Ener-Vate Consultancy Limited

Lostock Sustainable Energy Plant (LSEP)

Heat Demand Investigation

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Contents

Document Approval

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List of Abbreviations and Units

BEIS	[Department for] Business, Energy and Industrial Strategy
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
DECC	Department of Energy and Climate Change
DH	District Heat
DHC	District Heating and Cooling
EC	Energy Centre
EfW	Energy from Waste
EHL	Existing Heat Load
ESCo	Energy Services Company
GBP	Great British Pounds
GIFA	Gross Internal Floor Area
GIS	Geographic Information System
HIU	Heat Interface Unit
HNDU	Heat Networks Delivery Unit
HNIP	Heat Networks Investment Project
IRR	Internal Rate of Return
KCC	Kent County Council
kWh_{th}	kilowatt hours thermal
LA	Local Authority
LEP	Local Enterprise Partnership
M&E	Mechanical and Electrical
$MTCO_2$	Mega Tonnes Carbon Dioxide

MW_e	Megawatt electric
NIFA	Net Internal Floor Area
NPS	National Planning Statements
NPV	Net Present Value
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Impact Report
PHL	Planned Heat Load
SELEP	South East Local Enterprise Partnership
SPV	Special Purpose Vehicle
TPA	Thermal Purchase Agreement
WACC	Weighted Average Cost of Capital
WSHP	Water Source Heat Pump

01

Executive Summary

1 Executive Summary

1.1.1 FCC Environment UK Ltd (FCC) and Copenhagen Infrastructure Partners (CIP), referred to as the 'Facility Operators', have developed a Joint Venture (JV) partnership to deliver the Lostock Sustainable Energy Plant (LSEP) – a c. £480 million Energy from Waste (EfW) facility located at the Lostock Works site near Northwich, Cheshire.

1.1.2 The Facility Operators are cognisant of the benefits that low-carbon heat can provide to the local community and, in line with the Environment Agency's CHP Ready Guidance for Combustion and Energy from Waste Power Plants, have employed Ener-Vate Consultancy Ltd to perform a Heat Demand Investigation looking at potential heat off-takers within 10km (the Study Area) of the proposed LSEP.

1.1.3 It is proposed at this stage that the heat will be generated at the LSEP, purchased by a 3rd party Energy Services Company, and retailed to consumers through the implementation of a District Heat Network (DHN).

1.1.4 The Investigation highlights four separate are clusters within the Study Area with a high heat demand density, namely:

- Northwich (Central) Town Centre,
- Winsford,
- Middlewich, and
- Knutsford.

1.1.5 Within the four clusters, the Investigation identifies Anchor Loads, i.e. large heat loads, ideally with one (or few) point(s) of connection that are critical to the financial viability of such a scheme.

1.1.6 Furthermore, the Investigation also looks at any physical constraints such as rivers, motorways and railway lines that may prevent or prohibit the implementation of a District Heat Network.

1.1.7 The Anchor Loads have then been passed through a screening process that ultimately determines the likelihood of them connecting to the proposed DHN based on a number of factors such as their proximity to the LSEP, their current energy provisions, their appetite to join and many others.

1.1.8 The screening process results in a high-level desktop design of two DHN routes from the LSEP, one running West (Network 1) and one South (Network 2). The two routes have been financially appraised, again at a high-level, using Ener-Vate's proprietary commercial model to give outputs in the form of an Internal Rate of Return (IRR) and Net Present Value (NPV) for an ESCo entity.

1.1.9 Neither of the network routes at this stage can been deemed as financially viable assuming a target IRR of 8% desired by the private sector for such projects, with IRR's of 3.96% and 7.29% for Network's 1 and 2 respectively, assuming a 100% connectivity rate.

1.1.10 There exists several methods that may reconcile the commercial modelling outputs to an investible level, however most of these methods require more detailed engagement with the potential off-takers that is not required for this Investigation.

1.1.11 The Facility Operators, along with Ener-Vate Consultancy Ltd will continue to consult with stakeholders in the Study Area to further develop plans for a potential District Heat Network using Energy from Waste and update this document correspondingly.

02

Introduction

2 Introduction

2.1 Project Introduction

2.1.1 FCC Environment UK Ltd (FCC) and Copenhagen Infrastructure Partners (CIP), referred to as the 'Facility Operators', have developed a Joint Venture (JV) partnership to deliver the Lostock Sustainable Energy Plant (LSEP) – a c. £480 million Energy from Waste (EfW) facility located at the Lostock Works site near Northwich, Cheshire.

