anticipated. In Phase-2, the completion of the second train is foreseen. Accordingly, the minimum load for Phase-2 refers to the operational state in which only one train is running. As a result, the minimum and maximum heat loads values will differ between these two phases.

- *Phase-1 (single train):* The total potential heat available in a form that could be suitable for district heating up to 69 MWth at full load, whereas at partial load up to 41 MWth; and
- *Phase-2 (both trains):* The total potential heat available in a form that could be suitable for district heating up to 138 MWth at full load, whereas at partial load up to 41 MWth.

6.1.4 Based on the CHP envelope developed, the Proposed Development could achieve a maximum CHP efficiency of 62.2% and a PES of 5.9% under full-load operation for both phases. For partial load, CHP efficiency is calculated as 54.8% and PES value is 6% for both phases. These figures fall below the 10% PES threshold required for classification as 'high-efficiency CHP' under the Energy Efficiency Directive, and as such, a CBA is not required at this stage.

6.1.5 Nevertheless, the design will retain flexibility to enable future implementation of CHP, should it become economically viable. This includes incorporating provisions for future installation of heat exchangers, pipework, and necessary connections. However, the viability of CHP is constrained by several factors, including:

- the high internal heat demand of the carbon capture process, which reduces residual heat available for export; and
- the expected dispatchable operating regime of the plant, which may not align with the consistent heat supply needs of potential off-site users.

6.1.6 There may be a requirement for significant additional infrastructure to enable heat export from the Proposed Development, depending on the outcome of further technical and economic feasibility assessments. The Proposed Development will be operated under the Applicant's certified ISO 14001:2015 Environmental Management System (EMS), and responsibilities for maintaining environmental performance and compliance will be allocated across the operational team. In addition to technical and operational challenges, geographical considerations are also a limiting factor in the viability of CHP implementation at the Proposed Development. Many of the identified potential heat users are located on the opposite side of the River Dee, across the estuary from the Connah's Quay site. This introduces significant complexity in terms of infrastructure routing, as any heat export pipeline would likely need to cross the river via the Flintshire Bridge or other major crossings.

6.1.7 The CHP potential will be periodically reviewed as part of the Applicant's ongoing compliance with Environmental Permit conditions. Should future opportunities for viable CHP integration emerge, this assessment will be updated accordingly.

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Glossary

Abbreviation	Term
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 energy 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
CHP	Combined Heat and Power - process that captures and utilizes the heat that is a by-product of the electricity generation process
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 (among other things) incorporate or remove the need for a range of consents which would otherwise be required for a development. A DCO can also include powers of compulsory acquisition and temporary possession of land and interests in land.
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)
H&MB	Heat and Material Balance
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 energy.
MWth	Megawatts thermal – thermal energy
NRW	Natural Resources Wales
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 relevant statutory thresholds relating to their scale or effect.
PES	Primary Energy Saving – is an indicator that measures the amount of primary energy – meaning energy in its original form before conversion-saved by adopting CHP system compared to conventional separate generation of heat and power. 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

Abbreviations

Abbreviation	Term
BAT	Best Available Techniques
CBA	Cost-benefit Analysis
CCGT	Combined Cycle Gas Turbine
CCP	Carbon Capture Plant
CCS	Carbon capture and storage
CCUS	Carbon Capture, Usage and Storage
CHP	Combined Heat and Power
CHPQA	CHP Quality Assurance
CHP-R	CHP Ready
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CQLCP	Connah's Quay Low Carbon Power
DEC	Display Energy Certificate
DTI	Department of Trade and Industry
EfW	Energy from Waste
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPMS	Estates and Facilities Performance Management System
ERIC	Estates Return Information Collection
Ha	Hectares
HRSG	Heat Recovery Steam Generator
IP	Intermediate Pressure
km	kilometre
kV	kilovolt
LP	Low Pressure
m	Metre
MW	megawatts
ηCHP	CHP efficiency
NGET	National Grid Electricity Transmission
NO_x	Oxides of Nitrogen

NPS EN-1	Overarching National Policy Statement for Energy (EN-1)
NPS EN-2	National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)
NSIP	Nationally Significant Infrastructure Project
OS	Ordnance Survey
PES	Primary Energy Saving
PINS	Planning Inspectorate
SCR	Selective Catalytic Reduction
SoS	Secretary of State
UK	United Kingdom

Appendix A CHP-R Assessment Form

A.1.1. Phase-1 corresponds to the initial stage of the project, during which the construction of a single train is anticipated. In Phase-2, the completion of the second train is foreseen. Accordingly, the minimum load for Phase-2 refers to the operational state in which only one train is running.

Table A-1: CHP-R Assessment Form for Phase-1 (Single Train)

#	Description	Units	Notes/Instructions
Requirement 1: Plant, Plant Location and Potential Heat Loads			
1.1	Plant Name		CQLCP
1.2	Plant Description		A CCGT power station with a total net power capacity of approximately 690 MWe for a single train each with a post-combustion carbon capture plant. The power station will be fuelled by natural gas and the CCGT will comprise an H-class gas turbine, heat recovery steam generator and steam turbine.
1.3	Plant Locations (Postcode / Grid Ref)		Approximately 0.6 km north-west of the town of Connah's Quay in Flintshire, North East Wales at grid reference SJ 27347 71374.
1.4	Factors influencing selection of plant location		Ongoing development of an existing power generation site and proximity to a proposed HyNet Cluster
1.5	Operation of plant		Note: Plant is expected to operate with carbon capture through its design life and so answers to Section 1.5 corresponds to values given in Requirement 5.
a)	Proposed operational plant load	%	100 Single train design (one gas turbine, one HRSG, one steam turbine and one carbon capture plant)

#	Description	Units	Notes/Instructions
b)	Thermal input at proposed operational plant load	MW	1,221
c)	Net electrical output at proposed operational plant load	MW	690
d)	Net electrical efficiency at proposed operational plant load	%	56.5
e)	Maximum plant load	%	100
f)	Thermal input at maximum plant load	MW	1,221
g)	Net electrical output at maximum plant load	MW	690
h)	Net electrical efficiency at maximum plant load	%	56.5
i)	Minimum stable plant load	%	50
j)	Thermal input at minimum stable plant load	MW	703
k)	Net electrical output at minimum stable plant load	MW	345
l)	Net electrical efficiency at minimum stable plant load	%	49.1
1.6	Identified Potential Heat Loads		See details presented in Section 3
1.7	Selected Heat Loads		
a)	Category (e.g. industrial / district heating)		District heating (Health care + Future developments)
b)	Maximum heat load extraction required	MWth	151,469 (assuming 6000 hours annual)

#	Description	Units	Notes/Instructions
			25.2 MWth
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		Waste heat from CO_2 stripper column and stripper column LP condenser
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	69.2

#	Description	Units	Notes/Instructions
b)	Maximum heat extraction export flow at 100% plant load	t/h	Not available
c)	CHP mode net electrical output at 100% plant load	MW	690
d)	CHP mode net electrical efficiency at 100% plant load	%	56.5
e)	CHP mode net CHP efficiency at 100% plant load	%	62.2
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	5.9
2.2 Heat extraction at minimum stable plant load			
a)	Maximum heat load extraction at minimum stable plant load	MW	40.7
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Not available
c)	CHP mode net electrical output at minimum stable plant load	MW	345
d)	CHP mode net electrical efficiency at minimum stable plant load	%	49.1
e)	CHP mode net CHP efficiency at minimum stable plant load	%	54.8
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	6
2.3	Can the plant supply the selected identified potential heat load		Yes - See discussion in Section 5.

