Ener-Vate Consultancy Limited

Grangetown Energy from Waste

Heat Demand Investigation

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Contents

Document Approval

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List of Abbreviations and Units

BSRIA	Building Services Research and Information Association
CHP	Combined Heat and Power
CHP-R	Combine Heat and Power-Ready
CIBSE	Chartered Institution of Building Services Engineers
DCO	Development Consent Order
DESNZ	Department for Energy Security & Net Zero
DHN	District Heat Network
EC	Energy Centre
EfW	Energy from Waste
EHL	Existing Heat Load
ESCo	Energy Services Company
GBP	Great British Pounds
GHNF	Green Heat Network Fund
GIFA	Gross Internal Floor Area
GIS	Geographic Information System
HIU	Heat Interface Unit
HNDU	Heat Networks Delivery Unit
IRR	Internal Rate of Return
kWh_{th}	kilowatt hours thermal
LA	Local Authority
M&E	Mechanical and Electrical
NIFA	Net Internal Floor Area
NPV	Net Present Value
PHL	Planned Heat Load
SPV	Special Purpose Vehicle

TPA	Thermal Purchase Agreement
WACC	Weighted Average Cost of Capital

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Introduction

1 Introduction

1.1 Project Introduction

1.1.1 FCC Environment UK Ltd (referred to as the Applicant) are developing plans to develop a new Energy from Waste (EfW) Facility (referred to as the Facility) located in Grangetown, Teesside (the Site).

1.1.2 FCC recognize the economic efficiencies and environmental benefits that can arise from direct heating and power and, given the nature of the Site, existing properties and planned developments within the locale, FCC are keen to explore if a heat off-take business opportunity exists to either invest in directly, or be attractive enough to market the opportunity within an established community of Energy Services Company (ESCo) developers.

1.1.3 Heat would be distributed via a District Heating Network (DHN) and accordingly, the Applicant has worked to identify options for heat off-takes. This Heat Demand Investigation (the Investigation) sets out any heat opportunities that may exist, the constraints (both physical and time-based) and the likelihood of these heat opportunities becoming a realistic prospect at a time when connections can be made.

1.1.4 The reality is that the Proposed Extension is ideally located to benefit from several potential significant (in terms of kilo Watt thermal hours (kWh_{th})) heat opportunities that either already exist or are likely to be delivered along-side the proposed Facility. The proposed Facility will be CHP-Ready (see CHP Assessment).

1.2 Ener-Vate Consultancy Ltd

1.2.1 Ener-Vate Consultancy Ltd was created seven years ago to provide a truly independent service to developers of low-carbon and renewable energy projects to help and advise them on how to maximise their investment through the delivery of District Heating Networks – essential under the current energy market reform for certain lower carbon generation fuel sources.

1.2.2 Formed by three individuals who were pivotal to the growth and development of the E.ON Community Energy Team, we felt the experience and knowledge gained in developing residential, mixed use and city scale projects had value as an independent to other developers and existing asset owners.

1.2.3 Each of the three Directors has numerous years within the low carbon and renewable energy field with credible track records in the District Heat Network sector. We differentiate ourselves from similar consultancy service providers by essentially becoming part of the client team and fully embracing the projects personally.

1.2.4 We fully appreciate the whole value chain and requirements to deliver DHN schemes and develop opportunities that are viable in every essence. Key to this is customer and stakeholder engagement in person and developing relationships and trust. We have a strong track record in this area and contract negotiation.

1.2.5 Furthermore, the skills within Ener-Vate Consultancy Ltd offer a service to new residential developers who are considering the adoption of DHN technology for their sites. Having worked on many new build schemes both in and out of London, we feel our knowledge within this sector also has great value to offer developers in guiding, advising and developing commercial and technical structures that deliver added value.

1.2.6 For further information and detail on previous projects and client relationships we have, see the link below.

www.ener-vate.co.uk

1.2.7 Ener-Vate have previously worked closely with FCC and developers to inform the wider community of the benefits of DHN systems and consequently have now built a strong relationship with numerous councils located throughout the UK.

1.2.8 Ener-Vate and FCC have now built a strong relationship with three Councils in Scotland, namely Edinburgh, North Lanarkshire and Midlothian Councils, through the design of two DHN schemes using Energy from Waste (EfW).

1.2.9 More information on the two schemes can be found at:

https://www.shawfair.co.uk/

https://drumgray.fccenvironment.co.uk/

1.3 Purpose of the Investigation

1.3.1 The intentions of this report are to:

- Perform a desktop study to both identify and quantify any significant heat demands that lie within a 15km radius (the Study Area) of the proposed Facility,
- Conclude the most technically and commercially viable heat loads that show promise for the successful delivery of a DHN,
- Design indicative DHN route(s) taking heat from the proposed Facility to selected heat loads, and
- Assess the commercial viability of the proposed DHN route(s) using Ener-Vate Consultancy Ltd.'s proprietary commercial model.

02

District Heat Networks

2 District Heat Networks

2.1 Background

2.1.1 The use of DHNs in order to deliver low-carbon heating to residential and mixed-use developments is considered a contributory valuable technology to deliver the UK's national policy to reduce the carbon intensity of heating.

2.1.2 District heating has been operational across the UK for many years, as it has across Northern Europe, particularly within the Scandinavian regions. The UK Government has for a number of years been promoting this technology through large programmes of investments for feasibility studies through the Heat Network Delivery Unit (HNDU) and more recently, through a commitment of capital / loan arrangements for both the public and private sector under their Green Heat Network Fund (GHNF).

2.1.3 District Heating Infrastructure is a relatively simple concept of distributing heat in the form of hot water to connected buildings. Each building has a Heat Interface Unit (HIU) suitably sized to meet the building requirements that transfers the heat from the DHN to the traditional, internal wet radiator systems.

2.1.4 Heat generation sources are flexible and come in many forms including heat pumps, Combined Heat and Power (CHP) units and Energy from Waste (EfW). Generation plant is typically installed in Energy Centres (EC) situated close to the buildings and/or developments in which they are serving.

2.1.5 District heating in the UK has been difficult to implement historically due to the existence of an extensive natural gas network and a regulated energy supply market which allows customers the freedom to change suppliers to obtain preferential commercial terms. The high capital and operational costs of associated infrastructure can also be a barrier for DHNs, with a notable lack of domestic DHN pipe suppliers. Further developers of private residential properties have been reluctant to utilise DHNs as it often increases development costs.

2.1.6 However, DHNs can be successful in circumstances where:

- new-build housing developments are aligned with low-carbon heat sources in terms of timing and proximity,
- developments that offer high heat demand density, for example apartment blocks,
- there is a high level of Local Authority / housing association properties; and
- additional commercial/industrial civic (e.g. schools and hospitals) consumers are also connected to the district heating network to improve network diversity and offset wide fluctuations in heat demand associated with the UK weather.

2.2 Infrastructure

2.2.1 The main process constituents of a district heating scheme are:

- Primary heat station equipment at the point of supply,
- Secondary heat station equipment at the point of delivery; and
- A flow and return pipe system circulating hot water between the point of supply and the points of use.

2.2.2 The primary heat station would recover energy from the turbine and generate hot water which is then treated to form a brine solution and transferred via a primary heat exchanger to a district heating network.

2.2.3 Circulation pumps would pump this hot water through pre-insulated buried pipework consisting of a main 'spine' and numerous 'branches' to the secondary heat stations at the consumer's property and then return cooled water back to the heat source for reheating and recirculation.

2.2.4 Using a 'spine' and 'branch' system allows additional pipework to be added to the DHN retrospectively, and it is reasonably straightforward to add branches to serve new buildings/developments. Pipe technology is well proven and can provide a heat distribution system with a 30 year plus design life as per the CIBSE Code of Practice.

2.2.5 Modern heat-insulated piping technology also enables hot water to be transferred long distances without significant losses.

2.2.6 Condensate return pumps in the primary heat station would then return the condensate from the primary heat exchanger to the main condensate tank. The primary heat station would be likely to comprise:

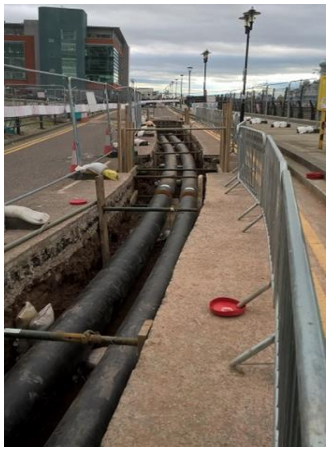
- Primary shell and tube heat exchanger(s),
- Condensate return pumps,
- District heating circulation pumps,
- Pressurisation system,
- Heat meters,
- Back up boilers (if required); and
- All other associated equipment.

2.2.7 The secondary heat station at the consumer would be likely to comprise a plate heat exchanger or heat interface unit which enables the exchange of energy from the hot water to the consumers heating system. This is normally located within the consumer's boiler house but can be in other locations.

2.2.8 The interface connections between the district heating network and the consumers heating system will typically comprise:

- Plate heat exchanger,
- Local controls,
- Heat meter,
- Flow isolation valve,
- Return isolation valve,
- Drain down point; and
- Electrical & control connections.

2.2.9 Examples of pipework and a Heat Interface Unit can be seen below:



2.3 Policy

2.3.1 The National Planning Statements (NPSs) were published in July 2011 and set out the Government's objectives for the development of nationally significant infrastructure projects (NSIPs).

2.3.2 NPS EN-1[2] (Overarching Energy Policy) outlines the Government's policy for delivery of major energy infrastructure in England and Wales. NPS EN-1 recognises that there is a significant need for energy infrastructure, identifies technology specific impacts and reaffirms the UK Government's current objectives relating to carbon reduction as follows:

- The Government's legally binding target is to cut greenhouse gas emissions by 80% by 2050, compared to 1990 levels (see para 3.1.14 below). The UK is committed to sourcing 15% of its total energy from renewable sources by 2020; and
- The transition to a secure, low carbon energy system is challenging, but achievable, and will require major investment in cleaner power generation.

2.3.3 Part 4 of NPS EN-1 sets out the assessment principles which should be taken into consideration for energy NSIPs. Paragraphs 4.6.1 - 4.6.12 of Part 4 outline the consideration of CHP and state that:

- Thermal generating station applications are required to include CHP or at least consider the use of CHP;
- Applicants are required to consult with stakeholders, including; potential heat customers, Homes England, Local Enterprise Partnerships and Local Authorities; and
- Applicants should explain how the technology required to produce a CHP enabled generating station should not affect the ability to be Carbon Capture Ready (where applicable) or set out any constraints which would prevent this.