2.1.2 FCC recognize the economic efficiencies and environmental benefits that can arise from direct heating and power using EfW, and such 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.

2.1.3 Heat would be distributed via a District Heating Network (DHN) and accordingly, the Facility Operators worked to identify options for heat off-takes. This Heat Demand Investigation (the Investigation) looks to identify heat opportunities within 10km of the site (the Study Area), the physical constraints of implementing a DHN to such heat opportunities, and the likelihood of these heat opportunities becoming a realistic prospect at a time when connections can be made.

2.1.4 The Association for Decentralised Energy's 2018 Market Report[1] estimates that DHNs can deliver up to 5.7 Mega Tonnes of CO_2 ($MTCO_2$) emissions reduction in residential and non-residential buildings by 2030, which represents around a six-fold increase on today's DHN carbon emissions savings level.

2.1.5 With 5 out of 10 households stating they would join a DHN if they would pay no more than what they currently pay, domestic consumers have a fairly positive attitude to DHNs. It is hoped that the increase in DHN implementation throughout the UK will give domestic consumers confidence that low-carbon heat can be as reliable and cost-effective as traditional methods.

2.2 Ener-Vate Consultancy Ltd

2.2.1 Ener-Vate Consultancy Ltd was created five 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.

2.2.2 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.

2.2.3 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.

2.2.4 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.

2.2.5 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.

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

www.ener-vate.co.uk

2.2.7 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 three Councils in Scotland, namely Edinburgh, North Lanarkshire and Midlothian Councils.

2.2.8 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).

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

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

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

2.3 Purpose of the Investigation

2.3.1 The intentions of this report are to:

- Identify and quantify the heat demand available from existing and new buildings/developments within a 10km radius of the Facility,
- Highlight any physical constraints that may prohibit or interfere with the implementation of a DHN,
- Determine which identified heat loads (or group of heat loads), if any, show good potential for the implementation of a DHN,
- Assess the commercial viability of the proposed DHN route(s) using Ener-Vate Consultancy Ltd.'s proprietary commercial model.

03

District Heat Networks

3 District Heat Networks

3.1 Background

3.1.1 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.

3.1.2 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 Heat Network Infrastructure Programme (HNIP).

3.1.3 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.

3.1.4 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.

3.1.5 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.

3.1.6 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.

3.2 Infrastructure

3.2.1 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.

3.2.2 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.

3.2.3 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.

3.2.4 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.

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

3.2.6 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:

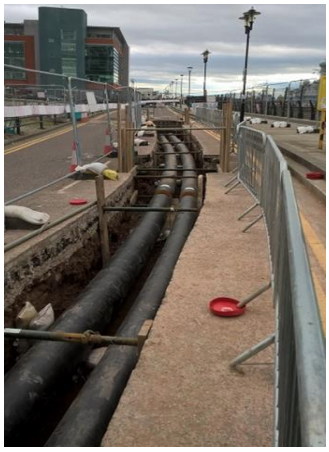
- Primary shell and tube heat exchanger(s),
- Condensate return pumps,
- District heating circulation pumps,
- Pressurisation system,
- Heat meters,
- Back up boilers (if required); and
- All other associated equipment.

3.2.7 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.

3.2.8 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.

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



3.3 Energy Services Companies (ESCo's)

3.3.1 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).

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 Ener-Vate's commercial model assessment (see Section 10) 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.

04

Heat Load Identification

4 Heat Load Identification

4.1 Introduction

4.1.1 For the purpose of the Investigation, heat loads are defined as the quantity of heat a building or development within the Study Area is projected to consume in the form of a kWh_{th}/annum value.

4.1.2 Heat loads have been identified using GIS software, Google Maps and a field visit of the Study Area undertaken on 21st April 2021.

4.1.3 First and foremost, the Investigation looks to identify large heat loads referred to as Anchor Loads.

4.1.4 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 facilitates smaller buildings/developments en-route to also join. Without a large Anchor Load(s) at some point on the network, these smaller buildings/developments could not possibly join as the network would not be economically viable for an entity to invest in, and therefore would likely not exist.

4.1.5 A good example of this is retrofitting domestic properties to allow them to take heat from a DHN. This often requires the internal heating system to be modified, adding cost and complexity to the project that homeowners/landlords may be hesitant to commit to.

4.1.6 Therefore, the Investigation looks to secure an Anchor Load(s) first, ensure the project is economically viable within its own right, and then look at heat loads situated close to the network that may also be able to connect.