#	Description	Units	Notes/Instructions
	(i.e.is the identified potential heat load within the 'CHP envelope')?		
Requirement 3: Operation of the Plant with the Selected Identified Heat Load (151,469 MWh / 25.2 MWth)			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	690
b)	CHP mode net electrical efficiency at proposed operational plant load	%	56.5
c)	CHP mode net CHP efficiency at proposed operational plant load	%	58.5
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	%	No reduction, heat is not extracted from the steam cycle
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	No reduction, heat is not extracted from the steam cycle
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	2.2
g)	Z ratio		N/A – (no loss of generation with heat offtake)
Requirement 4: Technical provision and space requirements			
4.1	Description of likely suitable extraction points		Extraction from CO_2 stripper column overhead stream and stripper column reboiler LP condenser
4.2	Description of potential options which could be incorporated in		N/A

#	Description	Units	Notes/Instructions
	the plant, should a CHP opportunity be realised outside the 'CHP envelope'		
4.3	Description of how the future costs and burdens associated with supplying the identified heat load / potential CHP opportunity have been minimised through the implementation of an appropriate CHP-R design		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?		Plant is NEW BUILD with CCP included
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	Not available
b)	Description of heat export (e.g. steam / hot water)		LP Steam
c)	Export pressure	bar a	Not available
d)	Export temperature	°C	Not available

#	Description	Units	Notes/Instructions
e)	Export flow	t/h	Not available
f)	Return pressure	bar a	Not available
g)	Return temperature	°C	Not available
h)	Return flow	t/h	Not available
i)	Likely suitable extraction points		LP/ IP crossover
	Minimum stable plant load		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	Not available
k)	Description of heat export (e.g. steam / hot water)		LP Steam
l)	Export pressure	bar a	Not available
m)	Export temperature	°C	Not available
n)	Export flow	t/h	Not available
o)	Return pressure	bar a	Not available
p)	Return temperature	°C	Not available
q)	Return flow	t/h	Not available
r)	Likely suitable extraction points		LP/ 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	1,221
c)	Carbon capture mode net electrical output at 100% plant load	MW	690

#	Description	Units	Notes/Instructions
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	56.5
e)	Minimum stable plant load with CCS	%	50
f)	Carbon capture mode thermal input at minimum stable plant load	MW	703
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	345
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	49.1
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	69.2
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	Not available
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	690
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	56.5

#	Description	Units	Notes/Instructions
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	62.2
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	5.9
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	40.7
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	Not available
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	345
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	49.1
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	54.8
f)	Reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	6
5.6	Can the plant with carbon capture supply the selected identified		Yes, plant with CCP can supply the selected identified potential heat load

#	Description	Units	Notes/Instructions
	potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		(22.4 MW), however, PES value is lower than 10%.
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		Provision of suitable tie in points
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

Table A-2: CHP-R Assessment Form for Phase-2 (Two Trains)

#	Description	Units	Notes/Instructions
Requirement 1: Plant, Plant Location and Potential Heat Loads			
1.1	Plant Name		CQLCP
1.2	Plant Description		A CCGT power station with a total net power capacity of approximately 1,380 MWe for two trains each with a post-combustion carbon capture plant. The power station will be fuelled by natural gas and the CCGT will comprise an H-class gas turbine, heat recovery steam generator and steam turbine.
1.3	Plant Locations (Postcode / Grid Ref)		Approximately 0.6 km north-west of the town of Connah's Quay in Flintshire, North East Wales at grid reference SJ 27347 71374.
1.4	Factors influencing selection of plant location		Ongoing development of an existing power generation site and proximity to a proposed HyNet Cluster
1.5	Operation of plant		Note: Plant is expected to operate with carbon capture through its design life and so answers to Section 1.5 corresponds to values given in Requirement 5.
a)	Proposed operational plant load	%	100 Two trains design (two gas turbines, two HRSGs, two steam turbines and two carbon capture plants)
b)	Thermal input at proposed operational plant load	MW	2,443
c)	Net electrical output at proposed operational plant load	MW	1,380
d)	Net electrical efficiency at proposed operational plant load	%	56.5
e)	Maximum plant load	%	100

#	Description	Units	Notes/Instructions
f)	Thermal input at maximum plant load	MW	2,443
g)	Net electrical output at maximum plant load	MW	1,380 for both trains (2 x 690)
h)	Net electrical efficiency at maximum plant load	%	56.5
i)	Minimum stable plant load	%	50% of single train
j)	Thermal input at minimum stable plant load	MW	703
k)	Net electrical output at minimum stable plant load	MW	345 for single train min load
l)	Net electrical efficiency at minimum stable plant load	%	49.1
1.6	Identified Potential Heat Loads		See details presented in Section 3.
1.7	Selected Heat Loads		
a)	Category (e.g. industrial / district heating)		District heating (Health care, Future developments) and Small Industrial
b)	Maximum heat load extraction required	MWth	Health care: 78,572 MWh (assuming 6000 hours annual, 13 MWth) Future development: 72,897 MWh (assuming 6000 hours annual, 12.1 MWth) Small industrial: 654,443 MWh (assuming 6000 hours annual, 109 MWth) Total: 134.2 MWth
1.8	Export and return requirements of heat load		
a)	Description of heat load extraction		Waste heat from CO_2 stripper column and stripper column LP condenser

#	Description	Units	Notes/Instructions
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	138.4
b)	Maximum heat extraction export flow at 100% plant load	t/h	Not available
c)	CHP mode net electrical output at 100% plant load	MW	1,380
d)	CHP mode net electrical efficiency at 100% plant load	%	56.5
e)	CHP mode net CHP efficiency at 100% plant load	%	62.2
f)	Reduction in primary energy usage for CHP mode at 100% plant load	%	5.9
2.2 Heat extraction at minimum stable plant load			
a)	Maximum heat load extraction at minimum stable plant load	MW	40.7

#	Description	Units	Notes/Instructions
b)	Maximum heat extraction export flow at minimum stable plant load	t/h	Not available
c)	CHP mode net electrical output at minimum stable plant load	MW	345 for single train min load
d)	CHP mode net electrical efficiency at minimum stable plant load	%	49.1
e)	CHP mode net CHP efficiency at minimum stable plant load	%	54.8
f)	Reduction in primary energy usage for CHP mode at minimum stable plant load	%	6
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 - See discussion in Section 5.
Requirement 3: Operation of the Plant with the Selected Identified Heat Load (134.2 MWth)			
3.1	Proposed operation of plant with CHP		
a)	CHP mode net electrical output at proposed operational plant load	MW	1,380
b)	CHP mode net electrical efficiency at proposed operational plant load	%	56.5
c)	CHP mode net CHP efficiency at proposed operational plant load	%	62
d)	Reduction in net electrical output for CHP mode at proposed operational plant load	%	No reduction, heat is not extracted from the steam cycle
e)	Reduction in net electrical efficiency for CHP mode at proposed operational plant load	%	No reduction, heat is not extracted from the steam cycle
f)	Reduction in primary energy usage for CHP mode at proposed operational plant load	%	5.7

#	Description	Units	Notes/Instructions
g)	Z ratio		N/A – (no loss of generation with heat offtake)
Requirement 4: Technical provision and space requirements			
4.1	Description of likely suitable extraction points		Extraction from CO_2 stripper column overhead stream and stripper column reboiler LP condenser
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?		Plant is NEW BUILD with CCP included
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	Not available
b)	Description of heat export (e.g. steam / hot water)		LP Steam
c)	Export pressure	bar a	Not available
d)	Export temperature	°C	Not available

#	Description	Units	Notes/Instructions
e)	Export flow	t/h	Not available
f)	Return pressure	bar a	Not available
g)	Return temperature	°C	Not available
h)	Return flow	t/h	Not available
i)	Likely suitable extraction points		LP/ IP crossover
	<u>Minimum stable plant load</u>		
j)	Heat load extraction for carbon capture at minimum stable plant load	MW	Not available
k)	Description of heat export (e.g. steam / hot water)		LP Steam
l)	Export pressure	bar a	Not available
m)	Export temperature	°C	Not available
n)	Export flow	t/h	Not available
o)	Return pressure	bar a	Not available
p)	Return temperature	°C	Not available
q)	Return flow	t/h	Not available
r)	Likely suitable extraction points		LP/ 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	2,443
c)	Carbon capture mode net electrical output at 100% plant load	MW	1,380
d)	Carbon capture mode net electrical efficiency at maximum plant load	%	56.5
e)	Minimum stable plant load with CCS	%	50% of single train