2.3.4 NPS EN-3[3] (Renewable Energy Supply from Waste) applies to nationally significant energy from biomass/waste infrastructure in England and Wales with at least 50 MWe generating capacity. NPS EN-3 states that new developments should consider CHP as part of its application or demonstrate that CHP has been considered and the Planning Inspectorate can seek further information should this not be provided. Section 2.5 of NPS EN-3 states that biomass/EfW generating stations can be configured to produce CHP.

2.3.5 On 27 June 2019, the Climate Change Act 2008 (2050 Target Amendment) Order 2019[4] came into force in the UK. This introduced a target of at least a 100% reduction of greenhouse gas emissions (compared to 1990 levels) in the UK by 2050. This legally binding target supersedes the previous target of an 80% reduction by 2050 and is expected to intensify the national focus on the requirement for new biomass and waste infrastructure to exploit CHP opportunities.

2.4 Energy Services Companies (ESCo's)

2.4.1 DHNs are, in the main, invested and delivered through the creation of a Special Purpose Vehicle (SPV) in the form of an ESCo (Energy Services Company).

2.4.2 The ownership and commercial structure of ESCo's does vary on a project-by-project basis. In the earlier years of ESCo's in the UK, the majority were owned by the major UK Energy Companies / Utilities providers. More recently, the ownership of ESCo's has become more fluid and an increased number of private entities have entered the market – as well as Public bodies such as Local Authorities.

2.4.3 In its most developed form, an ESCo provides a commitment to deliver the benefits of energy to a specified level of performance and reliability whilst providing the ESCo entity itself with long-term revenue streams.

2.4.4 For the purpose of the Investigation, Ener-Vate have assumed that the Applicant will either:

1) Create and wholly own an ESCo entity to retail heating and hot water to potential consumers, or

2) Create a business case for an ESCo entity that can be tendered to a market of experienced ESCo operators.

2.4.5 Ener-Vate's commercial model assessment (see Section 6) assumes an ESCo entity will be formed to deliver the DHN to potential consumers. This approach has been taken as a business that sells an energy service adds value to the provision of energy as a commodity by meeting some additional aspect of the customer's needs.

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Existing Heat Loads Assessment

3 Existing Heat Loads Assessment

3.1 Methodology

3.1.1 For the purpose of the Investigation, an Existing Heat Load (EHL) is defined as the quantity of heat an existing building or development within the Study Area is projected to consume in the form of a kWh_{th}/annum value, not including domestic properties.

3.1.2 Retrofitting domestic properties comes with added complexity when compared to new developments. Most importantly, this relates to the internal heating system contained within the domestic property and whether or not it would have to be modified to suit the needs of heat supplied by a DHN, therefore adding further cost to the project.

3.1.3 First and foremost, a DHN of this scale is designed to supply large Heat Loads (in the first instance). Once a financial and technical case has been proven for the DHN it is then feasible to look into domestic properties nearby that could potentially take heat, dependent on their existing energy provisions.

3.1.4 Therefore, the Investigation excludes any assessment of the viability of retrofitting existing domestic properties within the Study Area. This approach is in keeping with applications for Development Consent (e.g. Riverside Energy Park and Ferrybridge Multifuel 2) and is accepted by the Planning Inspectorate and a number of planning authorities.

3.1.5 All available EHLs are identified and quantified within the Study Area using heat mapping tools and Geographic Information System (GIS) software.

3.1.6 It should be noted that all EHLs calculated are produced entirely without access to the meter readings of buildings/developments and so EHLs are projections only.

3.1.7 GIS software was used to trace building outlines to determine the m^2 Gross Internal Floor Area (GIFA) of each identified building. Following this, Google Maps 360° Street View was used to find the number of storey's per building.

3.1.8 The following equations were used to quantify each EHL:

$$NIFA\ of\ Building = m^2\ GIFA\ \times No.of\ Storeys\ \times NIFA\ Factor$$

where:

NIFA[1] is defined as the Net Internal Floor Area of a building, and

3.1.9 The NIFA Factor is a percentage applied to convert the GIFA to NIFA. This is typically 90% (or 0.9) unless stated otherwise.

Then:

[1] The Net Internal Floor Area (NIFA) is defined as the usable area within a building measured to the face of the internal finish of perimeter or party walls ignoring skirting boards and taking each floor into account (BREEAM 2018).

$$Existing\ Heat\ Load\ (EHL) = NIFA\ of\ Building\ \times kWh_{th}/m^2\ Value$$

where the kWh_{th}/m^2 Value is a value derived using industry standard benchmarks provided by bodies such as the Building Services Research and Information Association (BSRIA), the Chartered Institution of Building Services Engineers (CIBSE) and the Department for Energy Security and Nett Zero (DESNZ), as well as data taken from past projects.

3.1.10 The EHL equation therefore gives a projected annual heat consumption in the form of a kWh_{th} value per building/development.

3.2 Findings

3.2.1 The initial desktop study identifies 357no. EHLs within the Study Area that are likely to be capable of connecting to a proposed DHN from the Facility. Figure 4-2 maps all 357no. EHLs relative to the Existing Station using GIS software.

3.2.2 Using the methodology stated in Section 4.1, all 357no. EHLs were quantified and can be seen in Appendix 1 along.

3.2.3 Table 4-1 below summarises the 357no. EHLs by categorising them by building type:

Building Type	No. of Buildings	Projected Heat Consumption per Annum (kWh_{th})
Care Homes	51	30,356,836
Educational Institutions	218	131,012,297
Hospitals	10	100,137,674
Leisure Centres/Gyms	9	6,879,631
Prisons	2	16,288,975
Retail	67	27,531,777
Total	**357**	**312,147,191**

Table 4-1 – EHLs Categorised by Building Type

3.2.4 As is stated, the 357no. EHLs amount to an estimated total of **312,147,191 kWh_{th}** per annum (c. 312 GWh_{th}).

3.2.5 Of the 357no. EHLs, the most sought-after heat loads, from a commercial perspective, are often classified as 'Anchor Loads'. An anchor load is described as a significant heat demand that has a high potential to be one of the first connected demands on a network.

3.2.6 Ideally an Anchor Load would be located some distance away from the Facility but not so far that connecting the Anchor Load to the Heat Source would be uneconomical.

3.2.7 Anchor Loads are critical to making a network economically viable. Having a single point of connection with a significant heat demand connect to the network allows smaller buildings/developments en-route to also join. Without this large Anchor Load at the end of the network, these smaller buildings/developments could not possibly join as the network would not be economically viable for the Applicant to invest in, and therefore would likely not exist.

3.2.8 Further to the desktop study findings, Ener-Vate also made effort to contact entities operating industrial processes highlighted in Tees Valley Combined Authority's (TVCA) Clean Energy report.

3.2.9 Being a heavily industrialised area, TVCA have begun to address the need to reduce its carbon footprint while growing a free and increasingly innovative economy. Figure 4-1 shows the industrial entities highlighted by TVCA int their Clean Energy report.

Figure 4-1 – TVCA Clean Energy Industrial Operations

3.2.10 Figure 4-1 shows entities operating industrial processes situated, for the most part, along the existing pipe corridors believed to be controlled by Sembcorp, originating at the Wilton International site.

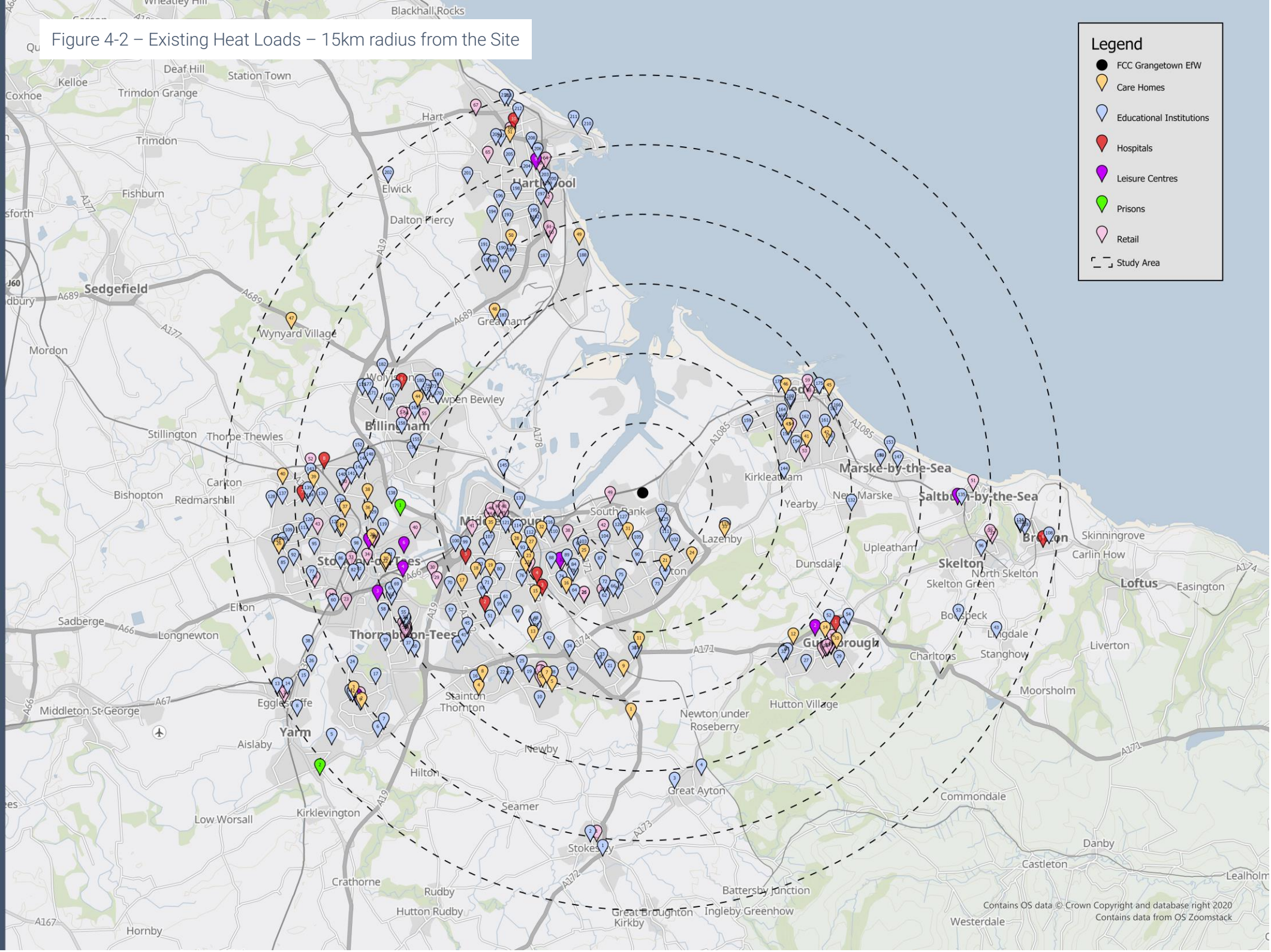
3.2.11 Each building operates a different industrial process, with some generating a surplus of heat and others demanding a large heat consumption. Such nature of these processes makes it difficult to determine what grade of heat is required to operate their facilities. Heat from a DHN, as already mentioned, can be distributed at different temperatures and pressures to meet the needs of the final consumer, and as such the heat demand cannot be estimated without consultation with the facility operators.