4.2 Methodology

4.2.1 All heat loads identified and included in the Investigation have been quantified using the following method.

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

4.2.3 GIS software was used to trace building outlines to determine the m^2 Gross Internal Floor Area (GIFA) of each identified building. Following this, LIDAR data was used to establish the mean height of the building, of which facilitated the calculation of the number of building storeys.

4.2.4 The following equations were used to quantify each heat load:

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

where:

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

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

Then:

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

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 Business, Energy and Industrial Strategy (BEIS), as well as data taken from past projects.

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

4.3 Findings

4.3.1 The Investigation identifies a total of 602no. buildings with a projected minimum heat consumption of 50,000 kWh_{th}/annum per building.

4.3.2 The total amount of heat available for all 602no. buildings is projected to be **c. 268 GWh_{th} per annum**. Individual heat loads can be found in the Appendix.

4.3.3 The heat loads are distributed such that they can be split in to 4no. clusters of areas with a high heat density. These areas of high heat density are expected as they are present in the four largest towns surrounding the LSEP, namely:

- Northwich (Central Cluster),
- Middlewich,
- Winsford, and
- Knutsford.

4.3.4 Figures 4-1 and 4-2, along with Table 4-1 show the heat demand density of the 4no. clusters along with a summary of the heat consumption per cluster.

[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).

Cluster No.	Cluster Name	No. of Buildings	Projected Heat Consumption (kWh/annum)
1	Central Cluster	216	94,888,290
2	Winsford Cluster	263	127,474,016
3	Middlewich Cluster	89	35,033,265
4	Knutsford Cluster	34	10,798,001
			272,193,572

Table 4-1 – Heat Consumption per Cluster

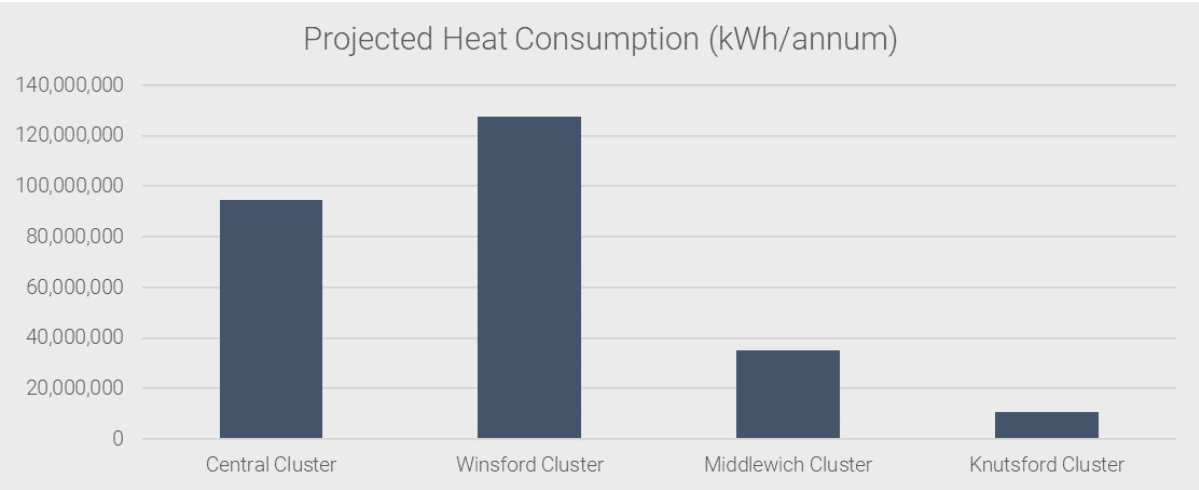


Figure 4-1 – Heat Consumption per Cluster

4.4 Planned Heat Loads

4.4.1 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.

4.4.2 Most notably, it allows developers to reduce building fabric costs in order to reach Part L requirements[2] and can be implemented at the design stage of each development or building as well as having a host of other benefits.

4.4.3 Therefore, as part of the Investigation, a planning application search has been conducted for applications submitted within the last 12 months that are awaiting a decision.

4.4.4 Applications to discharge pre-commencement conditions were disregarded due to the likelihood of their programme being too far advanced to consider a connection. Small residential proposals (sub 20 dwellings) were also disregarded. The search focused on residential, offices, commercial and industrial users. Those that endured the criteria set out above and show good promise are included in Table 4-2.