#	Description	Units	Notes/Instructions
f)	Carbon capture mode thermal input at minimum stable plant load	MW	703
g)	Carbon capture mode net electrical output at minimum stable plant load	MW	345
h)	Carbon capture mode net electrical efficiency at minimum stable plant load	%	49.1
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	138.4
b)	Maximum heat extraction export flow at 100% plant load with carbon capture	t/h	Not available
c)	Carbon capture and CHP mode net electrical output at 100% plant load	MW	1,380
d)	Carbon capture and CHP mode net electrical efficiency at 100% plant load	%	56.5
e)	Carbon capture and CHP mode net CHP efficiency at 100% plant load	%	62.2
f)	Reduction in primary energy usage for carbon capture and CHP mode at 100% plant load	%	5.9
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	40.7
b)	Maximum heat extraction export flow at minimum stable plant load with carbon capture	t/h	Not available
c)	Carbon capture and CHP mode net electrical output at minimum stable plant load	MW	345

#	Description	Units	Notes/Instructions
d)	Carbon capture and CHP mode net electrical efficiency at minimum stable plant load	%	49.1
e)	Carbon capture and CHP mode net CHP efficiency at minimum stable plant load	%	54.8
f)	Reduction in primary energy usage for carbon capture and CHP mode at minimum stable plant load	%	6
5.6	Can the plant with carbon capture supply the selected identified potential heat load (i.e. is the identified potential heat load within the 'CHP and carbon capture envelope')?		Yes, plant with CCP can supply the selected identified potential heat load (43.2 MW) above min load, however, PES value is lower than 10%.
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		Provision of suitable tie in points
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 Potential Heat Users Identification

B.1 Introduction

B.1.1. A new CCGT power station is proposed at the Connah's Quay Power Station in Flintshire, incorporating carbon capture technology to reduce CO_2 emissions. AECOM is supporting the preparation of the planning application for this development, with this heat demand assessment included as a supporting document. The assessment evaluates potential heat demand within a 15 km radius, focusing on known or consented future developments and identifying major heat users that could benefit from low-carbon heat.

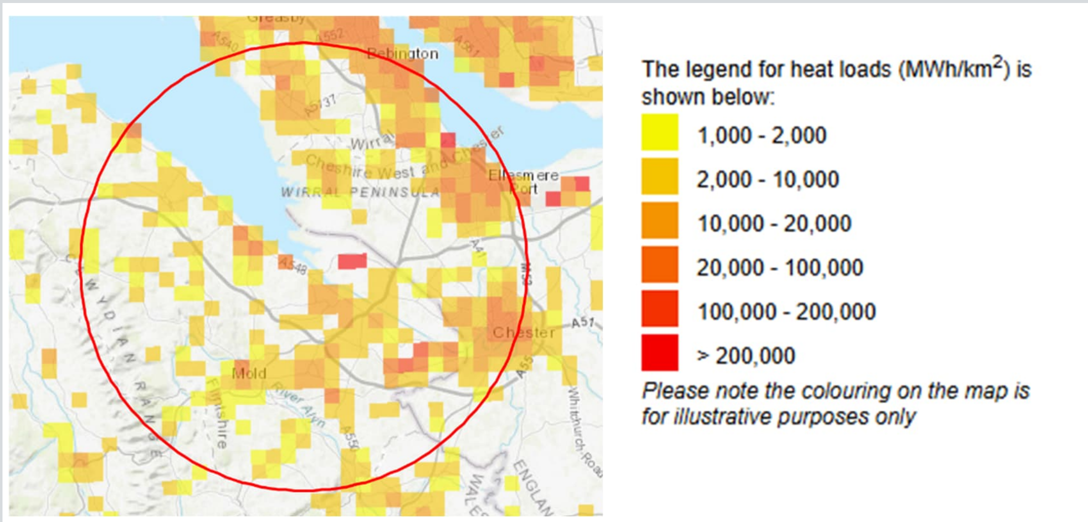
B.1.2. The potential heat loads have been identified using a review of publicly available datasets on fuel use in the region: the UK CHP Development map, NHS England Estates Return Information Collection (ERIC) 2023/2024, energy performance certificates, OS data, satellite imagery and aerial photographs. The CHP-R Guidance requires that the heat loads used in a CHP-R assessment to be agreed with the Environment Agency. At this stage, no detailed consultation with the Environment Agency regarding CHP has been undertaken.

B.2 Review of UK CHP Development Map

B.2.1. 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 (Ref 1).

B.2.2. The results from the examination of the UK CHP Development Map, covering a search area of 15 km centred on the proposed Connah's Quay Power Station site, are shown in **Plate B-1**.

Plate B-1: Results from the examination of the UK CHP Development Map: Total Heat Demand



B.2.3. **Table B-1** presents the results of the review of the UK CHP Development Map within a 15 km radius from Connah's Quay Power Station.

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	0.22%	35,707
Commercial Offices	0.73%	121,520
Domestic	17.66%	2,927,392
Education	0.38%	62,603
Government Buildings	0.04%	6,881
Hotels	0.15%	24,740
Large Industrial	75.61%	12,536,186
Health	0.12%	20,388
Other	0.07%	12,214
Small Industrial	3.95%	654,443
Prisons	0.00%	0
Retail	0.75%	123,659
Sport and Leisure	0.09%	14,594
Warehouses	0.24%	40,152
District Heating	0.00%	0

Sector	% Share Of Total Load Identified	Total Heat Load (MWh)
Total potential heat load within 15 km of Connah's Quay Power Station	**16,850,479**	

B.2.4. **Table B-2** shows the largest potential heat loads within the CHP search area (15 km radius from Connah's Quay Power Station), relate to:

- Large Industrial (75.61%),
- Domestic (17.66%), and
- Small industrial (3.95%).

B.2.5. The following figures illustrate the largest potential heat loads within the CHP search area.

Plate B-2: Results from the examination of the UK CHP Development Map: Large industrial heat loads

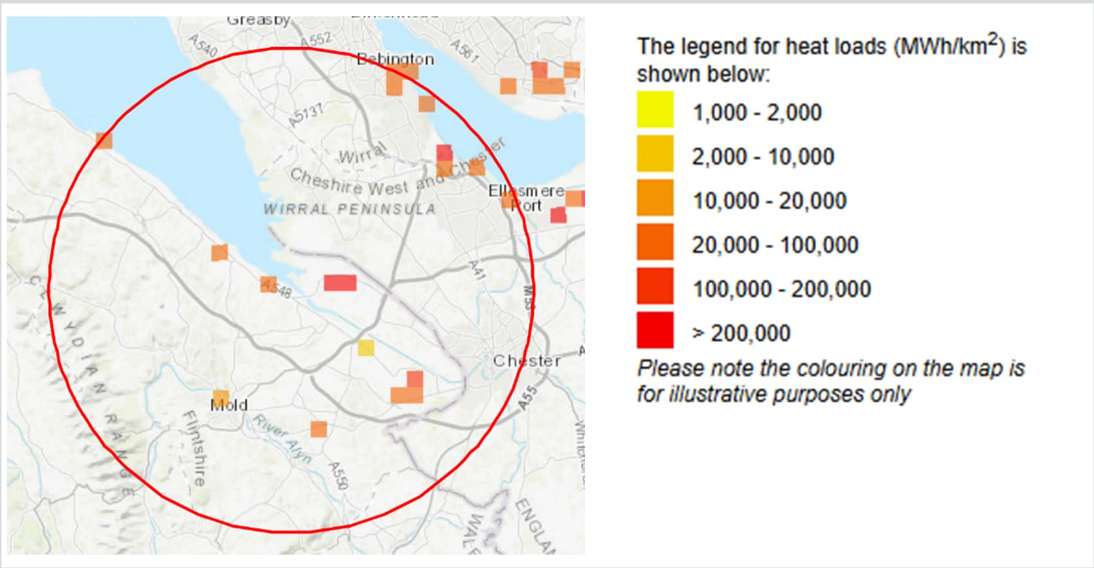


Plate B-3: Results from the examination of the UK CHP Development Map: Domestic heat loads