3.2.12 Ener-Vate attempted to contact many of these entities seen in Figure 4-1 (see also Appendix 3) through a variety of formats such as emails, phone calls and online forms. Entities such as those operating these industrial processes are particularly difficult to contact with little information available online to allow contact other than a generic email address. Ener-Vate are still in the process of working with the Applicant to gain contacts through mutual stakeholders for these entities where possible.

3.2.13 Concurrent to awaiting responses from the industrial entities, the Applicant had agreed a Non-Disclosure Agreement (NDA) with the South Tees Development Corporation (STDC) to discuss details surrounding their landholding directly North of the proposed Facility. See Section 5.3 for further details.

All Existing Loads

Figure 4-2 – Existing Heat Loads – 15km radius from the Site



04

Planned Heat Loads Assessment

4 Planned Heat Loads Assessment

4.1 Methodology

4.1.1 For the purpose of the Investigation, a Planned Heat Load (PHL) is defined as the quantity of heat a building or development with a submitted planning application to Local Authorities (LA's) operating within the Study Area is projected to consume in the form of a kWh_{th}/annum value.

4.1.2 Whilst retrofitting existing properties/buildings can present a strong case to a LA for the development of a DHN, and has been proven in cities such as Nottingham, Birmingham, Leeds, and Sheffield, it certainly remains more attractive to new developments.

4.1.3 Most notably, it allows developers to reduce building fabric costs in order to reach Part L requirements[4] and can be implemented at the design stage of each development or building as well as having a host of other benefits.

4.1.4 PHLs are identified using information provided through LA planning portals. The planning portals contain documents for each planning application that are available to the general public such as location plans, masterplans, and accommodation schedules.

4.1.5 The three documents mentioned above are key to both identifying and quantifying PHLs:

- Location plans give information as to where the development is situated,
- Masterplans give information as to where buildings are situated within the site boundary, and
- Accommodation schedules contain more granular information such as the m^2 floor plan of each building and any relevant phasing schedules for the development.

4.1.6 Where possible, PHLs are quantified using the above documents along with the equations used in Section 3.

4.1.7 If specific documents such as those mentioned above are not available, Ener-Vate have taken a pragmatic approach to assume what the likely PHL will be by assuming a NIFA value.

4.1.8 PHLs are also subject to change as planning applications progress through their various stages and processes. The Applicant will continue to check on the status of planning applications within the Study Area as the project develops to ensure any PHLs that don't initially pass the Screening Process are re-evaluated.

4.2 Findings

4.2.1 At the time of writing the Investigation, there are 33no. developments with planning applications submitted to the LA's operating within the Study Area.

4.2.2 Appendix 2 contains a list of all 33no. developments along with their descriptions and further information. Table 5-1 below simplifies the appendix:

Ref.	Project Name / Address	Development Description	Heat Load (kWh/annum)
1	Corporation Road	86 dwellings	309,600
2	West of Kirkleatham Lane	550 dwellings (potentially more)	1,980,000
3	Land at Mickles Dales	100 dwellings	360,000
3	Land at Mickles Dales	100 dwellings	360,000
4	Low Grange Strategic Farm	1,250 dwellings	4,500,000
5	Swans Corner, Nunthorpe	128 dwellings	460,800
6	Longbank Farm, Ormesby	320 dwellings	460,800
7	Spencerbeck Farm, Ormesby	82 dwellings	1,152,000
8	Normanby High Farm	150 dwellings	540,000
9	Land at Former Eston Park School	100 dwellings	360,000
10	Land at Cleveland Gate, Guisborough	137 dwellings	180,000
11	Land at Galley Hill, Guisborough	50 dwellings	180,000
12	Wilton International	Construction of numeroius industrial process facilities	Unknown
13	Plot 11 Wilton International	Construction of numeroius industrial process facilities	Unknown
14	Nunthorpe Grange, Middlesbrough	350 dwellings	1,260,000
15	Ford Riding Centre	69 dwellings	248,400
16	Grey Towers Farm	102 dwellings	367,200
17	Newham Hall Farm	1,100 dwellings	3,960,000
18	Stainton Vale Farm	500 dwellings	1,800,000
19	Stainsby Farm	1,300	4,680,000
20	St Davids	115 dwellings	414,000
21	Brackenhoe East	350 dwellings	1,260,000
22	Land north of Marton Avenue	72 dwellings	259,200
23	Grove Hill	292 dwellings	1,051,200
24	Acklam Iron and Steelworks Club	55 dwellings	198,000
25	Boro Park	86 dwellings	309,600
26	Former Erimus Training Centre	106 dwellings	381,600
27	Gresham	145 dwellings	522,000
28	Roworth Road	89 dwellings	320,400
29	Hemlington Grange	1,230 dwellings and 8 hectares of employment land	5,628,000
30	Land at South Tees Development Corporation	418,000 sqm B1, B2 and B8 floorspace	11,287,080
31	Land at South Tees Development Corporation	Future Phase	Unknown
32	Land at South Tees Development Corporation	Future Phase	Unknown
33	Land at South Tees Development Corporation	Future Phase	Unknown
			44,789,880

Table 5-1 – Planned Heat Loads

4.2.3 A combined total of **c. 45 GWh** of heat is projected to be required by the 33no. new developments.

4.2.4 Similar to the Anchor Load methodology previously stated in Section 4.2, the most viable connections will be those with large heat loads situated nearby the Facility. Specifically, PHLs 4, 12 and 30-33 lie in close proximity and may require a large heat load.

4.2.5 PHL 4 had planning application granted for outline consent for up to 1,250 dwellings, issued in 2016 to Taylor Wimpey subject to outline conditions. Little progress has been made in 7 years for this development, and as such it is concluded at this stage that it should not be considered for the remainder of the investigation.

4.2.6 PHL 12 contains three planning applications at the Wilton International site who are looking to deliver a mineral process and refining facility, an animal and food pellet plant and also a plastic conversion factory.

4.2.7 The heat demands for each facility are unknown at this moment in time and such cannot be assessed using Ener-Vate's commercial model. For this reason, they have also been omitted from the Investigation at this time.

4.2.8 Whilst the above Planned Heat Loads are not to be commercially assessed in this Investigation, the Applicant, along with Ener-Vate, will continue to gather further information surrounding the progress of each development and their requirements.

4.3 South Tees Development Corporation (STDC)

4.3.1 PHLs 30-33 are contained within a landholding owned by the South Tees Development Corporation (STDC), formerly occupied by British Steel, labelled as the Teesworks development.

4.3.2 STDC are planning to construct c. 418,000m^2 of B1, B2 and B8 industrial and commercial floor space. The project is still in it's infancy; however the Applicant was able to negotiate an NDA with STDC and meet with their development team alongside Ener-Vate to gather further information about their plans.

4.3.3 STDC's current masterplan for the Teesworks site consists of 9no. industrial plots as below:

Plot Name	Size (m^2)	Projected Heat Consumption per Annum (kWh$_{th}$)
Plot A	54,400	1,468,800
Plot B	54,400	1,468,800
Plot C	46,640	1,259,280
Plot D	44,000	1,188,000
Plot E	39,000	1,053,000
Plot F	89,600	2,419,200
Plot G	40,800	1,101,600
Plot H	26,400	712,800
Plot I	22,800	615,600
Total	**357**	**11,287,080**

Table 5-2 – Teesworks Buildings

4.3.4 The development is planned to have their first unit built and requiring heat by 2023 meaning the timelines for their development do not exactly match those of the proposed Facility. However, there will be many units that will not come online so early as well as further space allocated for future expansion.