[2] Part L requirements relate to the energy performance of buildings with regards to limiting heat losses and ensuring that energy-efficient fixed building services are installed. Low carbon heat sources such as energy from waste

Ref. No.	Application Ref.	Description
1	21/00055	Residential development for 359 homes + 36 apartments with associated access, car parking and landscaping.
2	20/03447/OUT	Construction of 14No industrial/office units and associated roads and parking
3	20/03068/FUL	Erection of 102 dwellings including associated works, access and landscaping
4	21/01438	Erection of a 3-storey residential development comprising of 34 apartments with associated car parking, landscaping and external works.
5	21/01244/FUL	Erection of 24no apartments, comprising 20no 1 bedroom and 4no 2 bedroom with car parking and associated external works

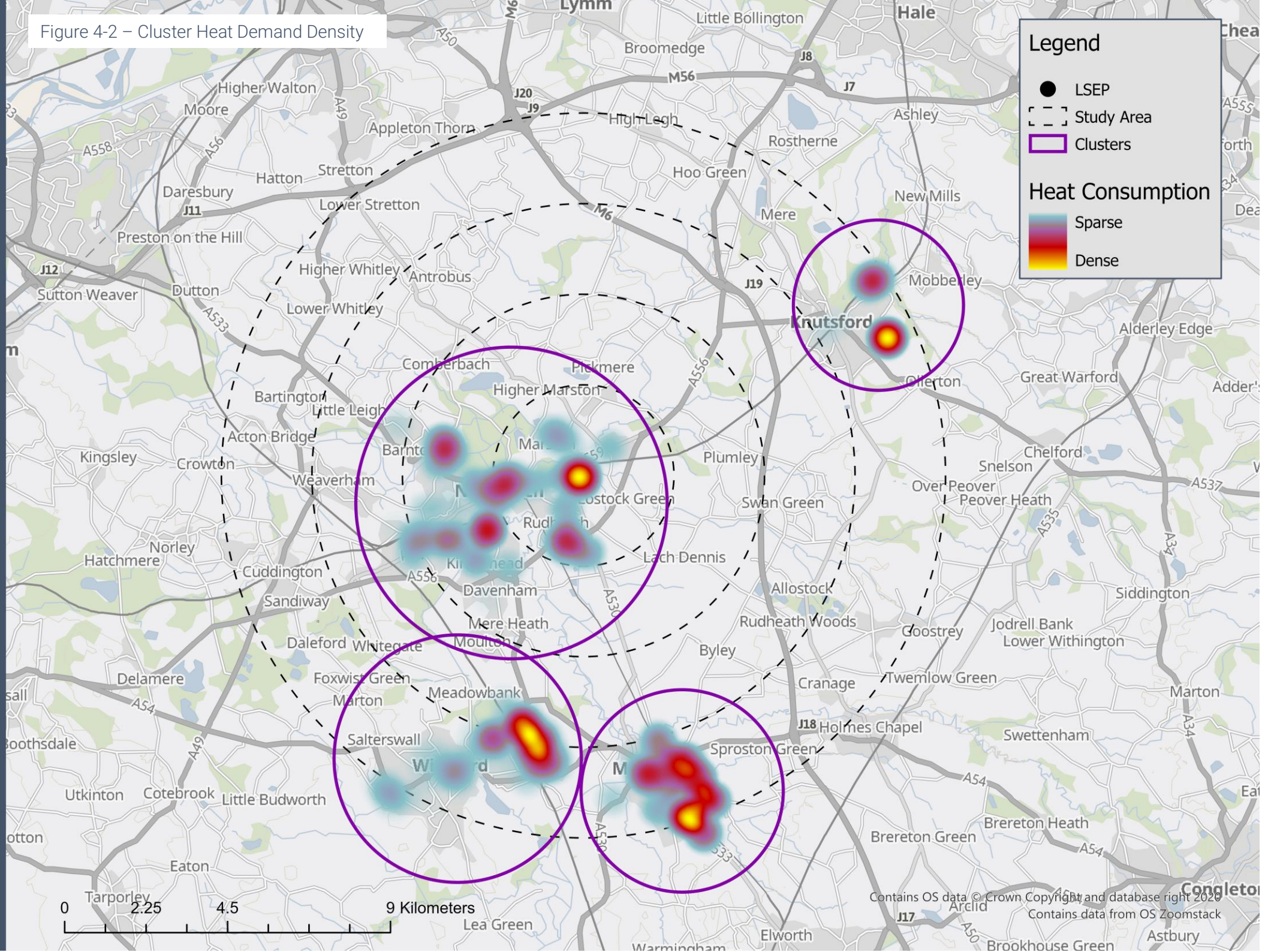
Table 4-2 – Planned Heat Load Data

4.4.5 Figure 4-3 accompanies Table 4-2 showing the distribution of the planned heat loads with respect to one another and their proximity to the LSEP.