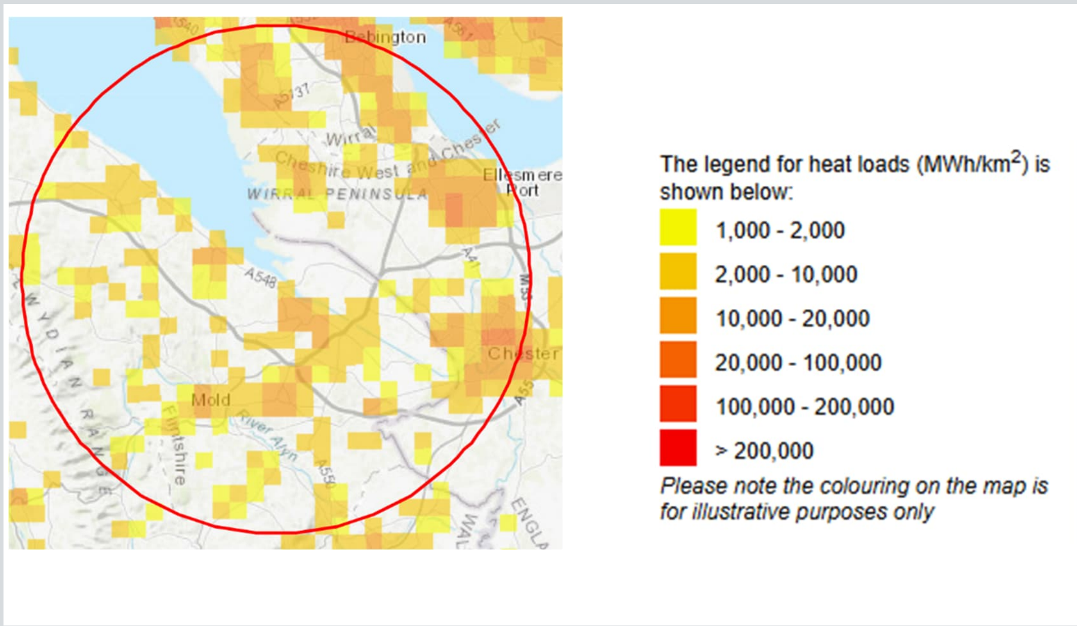
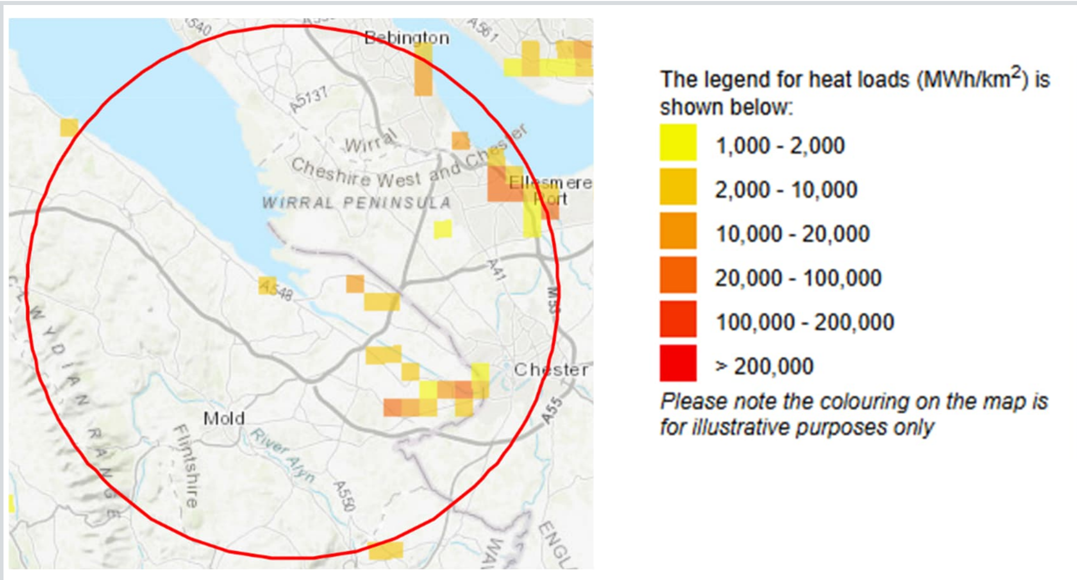


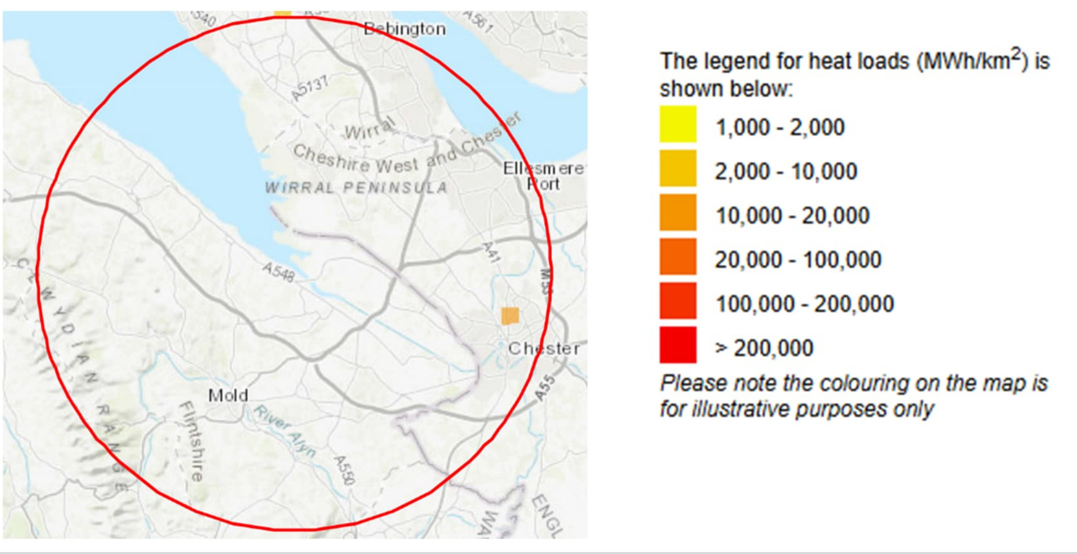
Plate B-4: Results from the examination of the UK CHP Development Map: Small Industrial heat loads



B.3 Review of Healthcare Data

B.3.1. **Plate B-5** shows heat loads from healthcare buildings within the 15 km radius of Connah's Quay Power Station as recorded on the UK CHP Development map.

Plate B-5: Results from the examination of the UK CHP Development Map: Health heat loads



B.3.2. To provide further granularity, NHS England publishes data on the costs associated with "*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*" through the ERIC. The 2023/24 ERIC summary results have been reviewed to identify healthcare related heat loads within a 15 km radius of Connah's Quay Power Station. These findings are summarised in **Table B-2**, where a total of 21 NHS sites and one private health care facility have been identified within a 15 km radius of Connah's Quay Power Station.