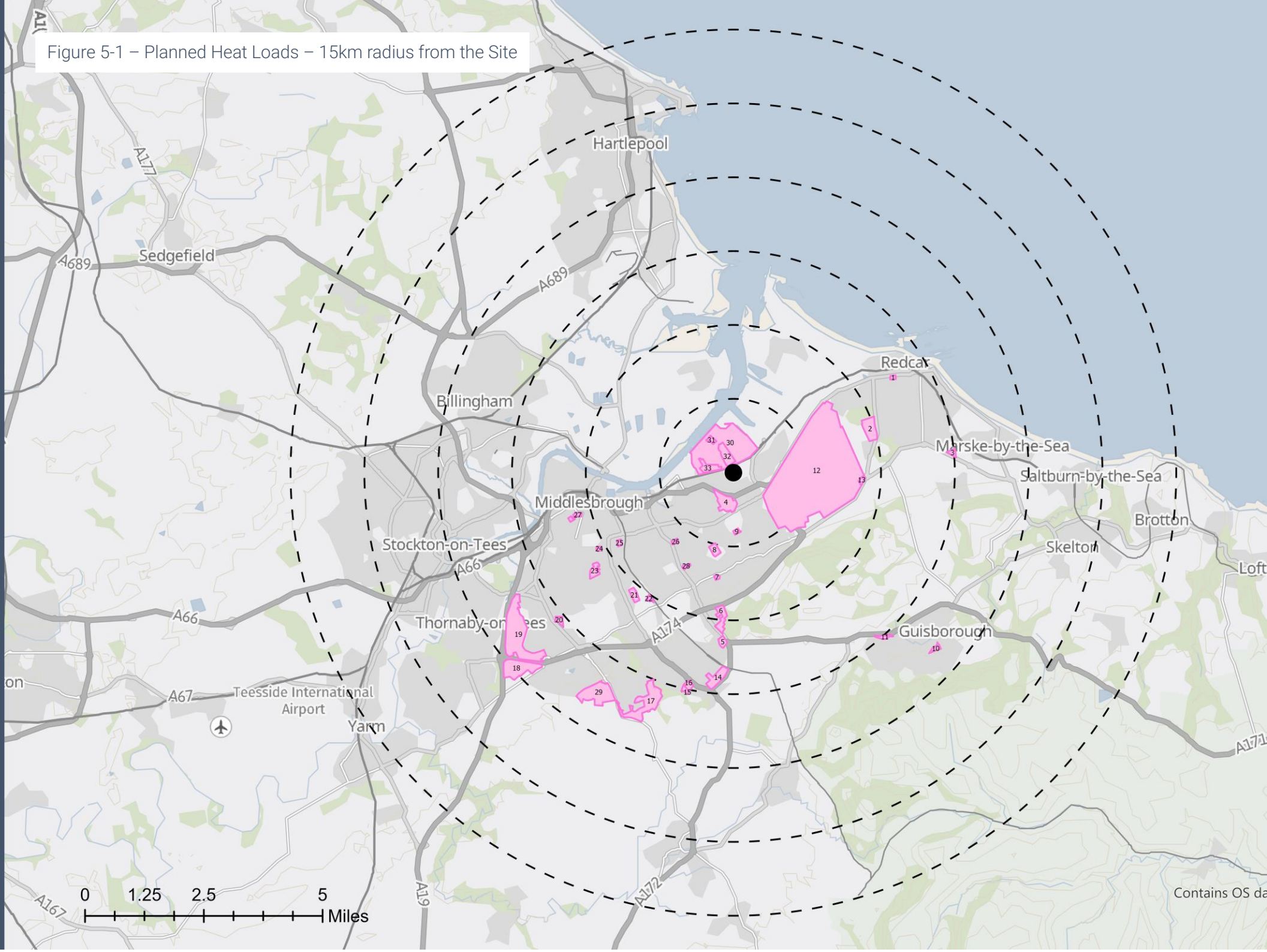
4.3.5 The plots contained with the Teesworks development have not been given a specific use meaning that the industrial units could range from large sheds to heavy duty industrial processes. Ener-Vate will take a conservative approach when commercially assessing the Teesworks development assuming most will be large sheds at this moment in time.

4.3.6 Using pre-determined utility corridors provided by STDC, an indicative DHN route can be designed taking heat from the Facility to each building contained within the Teesworks development (see Section 6).

4.3.7 The Teesworks development will form the basis of this Investigation considering its close proximity to the facility and potential large heat load. If commercially viable, securing this Anchor Load will allow for future expansion of the network to smaller heat loads nearby whilst also ensuring there is a sustainable, profitable business.

Planned Heat Loads

Figure 5-1 – Planned Heat Loads – 15km radius from the Site



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Network Design

5 Network Design

5.1 Proposed DHN Route

5.1.1 Using all data obtained in the Investigation thus far, it is possible to create an indicative network route from the Facility to the Teesworks site, distributing heat to each building. The network route is by no means a final product, but instead facilitates a more granular assessment of how much the DHN infrastructure is likely to cost.

5.1.2 The proposed Facility will be designed to achieve an availability of over 90% (i.e. at least c. 8,000 operational hours per year). During periods of routine maintenance or unplanned outages the Facility will not be operating, however the heat consumers will still require heat. There is therefore a need, somewhere within the heat distribution system to provide a back-up source of heat to meet the needs of the heat consumers.

5.1.3 Currently it is unknown where an Energy Centre (EC) that will house this infrastructure will be positioned. This requires a careful assessment from both STDC and FCC of where it will be best suited and is applicable at a later design stage. To remain conservative, it will be assumed that the SPV operating the DHN will pay a 'lease' in the commercial model, therefore acknowledging the cost involved without designating its positioning.

5.1.4 The network, therefore, will be capable of delivering heating and hot water to the industrial units throughout the year including when the Facility is down for maintenance, providing security of supply to the final consumer.

5.1.5 The temperature of the heat distributed is assumed to have a flow and return of 90^0C/60^0C. This can be increased should the final consumer require a higher grade of heat, however it will need to be balanced against the Applicant's current business model; a higher grade of heat requires a tap from the medium pressure turbine as opposed to low pressure for heating and hot water. This will result in a loss of power revenues for the Facility and as such will need to be assessed in detail before a decision can be made.

5.1.6 The proposed DHN route can be seen in Figure 6-1 and contains all buildings highlighted in Table 5-2.

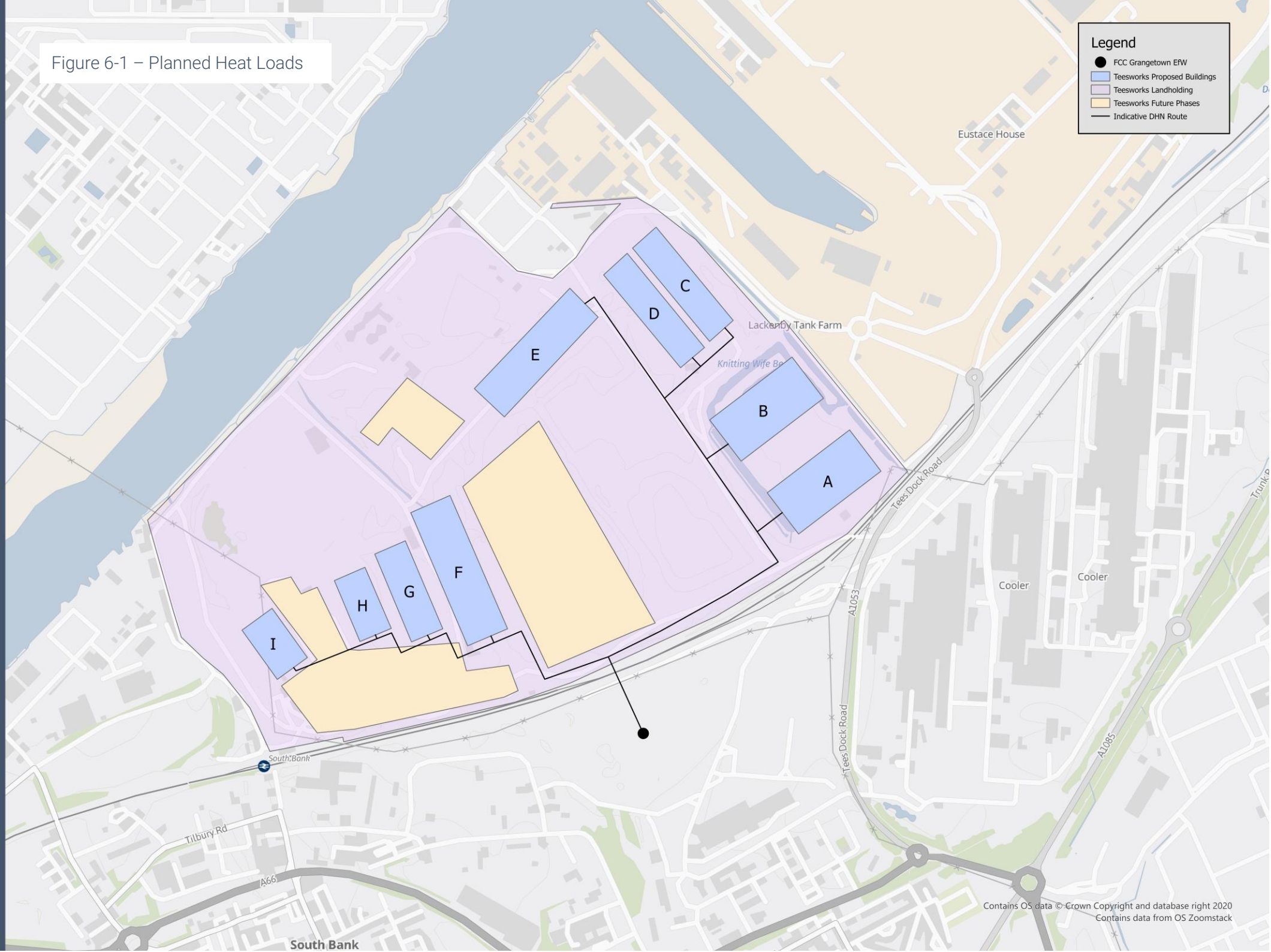
5.1.7 The Network consists of a spine requiring 3,745m of pipework, split in to two categories:

- 820m will be situated within existing pipe corridors, therefore requiring less up-front cost than traditional 'hard-dig-' methods in which ground has to be broken, trenched and backfilled to return it to its original state, and
- 2,925m of pipework will be hard dig, laid beneath public highways or existing roads/infrastructure, therefore incurring a large capital cost.

Costs of £1,000/m and £2,500/m have been assumed respectively for the pipe corridors and hard-dig methods, similar to those seen on large projects Ener-Vate are currently working on throughout the UK. Therefore, the pipe infrastructure alone is projected to cost in the region of £8 million.

Teesworks Proposed DHN Route

Figure 6-1 – Planned Heat Loads



06

Commercial Modelling

6 Commercial Modelling

6.1 Introduction

6.1.1 Ener-Vate have used our proprietary commercial model to assess the commercial viability of the DHN proposed.

6.1.2 The commercial model uses assumptions inputted by the user and uses a series of mechanisms to project all costs and revenues associated with the project over a 40-year concession period.

6.1.3 The model outputs relevant to this Investigation are given in the form of an Internal Rate of Revenue (IRR) and Net Present Value (NPV). IRR and NPV are two discounted cashflow methods used for evaluating investments or capital projects.

6.1.4 The Internal Rate of Return (IRR) estimates the profitability of potential investments using a percentage value rather than a GBP amount. The percentage value required to see a positive return on investment depends on the Weighted Average Cost of Capital (WACC) available to the Applicant.

6.1.5 For example, if the Applicant can secure funding at a WACC of 8% (a typical figure available to Private Entities), the IRR would need to be 8% for the project to break even. From this, it can be said that an attractive IRR to the market is around 10% to 11% for a secure investment.

6.1.6 Net Present Value (NPV) is described as the GBP amount difference between the present value of discounted cashflows less outflows over the 40-year period. Discounted cashflows refer to the WACC of 8% being applied.

6.2 Commercial Structure

6.2.1 The commercial model assumes that a Special Purpose Vehicle (SPV) in the form of an Energy Services Company (ESCo) will be created to deliver the project – as per Section 2.

6.2.2 ESCo's are very common in the world of District Heating, especially to the private market, allowing them to have a separately branded company that purchases heat from the Existing Station and retails it to consumers.