4.4.6 The planned heat loads above will be included in Section 6 of the Investigation in which heat loads are omitted from the study on the basis of technical and/or commercial viability.

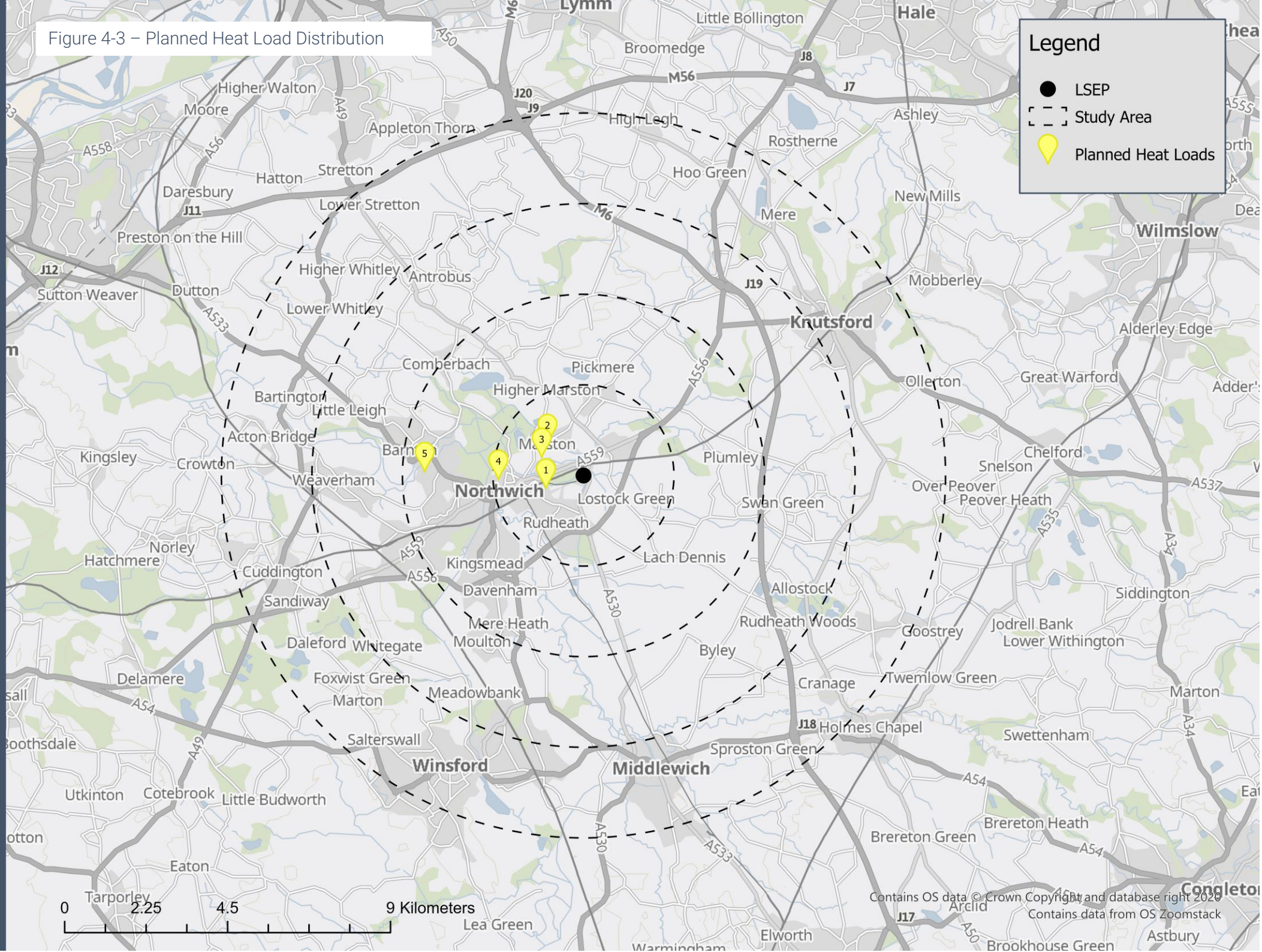
Heat Consumption

Figure 4-2 – Cluster Heat Demand Density



Planned Heat Loads

Figure 4-3 – Planned Heat Load Distribution



05

Constraints Assessment

5 Constraints Assessment

5.1 Introduction

5.1.1 Physical constraints that can prohibit or interfere with the implementation of DHNs must be identified and exposed to ensure a pragmatic approach is followed throughout the Investigation.