Table B-2: Summary of ERIC data for NHS England healthcare sites within a 15 km radius of Connah's Quay Power Station

Site Name	Postcode[1]	Gross Internal Floor Area (M^2)1	Distance From Connah's Quay Power Station (Km)[2]	Gas Consumed (KWh)1	Oil Consumed (KWh)
Blacon Children Centre	CH1 5DB	738	10.87	Not Applicable	Not Applicable
Fountains Health Centre	CH1 4DS	750	13.27	Not Applicable	Not Applicable
Countess Of Chester Hospital	CH2 1UL	65,338	12.52	26,252,235	0
1829 Building	CH2 1UL	2,228	12.52	Not Applicable	Not Applicable
Bowmere Hospital	CH2 1BQ	5,507	12.42	2,065,689	0
Eastway House	CH2 1UL	1,255	12.52	655,394	0
Churton House Resource Centre	CH2 1BD	863	12.35	29,196	0
The Oaks	CH2 4HY	939	14.26	63,955	0
Ancora House	CH2 1BQ	3,593	12.34	193,909	0
Other Reportable Sites	CH2 1UL	8,195	12.52	534,640	0
Redesmere	CH2 1BQ	5,774	12.34	224,204	0
Arrowe Park Hospital	CH49 5PE	87,111	15.32	41,637,100	0

[1] *Source: Estates Returns Information Collection, Summary page and dataset for ERIC 2023/24, Post code, Gross internal floor area and Gas consumed*

[2] *Distance measured as the crow flies*

Site Name	Postcode[1]	Gross Internal Floor Area (M^2)1	Distance From Connah's Quay Power Station (Km)[2]	Gas Consumed (KWh)1	Oil Consumed (KWh)
Clatterbridge Hospital	CH63 4JY	36,466	11.86	10,262,157	0
Clatterbridge Cancer Centre Wirral	CH63 4JY	12,746	11.86	1,830,154	0
Clatterbridge Hospital	CH63 4JY	6,481	11.86	1,268,758	0
Ellesmere Port Hospital	CH65 6SG	5,893	12.06	957,450	0
Coronation Road Workplace Hub	CH65 9AA	1,102	13.00	162,735	0
Cherrybank	CH65 0BY	1,332	13.01	171,704	0
Sycamore House	CH65 9HQ	1,063	13.00	21,832	0
Stanlaw Abbey Children Centre	CH65 9HE	525	13.60	Not Applicable	
Ellesmere Port Hospital	CH65 6SG	900	12.06	Not Applicable	Not Applicable
Nuffield Health Chester, Grosvenor Hospital[3]	CH4 7QP	738	13.87	1,101,963	Not Applicable

[3] *Private hospital*

B.3.3. Five NHS England sites - Blacon Children Centre, Fountains Health Centre, 1,829 building, Stanlaw Abbey Children's Centre and Ellesmere Port Hospital - do not have recorded consumption data in the ERIC database; therefore, the Display Energy Certificate (DEC) online database has been reviewed to obtain any additional information for these sites. This review also includes data for Nuffield Health - Grosvenor Chester Hospital, summarised in **Table B-3**.

Table B-3: DEC energy data for NHS England healthcare sites within a 15 km radius of Connah's Quay Power Station

Site Name	Post Code1	Gross Internal Floor Area (M²)1	Distance From Connah's Quay Power Station (Km)2	Gas Consumed (KWh)[4]	Oil Consumed (KWh)4
Blacon Children Centre	CH1 5DB	738	10.87	151,870	Not Applicable
Fountains Health Centre	CH1 4DS	750	13.27	482,793	Not Applicable
1829 Building	CH2 1UL	2,228	12.52	769,661	Not Applicable
Stanlaw Abbey Children Centre	CH65 9HE	525	13.60	13,489	
Ellesmere Port Hospital	CH65 6SG	900	12.06	Not Applicable	Not Applicable
Nuffield Health Chester, Grosvenor Hospital [3]	**CH4 7QP**	**738**	**13.87**	**1,101,963**	**Not Applicable**

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

B.3.4. Ellesmere Port Hospital does not have recorded consumption data in the ERIC dataset, nor a valid DEC available. Therefore, the CIBSE Benchmarking Tool has been used to estimate the building's gas consumption, as shown in **Table B-4**.

B.3.5. Some of the land within the 15 km radius of the site is in Wales; Wales is not included in the ERIC database; therefore, the Welsh equivalent data has been obtained.

B.3.6. Three NHS Wales health care sites located within a 15 km radius of Connah's Quay Power Station have been reviewed to assess their heat loads. Due to unavailability of data from the Estates and Facilities Performance Management System (EPMS), information found on the DEC database has been used, as shown in **Plate B-5**.

Table B-4: Benchmarked energy data for a selected NHS England healthcare site within a 15 km radius of Connah's Quay Power Station

Site Name	Post Code1	Gross Internal Floor Area (M²)1	Distance From Connah's Quay Power Station (Km)2	Gas Consumed (KWh)[5]	Oil Consumed (KWh)
Ellesmere Port Hospital	CH65 6SG	900	12.06	272,700	Not Applicable

Table B-5: Summary of NHS Wales healthcare sites within a 15 km radius of Connah's Quay Power Station

Site Name	Post Code4	Gross Internal Floor Area (M²)4	Distance From Connah's Quay Power Station (Km) 1	Gas Consumed (KWh)4	Oil Consumed (KWh)4
Deeside Community Hospital	CH5 1XS	5,113	4.22	1,649,943	Not known
Holywell Hospital	CH8 7TZ	4,335.9	9.89	327,248	Not known
Mold Hospital	CH7 1XG	4,413	8.17	Not known	Not known

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

B.3.7. Mold Hospital does not have consumption data recorded on the DEC database. The CIBSE Benchmarking Tool has been used to estimate the building's gas consumption, as shown in **Table B-6**.

B.3.8. The gas consumption data has been converted into estimated heat demand by assuming an existing boiler efficiency of 85%, which is representative of typical boiler performance. The resulting heat demands for the identified healthcare buildings are presented in **Table B-7**.

Table B-6: Benchmarked energy data for selected NHS Wales healthcare site within a 15 km radius of Connah's Quay Power Station

Site Name	Post Code4	Gross Internal Floor Area (M²)4	Distance From Connah's Quay Power Station (Km)2	Gas Consumed (KWh)5	Oil Consumed (Kwh)
Mold Hospital	CH7 1XG	4,413	8.17	1,337,027	Not known

Table B-7: Total potential healthcare heat load

Site Name	Total Fossil Fuel Consumption (Kwh)	Total Heat Demand (KWh)	Total Heat Demand (MWh)
Blacon Children Centre	151,870	129,090	129.09
Fountains Health Centre	482,793	410,374	410.37
Countess Of Chester Hospital	26,252,235	22,314,400	22,314.40
1829 Building	769,661	654,212	654.21
Bowmere Hospital	2,065,689	1,755,836	1,755.84
Eastway House	655,394	557,085	557.08
Churton House Resource Centre	29,196	24,817	24.82
The Oaks	63,955	54,362	54.36
Ancora House	193,909	164,823	164.82
Other Reportable Sites	534,640	454,444	454.44
Redesmere	224,204	190,573	190.57
Arrowe Park Hospital	41,637,100	35,391,535	35,391.54
Clatterbridge Hospital	10,262,157	8,722,833	8,722.83

Site Name	Total Fossil Fuel Consumption (Kwh)	Total Heat Demand (KWh)	Total Heat Demand (MWh)
Clatterbridge Cancer Centre Wirral	1,830,154	1,555,631	1,555.63
Clatterbridge Hospital	1,268,758	1,078,444	1,078.44
Ellesmere Port Hospital	957,450	813,833	813.83
Coronation Road Workplace Hub	162,735	138,325	138.32
Cherrybank	171,704	145,948	145.95
Sycamore House	21,832	18,557	18.56
Stanlaw Abbey Children Centre	13,489	11,466	11.47
Ellesmere Port Hospital	272,700	231,795	231.80
Nuffield Health Chester, Grosvenor Hospital 3	1,101,963	936,669	936.67
Deeside Community Hospital	1,649,943	1,402,452	1,402.45
Holywell Hospital	327,248	278,161	278.16
Mold Hospital	1,337,027	1,136,473	1,136.47
Total potential healthcare heat load within 15 km radius of Connah's Quay Power Station		**78,572,135**	**78,572.14**