6.2.3 Typical benefits of an ESCo entity are as below:

- An annual saving between 5% an 10% over the counterfactual provision on a holistic basis. This is regularly benchmarked and tested to maintain the benefits.
- Prices can decrease as well as increase in line with pre-issued price review mechanics – customer protection.
- Guarantees and Service Level Agreements for the provision of heat and hot water.

- Full maintenance and replacement of Heat Interface Units within the properties.
- 24/7, 365 Customer Services.
- Digital Automated Heat Meters – no need to provide readings.
- Flexible billing options – Direct Debit, pre-payment etc.

6.2.4 Figure 7-1 shows a typical ESCo Commercial Structure, where in this instance the 'ESCo' can either be wholly owned by the Applicant or purchased by a 3rd Party.

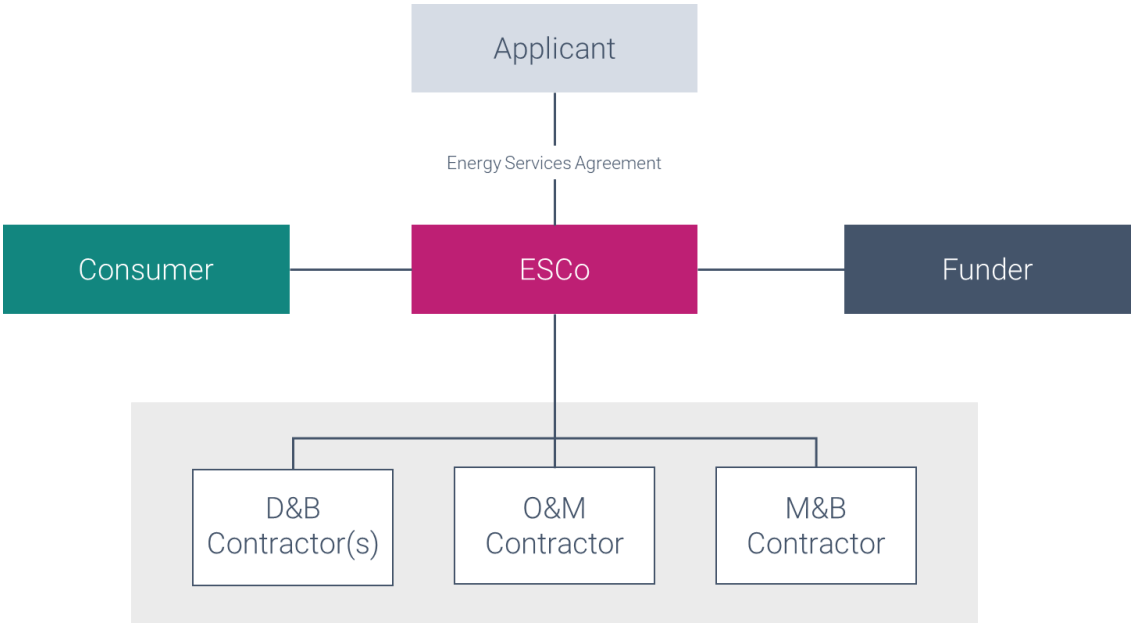


Figure 7-1 – Typical Commercial Structure

6.2.5 The ESCo will be responsible for funding all associated plant and infrastructure capital costs (including back-up resilience) related to the DHN proposed and will therefore own the asset.

6.2.6 This includes providing each building (including domestic properties) with a Heat Interface Unit (HIU) allowing heat to be transferred from the DHN to the building's internal heating system. The ESCo will therefore own the HIU within each building and be responsible for maintaining and replacing the unit should it default at any time.

6.2.7 The ESCo entity will be responsible for procuring the following:

- A Design and Build (D&B) contractor to design and build the low carbon energy scheme infrastructure and plant,
- An Operation and Maintenance (O&M) contractor to operate and maintain the low carbon energy scheme throughout a specified concession period, and

- A Metering and Billing (M&B) contractor to meter the energy provisions provided to the site and subsequently bill the consumers for the amount of energy consumed.

6.2.8 The ESCo will also be responsible for operating and maintaining the whole system and paying such costs to do so including, but not limited to:

- Commodities (for gas backup boiler resilient supply),
- HIU maintenance and replacement,
- Metering and Billing costs,
- Business Rates, and
- Staffing (to run the ESCo entity).

6.2.9 In return, the ESCo will receive income through the following three revenue streams:

1) **Connection Fees** – a 'one-time' fee paid to the ESCo by the owner and/or developer of the Heat Load.
2) **Standing Charge** – similar to a gas standing charge, this is an annual payment paid to the ESCo by the landlord/tenant of the building.
3) **Tariff Charge** – an amount of money paid by the landlord/tenant to the ESCo for every kWh_{th} consumed by the Heat Load.

6.3 Model Assumptions

6.3.1 Included in the commercial model assumptions are the projected heat demands previously quantified along with those outlined in Table 7-1 below:

Item	Value	Unit
Concession Period	40	Years
Weighted Average Cost of Capital (WACC)	8	%
Non-Domestic Variable Heat Tariff	3.5	p/kWh_{th}
Non-Domestic Fixed Heat Tariff	2.50	$£/m^2$
Thermal Purchase Agreement	0.75	p/kWh_{th}

Table 7-1 – Commercial Model Assumptions

6.3.2 The Thermal Purchase Agreement (TPA) relates to the cost of heat that the ESCo entity will be required to pay the Applicant per kWh_{th}. Therefore, in this instance, the ESCo will be required to pay 0.75p to the Applicant for every kWh_{th} delivered to consumers.

6.4 Model Outputs

6.4.1 Figure 7-2 shows the commercial model 'dashboard' containing outputs and total costs and revenues projected over the 40-year period.

6.4.2 For a capital cost of c. £13 million, the model outputs show an IRR 7.71% and NPV of -£416,412 for the period of 40 years beginning Q1 2023. These figures show a modest return assuming a WACC of 8% that may be attractive to the ESCo market following more detailed design.

6.4.3 All heat loads provided thus far are speculative only, and such the commercial model outputs show the 'base case' as it currently stands. This does, however, provide a solid understanding of the proposed system and can be a useful tool as the project develops to quickly determine the impact of any alterations.

6.4.4 The base case and indicative design now also give the Applicant and Ener-Vate a clear view of how the network can be optimised subject to the end consumers requirements as well as any future expansion considerations.

6.4.5 The Applicants next steps will be to continue to develop the indicative route, running sensitivities to assess the impact of connecting nearby loads, as well as keeping in contact with STDC to ensure they are up to date with the proposed build programme.

Figure 7-2 – Commercial Model Dashboard

Key project outputs

Project summary

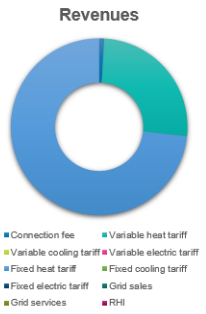
Total domestic	-	*# of Units*
Total non-domestic	376,236	*m2 NIA*
Domestic heat demand	-	*MWh at steady state*
Domestic cooling demand	-	*MWh at steady state*
Non-domestic heat demand	11,287	*MWh at steady state*
Non-domestic cooling demand	-	*MWh at steady state*
Non-domestic electric demand	-	*MWh at steady state*
Total heating demand	13,279	*MWh at steady state (inc. losses)*
Total cooling demand	-	*MWh at steady state (inc. losses)*
Project carbon emissions	13,209	*total tonnes CO2*
Counterfactual carbon emissions	124,666	*total tonnes CO2*
Carbon emission saving	111,456	*total tonnes CO2*

Financial summary

Pre tax IRR	9.04%	CAPEX (Real)	£13,169,500
Post tax IRR	7.71%	CAPEX (Nominal)	£13,869,549
NPV	-£416,412	HNIP Grant	£0
		HNIP Loan	£0

Revenues

Connection fee	£	878,407
Variable heat tariff	£	24,198,526
Variable cooling tariff	£	-
Variable electric tariff	£	-
Fixed heat tariff	£	68,753,119
Fixed cooling tariff	£	-
Fixed electric tariff	£	-
Grid sales	£	-
Grid services	£	-
RHI	£	-
Total	**£**	**93,830,052**



Costs

REPEX	£	4,480,534
OPEX	£	31,885,886
Commodities	£	11,969,540
Maintenance	£	6,170,905
Other	£	13,745,441
Total	**£**	**36,366,420**

Maintenance

Domestic HIU	£	-
Non-Domestic HIU	£	296,038
CHP	£	-
Gas Boiler	£	1,776,226
Abstraction and Injection	£	-
Solar PV	£	-
Heat Pump 1	£	-
Heat Pump 2	£	-
Energy Centre	£	1,395,213
Energy Centre land rent & ancilli	£	-
Network	£	2,703,428
Sub-total	**£**	**6,170,905**