5.1.2 Both the technology and engineering sectors have grown rapidly since the establishment of DHNs in the UK, allowing physical constraints to be overcome and more efficient systems to be used as each year passes.

5.1.3 The issue, however, is not one of technical viability, but more so the financial implications and vast timelines incurred when overcoming obstacles and constraints.

5.1.4 The Facility Operators are well aware of the technical capabilities and engineering solutions available to projects of this scale and are also cognizant of the prudential funding available to LA's to implement such projects should they wish to get involved. However, increased costs in installing DHN infrastructure is a careful balance on the commercial viability of such investments, which must be balanced in providing the end consumer with a competitive price for heat when compared to a similar counterfactual supply.

5.1.5 Physical constraints are defined, for this Investigation, as a barrier that would add significant time and capital cost to the project that will consequently jeopardise its commercial viability.

5.1.6 The Study Area is congested with railway lines, bodies of water and motorways, proving it difficult to navigate from the Existing Station to identified heat loads.

5.1.7 Further to this, whilst densely populated areas such as town centres present a good opportunity for a DHN, they do come with a number of potential challenge's such as:

- Costs incurred to deal with traffic management. Major traffic routes are more likely to incur limits on lengths of open trench at any one time, increasing the traffic management requirements and reducing productivity of installation,
- Disruption to local residents that would usually use the highly congested roads,
- Very often, major traffic routes contain multi-utility services, often limiting the location of major DHN infrastructure. This often leads to greater buried depths for DHNs increasing installation time and cost for reinstatement,
- Costs incurred for prelims – specifically surrounding productivity restrictions and back-filling and re-tarmacking road surfaces, and
- Increased Health and Safety precautions and alignment with other planned works.

5.1.8 Heat Loads identified in this Investigation may be omitted from the Study Area due to being unviable because of the physical constraints identified. In reality, whilst these Heat Loads will not be included in *this* Investigation, the data remains available to the Facility Operators and will be updated/reviewed periodically to assess whether those heat loads have become viable in the future as a result of changes.

5.1.9 For example, Network Rail typically do not grant easements/access above or through bridges without significant scrutiny. This is, of course, attributable to their duty of keeping all infrastructure under their control safe for the general public.

5.1.10 Therefore, for this Investigation, physical constraints that cannot be overcome without significant time and resources are viewed as a physical barrier to the development of a DHN and thus the Facility Operator has assessed whether a case for a DHN exists without having to overcome any physical constraints.

5.2 Methodology

5.2.1 Ener-Vate have conducted a desktop and field study to identify any physical constraints and assess the topography of the Study Area. Both studies looked at the following:

- Assessment of how the physical constraints that could potentially prohibit/limit DHN route's – such as major highways, railway lines, bodies of water, steep inclines, and trees (with Tree Protection Orders) – could be overcome,
- Potential roads and/or footpaths that the DHN route could follow whilst causing as little disruption to local traffic as possible, and
- Any further observations that may adversely affect the implementation of a DHN between the Proposed Extension and the identified Heat Loads.

5.2.2 During the field study, photographs were taken of each of the constraint crossings. These photographs are available in the appendix and are correlated with the reference numbers in Table 5-1 and Figure 5-1.

5.3 Findings

5.3.1 Figure 5-1 shows a GIS map of the constraints assessed during the field study. This is matched with Table 5-1 in which notes have been provided describing the constraint crossing and how it can be overcome, if at all.