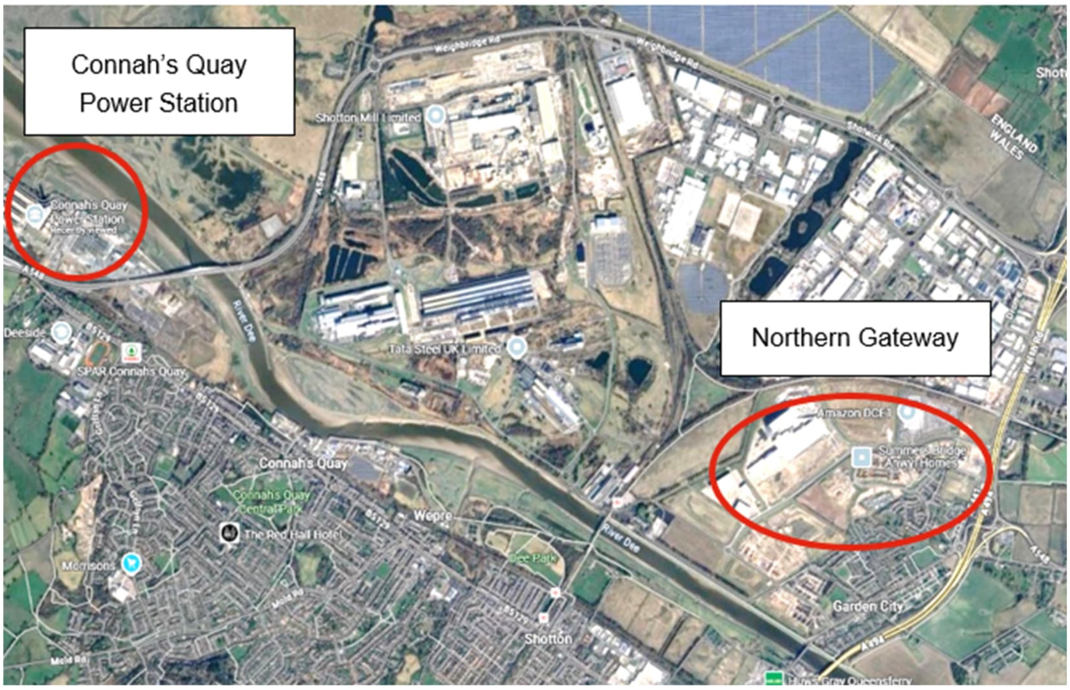
B.4 Review of Proposed Future Developments

B.4.1. A high-level desktop review of the Flintshire Local development plan 2015 – 2030[6] identifies a strategic mixed-use allocation near Connah's Quay Power Station, with Deeside and the Northern Gateway sites highlighted as key development areas under policy STR3A.

B.4.2. The Northern Gateway site, located near Deeside Industrial Park and Garden City, as shown in **Plate B-6**, sits at the core of the current Deeside Enterprise Zone, located south-east of Connah's Quay Power Station and within the 15 km radius search area. The Northern Gateway site is proposed to deliver:

- 1,325 new homes, including affordable housing;
- 72.4 ha of B2 and B8 employment land.

Plate B-6 Map illustrating the proximity of the proposed strategic development site (Northern Gateway) to Connah's Quay Power Station



[6] *Source: Flintshire Local development plan (2015-2030), https://www.flintshire.gov.uk/en/PDFFiles/Planning/Examination-Library-Documents/FINAL-LDP-Written-Statement-English.pdf*

Plate B-7: Map illustrating the Northern Gateway master plan, highlighting the proposed layout and land use [6]

B.4.3. Benchmarks have been used to calculate the overall gas demand that the Northern Gateway site may present, as illustrated below in **Table B-8**.

Table B-8: Benchmarked energy data for potential gas demands from Northern Gateway Site

Proposed Land Use	Quantity6	Total (M^2)[7]	Benchmark Gas Consumed ($KWh/M^2/Year$)[8]	Potential Gas Consumed (KWh)[9]
Domestic	1,325 new homes	123,225	126	15,526,350
B2 and B8 employment land	72.4 hectares	724,000	92	66,608,000

B.4.4. The domestic gas consumption data has been converted into estimated heat demand by assuming a new domestic boiler efficiency of 92%.[10] The small industrial load gas consumption data has been converted into estimated heat demand by assuming a new industrial boiler efficiency of 88%.[11]The overall heat demands that the Northern Gateway may present, are illustrated in **Table B-9** below.

Table B-9: Benchmarked energy data for potential heat demands from Northern Gateway Site

Land Use	Total Fossil Fuel Consumption (Kwh)	Total Heat Demand (KWh)	% Share Of Load Identified	Potential Future Heat Load (MWh)
Domestic	15,526,350	14,282,242	20%	14,284

[7] Source: Minimum gross internal floor areas and storage (m^2), https://www.gov.uk/government/publications/technical-housing-standards-nationally-described-space-standard/technical-housing-standards-nationally-described-space-standard - typical 3-bedroom, 5-person, 2 storey semi-detached dwelling.

[8] Source: CIBSE Energy Benchmarking Dashboard, https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/energy-benchmarking-dashboard/ - for typical practice fossil fuel consumption for semi-detached gas heated good practice fossil fuels.

[9] Source: CIBSE Energy Benchmarking Dashboard, https://www.cibse.org/knowledge-research/knowledge-resources/knowledge-toolbox/energy-benchmarking-dashboard/ - for typical practice fossil fuel consumption for industrial buildings post – 1995 good practice fossil fuels.

[10] Source: Conservation of fuel and power – Approved document, Part L, Volume 1: Dwellings – 2021 edition incorporating 2023 amendments-for use in England.

[11] Source: Conservation of fuel and power – Approved document, Part L, Volume 2: Buildings other than dwellings – 2021 edition incorporating 2023 amendments-for use in England.

B2 and B8 employment land	66,608,000	58,615,040	80%	58,615
	Total potential heat load within Northern Gateway development			**72,897**

B.5 CHP Viability

Large Industrial Loads

B.5.1. The UK CHP Development Map outputs in **Table B-8** indicate that the existing large industrial heat load within the search area is 12,536,186 MWh (approximately 75.61% of the total existing heat load within the search area). As shown in **Table B-9**, the heat load is scattered across the search area with the highest concentrations in key industrial areas – specifically Deeside industrial estate, the Vauxhall motor assembly plant, and the town of Ellesmere Port, which is adjacent to the Stanlow oil refinery.

B.5.2. Benchmarking industrial heat demands is particularly challenging due to the wide variation in industrial process requirements ranging from minimal heating to highly intensive heat use for core operations. While district heating for large industrial users can offer benefits such as economies of scale and support for sustainability targets, its viability depends on consistent demand, proximity of users, and compatibility with heat profiles. Challenges such as the need for high temperature or specialised heat profiles, high infrastructure costs (especially where physical barriers like the River Dee exist), and balancing variable heat loads is complex, and this is further complicated due to Connah's Quay Power Station's variable output which is dependent on the electricity grid demand.

B.5.3. While both the Vauxhall plant and potentially Stanlow could serve as a significant single heat offtaker, the River Dee presents a major physical barrier. This complicates the transport of any recovered waste heat to other industrial users across the River Dee, increasing both technical and financial challenges. Furthermore, the data available from the UK CHP mapping tool does not include the heat demand of individual heat off-takers, so it is unclear what scale of heat demand these sites may have.