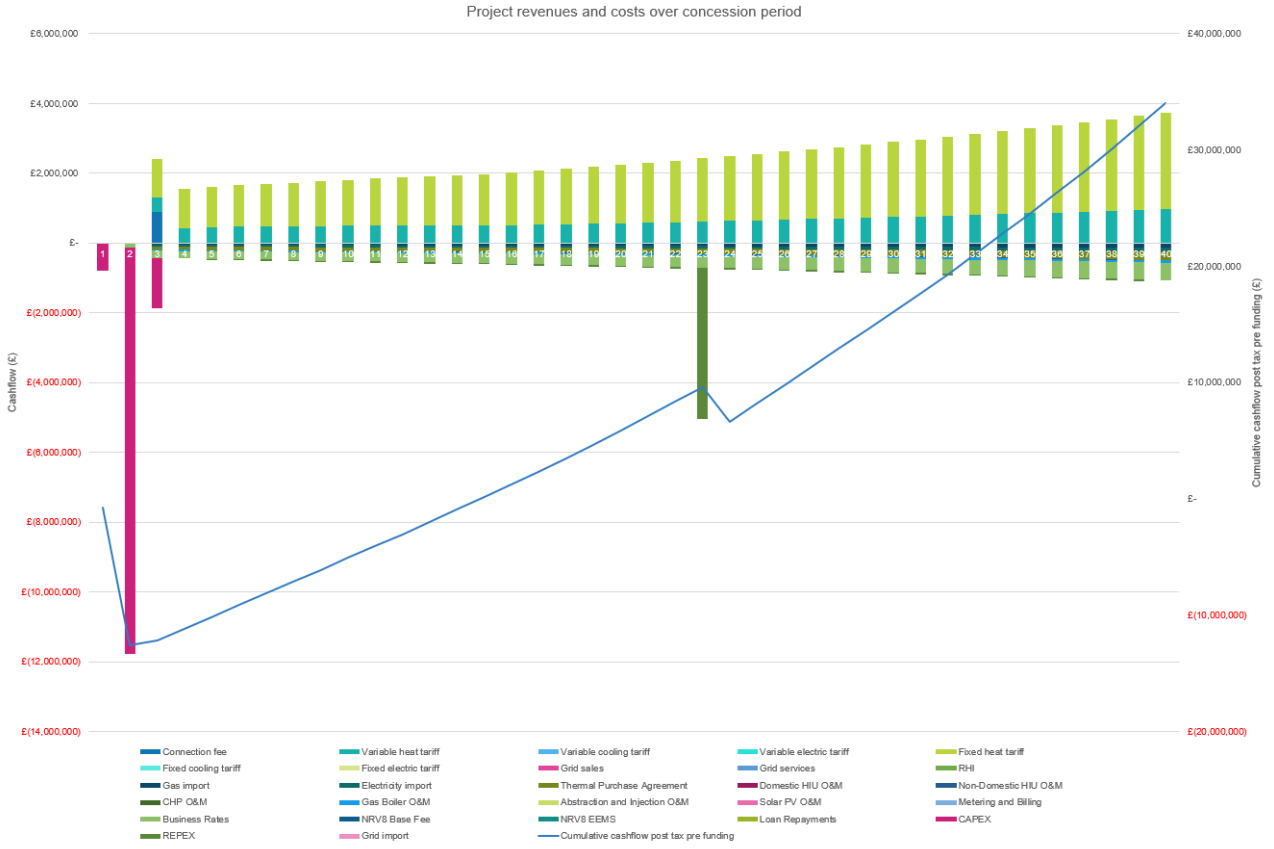
Commodities

Gas import	£	3,241,905
Electricity import	£	2,831,044
TPA	£	5,896,591
Sub-total	**£**	**11,969,540**

Other

Metering and Billing	£	-
Business Rates	£	12,815,924
NRV8 Base Fee	£	-
NRV8 EEMS	£	-
Loan Repayments	£	-
Domestic bad debt	£	-
Non-domestic bad debt	£	929,516
Sub-total	**£**	**13,745,441**

Project graph



Appendices

Appendix 1 – Existing Heat Loads

Ref.	Name	Estimated Heat Consumption (kWh/yr)
Care Homes		
1	Nunthorpe Hall	405,330
2	Ingleby Care Home	389,935
3	Roseville Care Centre	538,901
4	Stainton Lodge Care Centre	1,312,984
5	Fountains Court	392,474
6	Kirkley Lodge	678,519
7	Dalby Court Residential Care Home	822,154
8	Hemlington Hall	267,610
9	Nunthorpe Oaks Residential Care Home	227,794
10	Belmont View	386,869
11	Upsall House Residential Home Limited	784,384
12	Guisborough Manor Care Home	444,853
13	Tollesby Hall Nursing Home	521,981
14	Park House	1,026,466
15	The Willows - Care UK	1,040,251
16	Delamere Lodge	325,591
17	22 Levick Court	916,851
18	Windermere Grange Care Home	486,828
19	Loxley Chase Care Home	609,314

2	The Grove and The Courtyard	594,159
21	Astune Rise Nursing Home	265,041
22	Teesdale Lodge Nursing Home	301,367
23	Gables Care Home	503,217
24	Hill View Nursing Home	538,530
25	Cleveland View	305,893
26	Wellburn House	341,736
27	Longlands Care Home	205,550
28	Victoria House	2,485,306
29	Victoria House Nursing Home	658,828
30	Kirkdale Nursing Home	181,585
31	Briarwood Care Home	351,242
32	Elizabeth House	392,318
33	Nessfield Care Home	145,186
34	Beeches Care Home	937,538
35	Parkville Care Centre	1,060,556
36	Willow View Care Home	412,116
37	The Maple Care Home	293,994
38	Glenthorne Court	556,925
39	Roseworth Lodge Care Home	671,738
40	Stockton Lodge Care Home	158,770
41	Ann Charlton Lodge	224,516
42	Inglewood Care Home	387,492

43	Roseberry Court	1,271,842
44	Hadrian Park	563,424
45	Shoreline Nursing Home	784,123
46	Sand Banks Care Centre	1,061,787
47	Wynyard Woods	908,137
48	Stichell House	181,501
49	Warrior Park Care Home	802,821
50	Brierton Lodge Care Home	829,624
51	Gretton Court	400,886
Educational Institutions		
1	Stokesley School	1,151,679
2	Stokesley Primary Academy	208,316
3	Marwood Church of England Voluntary Controlled Infant School, Great Ayton	35,229
4	Roseberry Academy & Community Primary School	211,511
5	Levendale Primary School	134,264
6	Ingleby Mill Primary School	591,326
7	Ingleby Manor Free School & Sixth Form	812,913
8	Egglescliffe Church of England Primary School	196,402
9	Barley Fields Primary School	328,246
10	Rose Wood Academy	336,402
11	Myton Park Primary School	150,843
12	All Saints Academy	835,211
13	Durham Lane Primary School	28,350

14	Junction Farm Primary School	211,318
15	The Links Primary School	124,992
16	Hemlington Hall Academy	477,463
17	Whinstone Primary School	339,819
18	St Augustine's RC Primary School	273,297
19	The King's Academy	1,651,545
20	St Gerard's RC Primary School	148,832
21	Chandlers Ridge Academy	168,715
22	Viewley Hill Academy	352,301
23	Lingfield Primary School	152,797
24	St Francis of Assisi CofE School	287,842
25	Sunnyside Academy	487,934
26	Teesside High School	1,256,074
27	Highcliffe Primary School	466,969
28	St Bernadette's Primary School	129,389
29	Belmont Primary School	132,711
30	Westlands Academy	339,006
31	Galley Hill Primary School	223,755
32	Saint Paulinus Catholic Primary School, A Catholic Voluntary Academy	149,976
33	The Avenue Primary School	421,688
34	Captain Cook Primary School	379,285
35	Nunthorpe Academy	2,304,654
36	Nunthorpe Primary Academy	169,011

37	Christ The King Roman Catholic Primary School, A Voluntary Catholic Academy	194,849
38	Preston Primary School	154,422
39	Bader Primary School	643,345
40	St Clare's RC Primary School	170,967
41	Acklam Whin Primary School	326,355
42	Marton Manor Primary School	183,664
43	Lingdale Primary School	135,477
44	Holmwood School	251,637
45	Kader Academy	356,899
46	Askham Bryan College Guisborough Campus	1,539,953
47	St Thomas More RC Primary School	149,925
48	Easterside Academy	321,948
49	Thornaby-on-Tees Church of England Voluntary Controlled Primary School	173,852
50	Thornaby Academy	1,491,033
51	Outwood Academy Acklam	2,790,637
52	Chaloner Primary School	277,911
53	Lockwood Primary School	202,955
54	Laurence Jackson School	983,480
55	St Patrick's Catholic College, A Voluntary Catholic Academy	898,665
56	Trinity Catholic College	1,847,242
57	Acklam Grange School	2,161,120
58	Village Primary School	174,404
59	Newham Bridge Primary School	185,092

60	Hartwell School	428,331
61	Beverley School	790,757
62	Ormesby Primary School	541,936
63	Mandale Mill Primary School	203,623
64	Park End Primary School	356,326
65	Overfields Primary School	250,491
66	Saint Gabriel's Catholic Voluntary Primary Academy	242,423
67	St. Patrick's Roman Catholic Primary School, A Voluntary Catholic Academy	555,856
68	Green Lane Primary Academy	721,972
69	Harewood Primary School	389,888
70	Whinney Banks Primary School	1,112,483
71	The Northern School of Art	1,152,522
72	Pennyman Primary Academy	536,130
73	Normanby Primary School	235,211
74	St Pius X Catholic Primary School, a Catholic Voluntary Academy	239,551
75	Outwood Academy Ormesby	1,743,969
76	Beech Grove Primary School	571,627
77	Hartburn Primary School	192,080
78	Unity City Academy	1,285,209
79	Bankfields Primary School	406,610
80	St Edward's RC Primary School	201,527
81	St Cuthbert's RC Voluntary Aided Primary School	216,653
82	Bowesfield Primary School	291,744

83	Linthorpe Community Primary School	954,850
84	River Tees High Academy	385,819
85	Holy Trinity Rosehill CofE Voluntary Aided Primary School	308,541
86	Oxbridge Lane Primary School	307,676
87	Thorntree Primary School	421,975
88	Berwick Hills Primary School	483,143
89	Pallister Park Primary School	505,711
90	Teesville Academy	234,081
91	Stockton Riverside College	4,123,804
92	Ian Ramsey Church of England Academy	1,156,243
93	St Joseph's RC Primary School	340,172
94	Sacred Heart Primary School	219,082
95	The Grangefield Academy	444,916
96	Skelton Primary School	484,506
97	Corpus Christi RC Primary School	322,084
98	Mill Lane Primary School	196,844
99	Archibald Primary School	693,312
100	Macmillan Academy	2,584,191
101	Fairfield Primary School	437,020
102	Whale Hill Primary School	449,921
103	Brambles Primary Academy	525,044
104	Caldicotes Primary Academy	284,295
105	Gillbrook College	1,404,868

106	St Patrick's Roman Catholic Voluntary Aided Primary School	150,367
107	Ayresome Primary School	551,401
108	Badger Hill Academy	171,968
109	St Mark's Church of England Primary School	283,941
110	St Alphonsus' RC Primary School	212,863
111	Caedmon Primary School	378,448
112	Breckon Hill Primary School	658,490
113	Our Lady & St. Bede Catholic Academy	1,520,468
114	Abingdon Primary School	597,811
115	Wilton Primary Academy	75,750
116	North Ormesby Primary Academy	203,448
117	St Bede's Catholic Academy	143,046
118	Freebrough Academy	1,735,253
119	Tilery Primary School	321,561
120	South Bank Community Primary School/Beech Grove Primary School	845,269
121	Teesside University	13,574,611
122	The Oak Tree Academy	325,410
123	Kilton Thorpe Specialist Academy	202,898
124	St Peter's Church of England Primary School	307,588
125	St Mary's Catholic Voluntary Primary Academy	168,312
126	Whitehouse Primary School	281,188
127	Saint Peter's Catholic Voluntary Academy	792,503
128	Bishopsgarth School	883,350