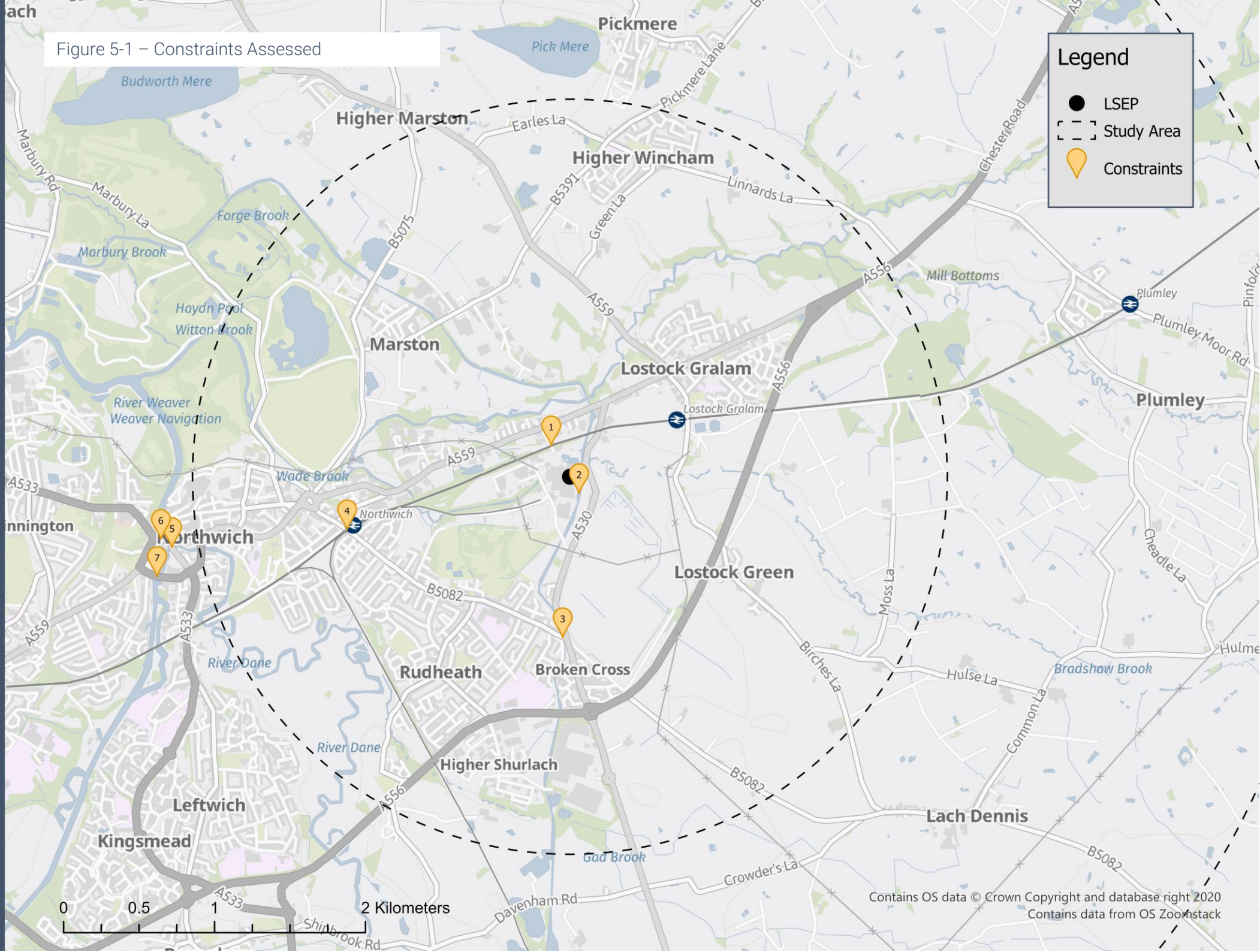
5.3.2 The most congested area in terms of physical constraints can be seen in and around Northwich Town Centre.

Ref.	Name	Constraint Type	Notes
1	Railway Line Crossing to the North of the LSEP	Railway Line	The railway line directly to the North of the LSEP has an existing dedicated works tunnel running below the railway line. The tunnel road does not look congested with utilities from above and so is assumed that it could be used to lay DHN pipes if required. The use of this tunnel will likely incur further costs for the granting of easements etc.
2	LSEP Canal Crossing (directly adjacent to LSEP)	Canal	The canal directly adjacent to the LSEP has numerous pipe bridges constructed for the TATA Chemicals processing plant and associated utilities. Due to the industrial nature of the area surround the site, and because there are existing pipe bridges deployed over the canal, it is assumed that the LSEP DHN project will also be able to deploy their own dedicated pipe bridge if required.
3	B5082 East Canal Crossing	Canal	Another crossing for the Canal running South of the LSEP is a bridge crossing where the B5082 and the A530 merge. The bridge has a depth of c. 0.8m at its deepest point. Standard trenching requires a minimum of 0.6m cover for a road to protect pipes adequately from vehicles. It is assumed therefore that this bridge could potentially be used as a crossing for the DHN either through laying pipes in the bridge itself or mounting a pipe to the side of the bridge.
4	B5082 (Northwich Town Centre) Railway Crossing	Railway Line	The railway line can be crossed using a bridge crossing the B5082 in Northwich Town Centre. The bridge seems to have sufficient depth to house DHN pipework, however there may be a congestion of utilities beneath the surface of the bridge. Alternatively, the pipe may be mounted to the side of the bridge.
5, 6, 7	Northwich Town Centre River Crossings	River	Northwich Town Centre has a small inner ring road made up of the A5509, A559 and A533 roads. The inner ring road crosses the River Weaver at three separate points allowing the DHN to take one of a number of routes through the Town Centre. Two of the bridges (6 & 7) are similar in structure and can rotate to allow larger boats to pass through. These bridges are listed structures that are currently functioning and operational – any alterations would require listed building consent which can be protracted.