B.5.4. The high-level review identifies the nearby Deeside industrial park as having the highest heat load density within the 15 km search area. Major large industrial heat consumers and potential heat offtakers, include Tata Steel Shotton, which reported 246,620 MWh of natural gas use[12]. Another significant industrial load in the area is Shotton Mill, a paper manufacturer, which reported 55,487 MWh of natural gas use. However, Shotton Mill is building a new paper manufacturing which will include an on-site CHP plant thus displacing the demand that Connah's Quay might have supplied[13]. These large industrial sites collectively represent a significant portion of local

[12] *Source:https://www.tatasteeluk.com/construction/sustainability/performance-at-our-sites/shotton*

[13] *Source: https://shottonmill.co.uk/blog/eren-holding-launches-%C2%A31bn-shotton-mill-project-61*

heat demand. Other significant industrial consumers and potential heat offtakers in the vicinity include Toyota manufacturing, and ICT UK Ltd, which is a tissue paper production plant[14].

B.5.5. Despite there being potential large heat off takers, the absence of a single anchor load and the presence of multiple private sector users introduces considerable legal and financial risks to the development of a heat network.

B.5.6. Reporting undertaken historically for DECC ("Potential and costs of district heating networks", Pöyry and Faber Maunsell, 2009), highlights specific issues and challenges to heat networks, noting "*achieving a satisfactory base load heat demand will be risky if it relies on securing commitments from a large number of private sector users* […]".

B.5.7. Given the factors outlined above, large industrial heat loads are not currently considered to be a viable CHP opportunity without detailed, validated site-specific data and heat profiling, this information was not available at the time of writing this report. Future feasibility studies for identifying potential heat offtakers will depend on:

- access to granular operation data from potential heat off takers;
- alignment of heat quality and profile with user requirements; and
- compatibility between the volume and timing of waste heat available from Connah's Quay Power Station and the heat demand profiles of potential users - particularly important if contractual guarantees on heat supply hours are to be established.

Domestic Loads

B.5.8. The UK CHP Development Map outputs within **Plate B-3** indicate that the existing domestic heat load within the search area is 2,927,392 MWh (approximately 17.66% of the total heat load within the search area). As shown in **Plate B-3**, the heat load is spread across the CHP search area, with the highest concentrations located in the settlements of Connah's Quay, Queensferry, Chester and its surrounding areas, Ellesmere Port, and the towns Bromborough and Bebington.

B.5.9. Reporting undertaken historically for DECC ("Potential and costs of district heating networks", 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 200 MWth within 15 km.

B.5.10. 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 disparate settlements.

B.5.11. The largest domestic heat loads are to the east of the search area in Chester and Ellesmere Port which would therefore necessitate the construction of pipework crossing the River Dee to connect the Power Station to any network.

B.5.12. 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

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[14] *Source: https://www.ictgroup.net/en/who-we-are/the-group/ict-uk/who-we-are*

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

Small Industrial

B.5.13. The UK CHP Development Map outputs within **Plate B-4** indicate that the small industrial heat load within the search area is 654,443 MWh (approximately 3.95% of the total heat load within the search area). As shown in **Plate B-4** the heat loads are clustered between industrial facilities located nearby in Broughton, Chester, Ellesmere Port and Bromborough. There is no notable local small industrial facility in very close proximity to Connah's Quay Power Station.

B.5.14. Benchmarking industrial heat demand is particularly challenging due to the wide variation in industrial processes. Many industrial units require little to no heating—often limited to frost protection—while others depend on substantial heat for core operations. As a result, benchmarked heat demand figures for this sector carry a high degree of uncertainty and should be validated with site-specific data before progressing with heat network design.

B.5.15. Small industrial sites within the search area—particularly in Broughton, Deeside, Queensferry, and the outskirts of Chester—may present some heat load potential. However, these are dispersed and lack a single anchor load, consisting instead of multiple, disparate users. This fragmentation increases the cost and technical complexity of installing a heat network, particularly when balancing variable loads against the dispatchable nature of Connah's Quay Power Station.

B.5.16. Moreover, the absence of a centralised load introduces significant legal and financial complexity in establishing heat supply agreements with numerous private-sector users.

B.5.17. This challenge was highlighted in a 2009 DECC report, highlighting 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*."

B.5.18. Given these factors, small industrial heat loads are not currently considered a viable opportunity for CHP integration without detailed site-specific validation and profiling prior to further development of heat network design.

Healthcare Loads

B.5.19. The UK CHP Development Map outputs within **Plate B-5** indicate that the healthcare heat load within the search area is 20,388 MWh (approximately 0.12% of the total calculated heat load within the search area).

B.5.20. A subsequent review of other datasets indicates that the total healthcare heat load within the search area is approximately 78,572 MWh, see **Plate B-5**. Arrowe Park Hospital has the highest heat demand at 35,391.54 MWh, this is included within the 78,572 MWh total heat load although it is located just outside the 15 km search radius, at 15.32 km. The remaining healthcare heat loads are concentrated near to major towns, such as Mold, Holywell, Chester, Ellesmere Port, and at the northern edge of the search area - Arrowe Park along with associated smaller primary healthcare settings.

B.5.21. The healthcare loads are widely dispersed and on the opposite side of the River Dee from the power plant. These characteristics indicate that a heat network serving just healthcare loads would be unlikely to be viable. However subsequent sections of this report consider the potential for serving a combination of healthcare and other loads with a shared network.

Proposed Future Developments

B.5.22. Section B4 provides a high-level review of proposed future developments within the 15 km radius of Connah's Quay Power Station. It identifies the Northern Gateway as the only significant planned development in this area. Based on the heat demand assessment, modelling indicates that this strategic mixed-use site is projected to have substantial heat demand, estimated at 14,282 MWh for domestic and 58,615 MWh for small industrial heat demand. Despite this potential, accurately benchmarking small industrial heat demands is challenging due to factors outlined in Small Industrial Load section.

B.5.23. Due to the Northern Gateway's relatively close proximity to Connah's Quay Power Station – and the concentrated nature of the associated heat demand – this demand is considered potentially viable for CHP integration. This is subject to further site investigation and detailed, site-specific validation. This site is located on the opposite side of the River Dee to Connah's Quay Power Station, presenting logistical and infrastructure challenges to CHP integration.

B.5.24. To further assess the viability of the opportunities presented by both health care and proposed future development heat demands, additional analysis and heat mapping profiling has been undertaken to identify potential areas where heat demand may be significant.

B.6 Connah's Quay Power Station Heat Availability Assessment

B.6.1. To further explore viability, AECOM has undertaken a high-level heat mapping exercise, incorporating the calculated heat availability capacity of the power plant. The instantaneous heat output from Connah's Quay Power Station is inherently variable, as it is influenced by fluctuations in electricity grid supply and demand. The power plant is being developed in two phases. Phase-1 will be a single line; Phase-2 would add a second line to the plant (thus doubling its output. **Table B-10** and **Table B-11** show the differing heat recovery capacities under these two potential scenarios, reflecting the power station's ability to supply heat to a district heating network.

Table B-10: Connah's Quay Power Station heat availability potential from Scenario 1 – Phase-1 (one line)

Connah's Quay Operating Capacity Mode	Instantaneous Heat Availability (MW)	Potential Heat Availability (MWh)[15]
Minimum load	40.7	244,200
Maximum load	69.2	415,200

[15] *Source: Potential heat availability is based on assumed planned annual run hours of 6,000*

B.6.2. **Table B-10** shows the initial calculated heat availability potential ranges between 40.7 MW and 69.2 MW.

Table B-11: Connah's Quay Power Station heat availability potential from Scenario 2 – Phase-2 (two lines)

Connah's Quay Operating Capacity Mode	Instantaneous Heat Availability (MW)	Potential Heat Availability (MWh)[15]
Minimum load	40.7	244,200
Maximum load	138.4	840,400

B.6.3. **Table B-11** shows the initial calculated heat availability potential ranges between 40.7 MW and 138.4 2 MW when Scenario 2 – Phase-2 is implemented.

B.6.4. The summary table, **Table B-12,** shows the largest identified potential heat loads, with large industrial heat demand being the largest at 77% of the identified potential heat demand, while future developments contribute just 0.45% of the potentially viable heat demand.