129	North Shore Academy	1,701,668
123	Grangetown Primary School	420,458
131	Middlesbrough College	4,652,647
132	New Marske Primary School	184,345
133	St John the Baptist Church of England Voluntary Controlled Primary School	246,322
134	Abbey Hill Academy	733,669
135	Huntcliff School/Saltburn Learning Campus	2,147,957
136	St Gregory's Catholic Academy	260,344
137	Hardwick Green Primary Academy	396,825
138	Norton Primary Academy	233,218
139	Harrow Gate Academy	314,793
140	The Glebe Primary School	276,030
141	Frederick Nattrass Primary Academy	333,062
142	St Joseph's Catholic Academy	228,745
143	Rosebrook Primary School	275,407
144	Kirkleatham Hall School	676,896
145	High Clarence Primary School	111,449
146	Red House School	490,337
147	Errington Primary School	253,993
148	King Edwin School	275,238
149	Saint Bede's Catholic VA Primary School	214,897
150	Westgarth Primary School	123,543
151	Billingham South Community Primary School	547,287

152	Crooksbarn Primary School	167,550
153	Outwood Academy Bydales	1,074,238
154	Green Gates Primary School	337,679
155	St John the Evangelist Roman Catholic Voluntary Aided Primary School	168,598
156	Wheatlands Primary School	245,297
157	Riverdale Primary School	167,004
158	Pentland Primary School	556,026
159	Dormanstown Primary Academy	398,030
160	Redcar Community College	1,661,397
161	Rye Hills Academy	1,331,633
162	Lakes Primary School	300,290
163	Ings Farm Primary School	393,027
164	Newcomen Primary School	572,159
165	Roseberry Primary School	278,144
166	John Emmerson Batty Primary School	173,827
167	St Benedict's Primary Catholic Voluntary Academy	488,952
168	Our Lady of the Most Holy Rosary Catholic Academy	129,308
169	Sacred Heart Catholic Secondary	980,593
170	St Michael's Catholic Academy	578,306
171	Prior's Mill Church of England Controlled Primary School, Billingham	232,508
172	New Life CC	136,444
173	St Joseph's Roman Catholic Voluntary Aided Primary School, Billingham	129,903
174	Oakdene Primary School	279,322

175	Zetland Primary School	118,483
176	St Paul's Roman Catholic Primary School	158,400
177	Northfield School and Sports College	1,774,759
178	Coatham Church of England Primary School	176,682
179	Ash Trees Academy	183,329
180	Bishopton Centre	967,022
181	Bewley Primary School	298,992
182	Wolviston Primary School	114,450
183	Greatham CofE Primary School	125,756
184	Fens Primary School	414,354
185	Grange Primary School	342,806
186	Manor Community Academy	368,494
187	Golden Flatts Primary School	409,276
188	Holy Trinity Church of England Primary School	151,155
189	St Teresa's RC Primary School	127,881
190	Rossmere Primary School	710,782
191	Eskdale Academy	300,236
192	St Aidan's Church of England Memorial Primary School	194,627
193	Kingsley Primary School	398,355
194	Rift House Primary School	196,960
195	St Cuthbert's RC Primary School	189,788
196	Catcote Academy	381,961
197	Stranton Primary School	381,039

198	Eldon Grove Academy	307,098
199	Ward Jackson Church of England VA Primary School	123,859
200	St Joseph's RC Primary School	157,044
201	West Park Primary School	169,474
202	St Peter's Elwick Church of England Primary School	80,529
203	Hartlepool College of Further Education	4,427,700
204	Lynnfield Primary School	319,301
205	Sacred Heart RC Primary School	300,859
206	Brougham Primary School	405,824
207	Springwell School	172,015
208	Dyke House Sports and Technology College	2,025,621
209	Throston Primary School	242,105
210	St Helen's Primary School	259,960
211	St Bega's RC Primary School	103,812
212	West View Primary School	535,481
213	St John Vianney RC Primary School	181,825
218	St Hild's Church of England Voluntary Aided School	1,227,981
Hospitals		
1	Guisborough General Hospital	1,566,154
2	Tees Valley Hospital	628,132
3	The James Cook University Hospital	38,755,172
4	Roseberry Park Hospital	10,222,733
5	West Lane Hospital, Middlesbrough	1,884,149

6	East Cleveland Hospital	936,755
7	University Hospital Of North Tees	26,756,898
8	Nuffield Health, Tees Hospital	789,312
9	Billingham Grange Independent Hospital	612,125
10	University Hospital Of Hartlepool	17,986,243
Leisure Centres/Gyms		
1	Bannatyne Health Club Ingleby Barwick	356,123
2	Guisborough Swim & Fitness Centre	185,196
3	Thornaby Pool	338,061
4	Total Fitness Teesside	1,076,848
5	Neptune Leisure Centre	833,548
6	David LLoyd Teesside	1,793,738
7	Stockton Splash	570,302
8	Saltburn Leisure Centre	772,026
9	Mill House Leisure Centre	953,788
Prisons		
1	HMP Holme House	12,615,928
2	HMP Kirklevington Grange	3,613,047
Retail		
1	Co-op Springfield Stokesley	109,679
2	Tesco Stockton-on-tees Ingleby Barwick Superstore	433,348
3	Tesco Stockton-on-tees Yarm Egglescliffe Superstore	207,310
4	Sainsburys Egglescliffe Local	28,899

5	Aldi Coulby Newham Middlesbrough	119,357
6	Tesco Middlesbrough Coulby Newham Extra	593,415
7	Sainsburys Avenue Local	887,671
8	Lidl Guisborough	29,999
9	Sainsburys Guisborough	112,718
10	M&S Guisborough Foodhall	189,536
11	Iceland Guisborough	131,815
12	Aldi Guisborough	166,728
13	Aldi South Thornaby Thornaby On Tess	104,459
14	Morrisons Guisborough	92,181
15	Asda Thornaby Superstore	151,445
16	Fultons Thornaby	193,528
17	Iceland Thornaby	716,003
18	Lidl South Thornaby Thornaby On Tess	95,757
19	Makro Teesside	349,438
20	Lidl Yarm Road Stockton	196,157
21	Asda Middlesbrough Park End Supermarket	198,708
22	Iceland Ormesby Road	152,543
23	Farmfoods Ormesby Middlesbrough	585,086
24	Co-op Hartburn	172,758
25	Morrisons Linthorpe Middlesbrough	82,607
26	Aldi Grove Hill Middlesbrough	54,777
27	Morrisons Ormesby Middlesbrough	68,828

28	Aldi Stockton	58,027
29	Asda Stockton Bath Lane Supermarket	2,693,210
30	Farmfoods Stockton	549,504
31	Aldi Skelton	103,301
32	Lidl Ormesby Middlesbrough	533,164
33	Asda Skelton Supermarket	113,303
34	Asda Stockton Supercentre	1,682,069
35	Lidl Linthorpe Middlesbrough	72,777
36	Sainsburys Whitehouse Farm	48,499
37	Aldi Linthorpe Middlesbrough	143,148
38	Sainsburys Middlesbrough	112,823
39	Asda Middlesbrough Superstore	337,081
40	Aldi Norton Stockton	543,315
41	Sainsburys Saltburn by the Sea	110,441
42	Lidl Hardwick Stockton	2,135,811
43	Aldi Kirkleatham Village Redcar	312,429
44	Asda Redcar Supermarket	212,103
45	Tesco Billingham Superstore	1,885,290
46	Aldi Billingham	401,773
47	Asda Billingham Supermarket	2,256,500
48	Tesco Redcar Superstore	1,027,244
49	Morrisons Coatham Redcar	709,723
50	Lidl Brenda Road Hartlepool	112,707

51	Aldi Foggy Furze Hartlepool	135,544
52	Tesco Hartlepool Extra	162,688
53	Morrisons Marina Hartlepool	256,080
54	Asda Hartlepool Superstore	181,919
55	Aldi Throston Grange Hartlepool	406,892
56	Lidl Throston Grange Hartlepool	115,840
57	Sainsburys Middle Warren	197,247
58	Parkway Shopping Centre	353,049
59	B&M Home Store with Garden Centre Guisborough	459,601
60	Thornaby Retail Block	173,317
61	Pavilion Shopping Centre	108,058
62	Teesside Shopping	960,105
63	Castlegate Shopping Centre	561,157
64	Cleveland Retail Park	797,645
65	Cleveland Centre	113,464
66	Hill Street Shopping Centre	92,535
67	Dundas Shopping Mall	77,643

Appendix 2 – Planned Heat Loads

Ref.	Project Name / Address	Development Description	Related Planning Refs	Planning Status	Notes	Estimated Heat Consumption (kWh/yr)
1	Corporation Road	86 dwellings		Local Plan Status: Allocated Site		309,600
2	West of Kirkleatham Lane	550 dwellings (potentially more)	R/2016/0663/OOM	Local Plan Status: Allocated site Application Status: Reserved Matters for 375 homes approved 2019 on Phase 1	Phase 1A under construction. Site to the north to be subject to planning permission relatively soon.	1,980,000
3	Land at Mickles Dales	100 dwellings		Local Plan Status: Allocated site	Although allocated, there is currently no access to the site from the north and unlikley to be developed soon.	360,000
3	Land at Mickles Dales	100 dwellings		Local Plan Status: Allocated site	Although allocated, there is currently no access to the site from the north and unlikley to be developed soon.	360,000
4	Low Grange Strategic Farm	1,250 dwellings	R/2014/0372/FFM	Outline consent for up to 1,250 dwellings and with a lifespan of 10 years was granted in 2016 to Taylor Wimpey subject to conditions.		4,500,000

5	Swans Corner, Nunthorpe	128 dwellings		Local Plan Status: Allocated site	Under construction	460,800
6	Longbank Farm, Ormesby	320 dwellings	R/2014/0304/OOM	Local Plan Status: Allocated site Application Status: Outline planning permission granted on appeal to Avant Homes for 320 dwellings in March 2016.	The planning approval expired in March 2019.	460,800
7	Spencerbeck Farm, Ormesby	82 dwellings	R/2016/0410/OOM	Local Plan Status: Allocated site Application: Outline for residential development (all matters reserved) - Approved		1,152,000
8	Normanby High Farm	150 dwellings		Local Plan Status: Allocated site		540,000
9	Land at Former Eston Park School	100 dwellings		Local Plan Status: Allocated site		360,000
10	Land at Cleveland Gate, Guisborough	137 dwellings	R/2016/0614/FFM R/2017/0893/FFM	Local Plan Status: Allocated site Application Status: R/2016/0614/FFM - Erection of 114 dwellings - Approved		180,000

				and under construction R/2017/0893/FFM (Site immediately to the north) - 47 dwellings - Undetermined		
11	Land at Galley Hill, Guisborough	50 dwellings	R/2018/0621/OOM	Local Plan Status: Allocated site Application Status: Outline application for 60 dwellings - Undetermined		180,000
12	Wilton International		R/2017/0876/FFM R/2018/0496/FF R/2019/0031/FFM	Local Plan Status: Allocated Employment Site - 184 hectares Applications: R/2017/0876/FFM - Construction of a mineral process and refining facility - Approved R/2018/0496/FF - Construction of animal and food pellet plant - Approved R/2019/0031/FFM - Construction of a plastic conversion factory - Approved		
13	Plot 11 Wilton International			Local Plan Status: Allocated employment site Application Status: Current undetermined outline application for roadside sevices		

				including 60 bed hotel, service station, 4,000sqft convenience store, drive thru and 5,000sqft A3 food unit and 10 EV charging points		
14	Nunthorpe Grange, Middlesbrough	350 dwellings		Local Plan Status: Allocated site in adopted plan. Draft allocation in emerging plan.		1,260,000
15	Ford Riding Centre	69 dwellings	20/0199/FUL	Local Plan Status: Allocated site. Allocated in emerging plan. Application: Erection of 69 dwellings - undetermined		248,400
16	Grey Towers Farm	102 dwellings	19/0458/FUL	Local Plan Status: Allocated site Application: Erection of 102 dwellings - Approved		367,200
17	Newham Hall Farm	1,100 dwellings		Local Plan Status: Allocated. Proposed allocation in emerging plan.		3,960,000
18	Stainton Vale Farm	500 dwellings		Local Plan Status: Proposed Allocation in emerging plan		1,800,000

19	Stainsby Farm	1,300	17/0045/FUL	Local Plan Status: Allocated. Proposed allocation in emerging plan. Application: Erection of 229 dwellings - Approved	Southern strip of land adjacent to A174 is currently under construction	4,680,000
20	St Davids	115 dwellings	20/0004/FUL	Local Plan Status: Allocated. Propopsed allocation in emerging plan. Application: Erection of 139 dwellings - undetermined		414,000
21	Brackenhoe East	350 dwellings	18/0616/OUT	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Outline for 350 homes - Approved	Under construction	1,260,000
22	Land north of Marton Avenue	72 dwellings	18/0477/OUT	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Outline for 72 dwellings - Approved		259,200
23	Grove Hill	292 dwellings	17/0895/FUL 20/0546/FUL	Local Plan Status: Allocated. Proposed allocation in emerging plan Applications: Site is split in two and separated by a road. The northern section (17/0895/FUL) has approval for 92		1,051,200

				dwellings. Construction may have started on this part. There is on the larger southern section (20/0546/FUL) for 296 dwellings which is undetermined.		
24	Acklam Iron and Steelworks Club	55 dwellings	20/0159/OUT	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Outline for 55 dwellings - Approved		198,000
25	Boro Park	86 dwellings	18/0247/FUL	Local Plan Status: Proposed allocation in emerging plan Application: Erection of 86 dwellings - Approved	May be under construction	309,600
26	Former Erimus Training Centre	106 dwellings	17/0347/FUL	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Erection of 106 dwellings - Approved		381,600
27	Gresham	145 dwellings	20/0289/FUL	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Erection of 145 dwellings - Approved		522,000

28	Roworth Road	89 dwellings	18/0634/FUL	Local Plan Status: Allocated. Proposed allocation in emerging plan Application: Erection of 89 dwellings - Approved		320,400
29	Hemlington Grange	1,230 dwellings and 8 hectares of employment land	19/0530/RES 19/0597/RES	Local Plan Status: Allocated for housing and employment land. The proposed allocation in the emerging plan proopses to increase the number of dwellings to 1,330. Application: Site is subject to a number of planning applications including an two reserved matters totalling 438 dwellings	First phase of housing is under construction	5,628,000
30	Land at South Tees Development Corporation	418,000 sqm B1, B2 and B8 floorspace	R/2020/0357/OOM	Undetermined	Undetermined	11,287,080
31	Land at South Tees Development Corporation	Future Phase				
32	Land at South Tees Development Corporation	Future Phase				
33	Land at South Tees Development Corporation	Future Phase				

Appendix 3 – Industrial Entities Contacted

Entity Name	Entity Type	Notes
Conoco Phillips	Crude Oil Storage	Crude oil reception, processing, storage and trans-shipment installation. The terminal also fractionates natural gas liquids into ethane, propane and butane. Operations comprise both processing and tanker-loading facilities covering a 285-acre site at Seal Sands. Conoco Phillips reference "Methane is used for the plant."
Venator	Tioxide	Venator (formerly Huntsman Dry Dioxide site) is the pigments division of Huntsman that has split from its parent company to become an independent specialist in titanium dioxide (Tioxide) and performance additives. Venator invested c. £15 million in Q3 2019 on 4no. new boilers to be installed at the Greatham site. Quoted “the new boiler will give the Greatham plant better manufacturing resilience.
Inter Terminals	Chemical Storage	Fifth largest bulk liquid storage provider in Europe and the largest in the UK and Scandinavia. The Seal Sands site has 246,000 m3 of tank storage for bulk liquids and gas.
Greenergy	Biodiesel	Supplier and distributor of transport fuels - managing the movement of fuel from refinery gates to anywhere in the world at their customers' sites. The Seal Sands site purchases waste oils from around the world and converts them to clean, renewable biodiesel.

Fine Organics	Fine Chemicals	Lianhetech Seal Sands is a manufacturer of high-quality fine chemicals for use in crop protection, pharmaceuticals and the performance chemicals market. Previously known as Fine Organics Ltd., the site was acquired by Lianhe Chemical Technology (Lianhetech) in June 2017.
PX	Teesside Gas Processing Plant	px Group operates and manages this Upper Tier COMAH installation, and over 30km of associated pipework. Feedstock arrives from North Sea fields via the 250 mile CATS pipeline. Main function is gas import and processing.
SABIC	Underground Chemical & Hydrogen Storage	1/3 SABIC Sites (North Tees). The site consists of numerous storage tanks, underground salt cavities, a liquefaction plant and jetties.
APS Growers Ltd	Greenhouses	APS Growers Ltd's Tees Valley site contains 9 hectares of glasshouse nurseries. They have led the UK tomato industry with regards to CHP and CO_2 extraction since 1998. The Tees Valley site has a 6.6MW_e Jenbacher CHP plant and it seems they are also taking heat/CO2 from CF Fertilisers.
Fujifilm Diosynth Biotechnologies (FDB)	Bio Pharmaceuticals	FDB develop and produce biologics, gene therapies and vaccines. They are in the process (near completion) of a new BioCampus including "a 42,000 square foot purpose built office accommodation and visitor centre in addition to making ready the land for potential expansion that could include additional research and development laboratories and new manufacturing facilities." Heavy ties to the Tees Valley Mayor and Combined Authority.

SNF	Speciality Chemicals	SNF UK is a subsidiary of the French SPCM Group – world leader in polyacrylamide and associated acrylic chemistries used in water intensive industries such as Water and Wastewater treatment, Oil & Gas production, Pulp & Paper production, Mining and Personal Care. The 1st production line, for cationic inverse emulsion, is now operational and is producing material to primarily support the water and wastewater treatment industry. Construction of the 2nd and 3rd lines (Anionic Inverse Emulsion) as well as Bio-Acrylamide is underway and is targeted at serving the anticipated demand for EOR applications in the North Sea. The site will be developed further in line with future market and customer demand.
Johnson Matthey	Catalyst	
CF Fertilisers	Ammonia	The site consists of two main areas the Ammonia Plant and Portrack which supplements Ammonium Nitrate (Nitram) production from Ince. The Billingham site has its own laboratory where products are tested at many stages of manufacture to ensure they meet specifications before being released for sale.
Chemoxy	Fine Chemicals	Chemoxy have two sites in Teesside - Middlesbrough and Billingham. Both undertake toll manufacturing services and chemical product manufacturing. Billingham site still has 5 acres available for expansion.
Lucite	Acrylics	Part of the Mitsubishi Chemical Lucite Group. The site has a large number of integrated chemical plants for the production of methacrylates.

TWI	The Welding Institute	Technology and training centre for welding. Unknown processes. Building looks relatively new so may not require energy provisions.
ICGL	Bitumen	
SABIC	Ethylene Cracker, Hydrogen Storage & Chemical Processing	SABIC UK Petrochemicals Limited has its headquarters based within the Wilton Centre, but has manufacturing and storage facilities located over three nearby sites, at Wilton International, Teesport and North Tees.Many of thei logistical facilities are located at our North Tees site, which includes numerous storage tanks, underground salt cavities, a liquefaction plant and jetties. They also have jetties at our Teesport site.
BOC Linde	Gas Pipeline Grids	BOC Linde operates one of the world's largest industrial gas pipeline grids supplying hydrogen, oxygen, nitrogen and argon in Tees Valley. Also has a steam methane reformer.
Ineos	Nitriles	The INEOS Nitriles plant in Seal Sands Teesside is one of the largest manufacturers of Acrylonitrile and purified Acetonitrile in Europe.
Navigator Terminals	Chemical Storage	Navigator Terminals are the UK's leading independent bulk liquid storage provider. They have two sites, one in North Tees and one at Seal Sands.
Sirius	Mineral Processing	

Huntsman	Polyurethanes	Huntsman Polyurethanes has an aniline plant and a nitrobenzene plant at Wilton - both of which are the largest of their type in the world. The key feedstocks for the plants are nitric acid, benzene and hydrogen
Biffa	Polymer Recycling	Biffa constructed the world's first commercially available rHDPE food grade production plant in 2008. The facility has been designed to process 50k tonnes of material through its three business processes. This ground-breaking plant creates rHDPE from recycled milk bottles. The UK dairy sector targets inclusion of 50% recycled materials in milk bottles in 2020 - currently this is between 15% and 20%.
Materials Processing Institute	Materials Processing	
Lotte Chemicals	PET/Plastics	
Crop Energies	Biofuels	
Calysta	Protein Manufacturer	Naturally produced fish and animal feed. They occupy more than 29,000 sq ft, at the Wilton site.
CPI	Manufacturing Catapult	CPI use applied knowledge in science and engineering combined with state of the art facilities to enable their clients to develop, prove, prototype and scale up the next generation of products and processes.