Table B-12: Key heat demand sectors within 15 km of Connah's Quay Power Station

Sector	Sector Heat Loads (MWh)	% Share Of Sector Load	% Of Heat Potentially Demand Met[16]	Viability Of Delivering the Required Supply
Large Industrial	12,536,186	77.1%	Demand exceeds availability	The demand exceeds the capacity however a few selected heat demands may be a good match for the power plant heat off-take. While demand exceeds capacity, selected heat demands may align well with the plant's heat off take.
Domestic	2,927,392	18%	Demand exceeds availability	The demand exceeds the capacity and is spread across a large area with thousands of connection points.
Small Industrial	654,443	4%	Demand exceeds availability	The demand exceeds the capacity and is highly uncertain.
Health care	78,572	0.50%	100%	Heat demand is within the capacity of the power plant but dispersed across multiple geographically distant sites.

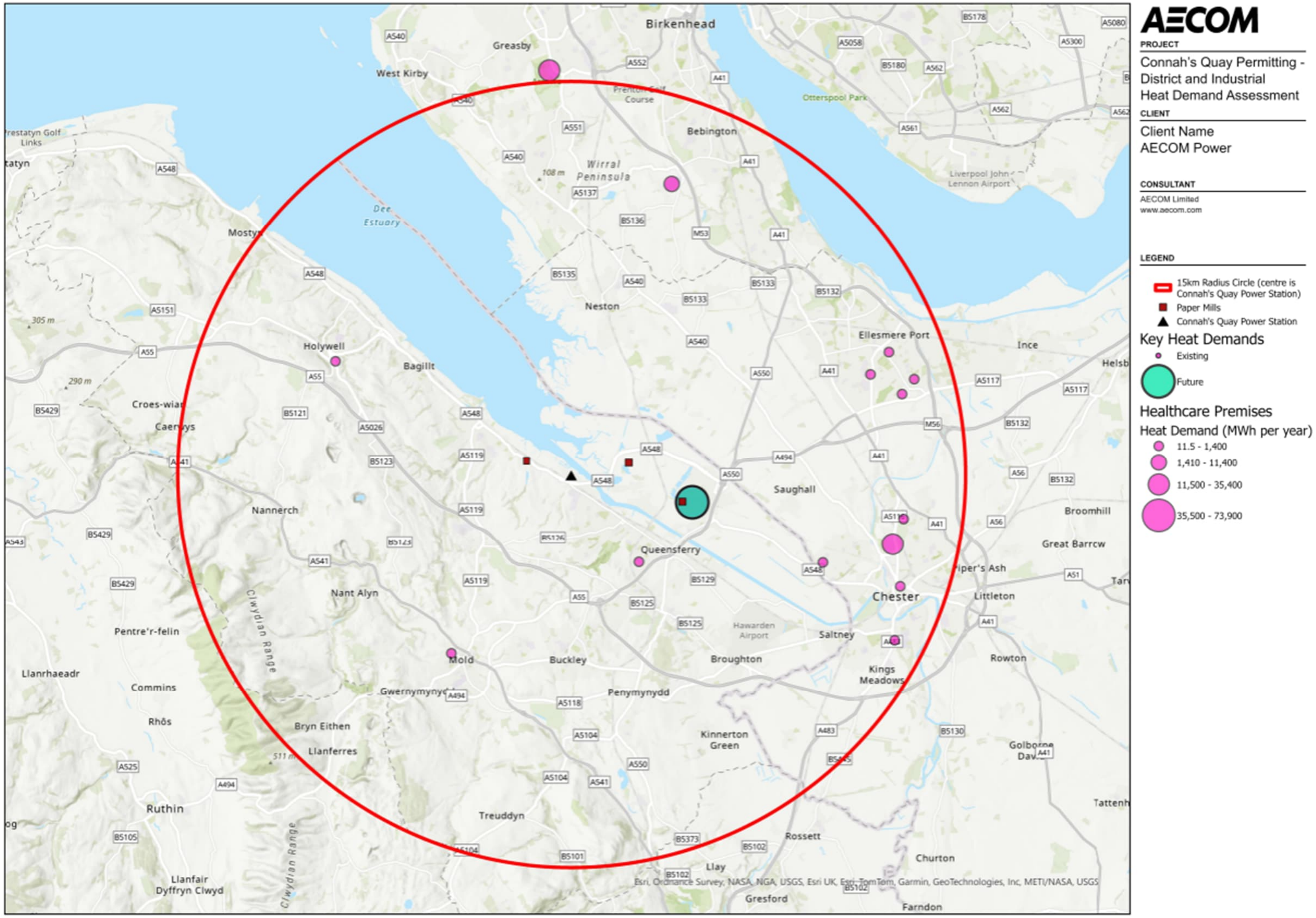
[16] % of heat demand met from Connah's Quay Power Station heat availability at minimum and maximum operation levels

Sector	Sector Heat Loads (MWh)	% Share Of Sector Load	% Of Heat Potentially Demand Met[16]	Viability Of Delivering the Required Supply
Future developments	72,897	0.40%	100%	Heat demand is within the capacity of the power plant and concentrated at a single location.
Total viable heat load within 15 km of Connah's Quay	**16,269,490**			**While demand exceeds capacity, selected heat demands may align well with the plant's heat off take**

B.6.5. Comparing **Table B-10** and **Table B-11** with **Table B-12**, the disparity between potentially viable heat demand and the potential heat supply is shown to be large; there is much more demand (especially large industrial) than the calculated supply capacity. Connah's Quay at maximum operation, when phase-2 is fully operational, could provide 830,400 MWh per year. This is sufficient to supply all the small industrial, health care and future development sites identified; a combined heat demand of 805,912 MWh per year. The combined demand of the health care and future developments could be met by just one of the Connah's Quay lines even if phase-2 was not built. The small industrial heat demand is widely dispersed and highly uncertain as the heat demand for this sector varies a lot depending on the nature of the industry. Moreover, many industrial buildings use direct gas-fired radiant heating systems that are not compatible with district heating. For this reason, this type of demand would require substantial validation before building a case for a district heat network to serve these small industrial buildings. On the other hand, some of the large industrial processes discussed below may be readily compatible with heat supplied from the power plant.

B.6.6. The calculated health care and future development heat demands have been mapped in **Plate B-8,** alongside potential large industrial offtakers near the future development site, including existing paper manufacturers, Essity (unknown demand) and Shotton Mill (constructing an on-site CHP plant) and a new ICT tissue paper manufacturing facility under construction.

Plate B-8: Locations of calculated heat demands for healthcare and future developments; locations of paper mills shown relative to proposed Connah's Quay power station.



B.6.7. Connah's Quay Power Station is shown at the centre of the search area in **Plate B-8** this mapping illustrates the largest health care loads are at the edges of the search radius and are widely dispersed, with Queensferry and Chester being the nearest viable potential loads.

B.6.8. The future development is located reasonably close to the power station with a potential heat demand of 72,897 MWh per year which Connah's Quay Power station could supply at its minimum load.

B.6.9. In addition to these loads, three paper mills have been identified in the vicinity of the proposed power plant. These may have heat demands which align with the quantity and grade of heat available from the power plant; however further engagement with the operators will be required to confirm this and to explore the viability of a heat network serving these demands.

B.7 Conclusion

B.7.1. Based on supply, demand, and practical considerations, there may be potential for a viable district heat network supplying a suitable combination of the following demands:

- The Northern Gateway development
- One or more of the clusters of healthcare buildings (notably Chester and Ellesmere Port)
- One or more of the Paper Mills identified in the vicinity

B.7.2. The majority of these demands are on the opposite side of the River Dee from the power station. This presents logistical and infrastructure challenges that would need to be carefully considered before progressing with CHP integration.

B.7.3. To move forward, a comprehensive feasibility study to evaluate the technical, economic and environmental implications of CHP integration would be required.