Table 5-1 – Study Area Constraints

Constraints

Figure 5-1 – Constraints Assessed



06

Cluster Assessment

6 Cluster Assessment

6.1 Introduction

6.1.1 The Cluster Assessment analyses all data obtained in the Investigation thus far to determine, pragmatically, the direction in which a DHN may take.

6.1.2 There are many variables that determine whether or not a heat load will remain as part of the Investigation, including but not limited to:

- The proximity of a heat load relative to the LSEP,
- The proximity of a heat load relative to the next-closest lying heat load,
- The physical constraints that lie between the LSEP and a given heat load,
- The type of building/development related to the heat load,
- Any site-specific information for a given heat load (for example existing energy provisions, congested utilities beneath the ground etc.)

6.1.3 The most notable variable used in this Investigation, however, is the relationship between the length of a DHN and its capital cost.

6.1.4 Having worked on numerous DHN schemes throughout the UK over the years, Ener-Vate would expect to see pipe installation costs similar to those of a scheme we are currently delivering in North-West England. This is due to both areas having similar topographies, that is, highly congested areas.

6.1.5 Pipe installation costs can be given as a single metric for the purpose of this Investigation, being the 'cost per metre of pipework', and includes:

- The cost of the pipes required,
- All backfill and re-instatement costs,
- Traffic Management costs, and
- Prelims/civils costs.

6.1.6 For areas requiring 'hard-dig' pipework installation, i.e. the digging and laying of pipes beneath public highways, a figure of **£2,500 per metre** is used.

6.1.7 For areas requiring 'soft-dig' pipework installation, i.e. the digging and laying of pipes beneath greenfield land with no pre-laid utilities, a figure of **£1,000 per metre** is used.

6.1.8 The 'cost per metre of pipework' therefore does not show the total life-cycle cost of the DHN system but instead provides a simple metric that allows the user to quickly determine the most pragmatic heat loads within the Study Area.

6.2 Northwich (Central) Cluster

6.2.1 The Northwich (Central) Cluster consists of 216no. buildings with a total projected heat load of c. 94 GWh_{th} per annum. Table 6-1 shows the heat loads split per building type:

Building Type	Projected Heat Consumption (kWh/annum)
Childcare	393,013
Commercial	48,146,042
Healthcare	15,126,422
Industrial	12,015,743
Nursing Home	2,009,142
Restaurant	0
Retail	2,208,981
School	13,229,999
Veterinary	1,354,067
	94,483,410

Table 6-1 – Northwich (Central) Cluster Projected Heat Consumption per Building Type

6.2.2 Being within the closest proximity to the LSEP, Northwich (Central) is, in the first instance, the most attractive cluster of the 4no. proposed. A close proximity to the LSEP means network length is significantly reduced requiring less capital expenditure.

6.2.3 Navigating a DHN through Northwich Town Centre, however, is a complicated process due to the River Weaver/ River Dane confluence directly in the Town Centre.

6.2.4 The confluence, along with the railway line running from Northwich towards Cuddington, have resulted in an area with multiple bridge crossings requiring more advanced network design and implementation.

6.2.5 Analysis of the Northwich (Central) Cluster identifies a number of Anchor Loads that could facilitate the implementation of a DHN. The Anchor Loads, i.e. those with the largest heat consumption, found in the Central Cluster are as below:

- Tata Chemicals Lostock Works (Formerly Brunner Mond),
- Northwich High Street (Witton Street and surrounding retail/commercial buildings),
- Sir John Deane's College,
- Higher Shurlach Business Park, and

6.2.6 The Tata Chemicals Europe (TCE) manufacturing facility, formerly known as Brunner Mond, is located directly adjacent to the LSEP. The facility is focused around the processing and storage of chemicals to be distributed throughout the UK and worldwide.

6.2.7 When the consent for the LSEP facility was being developed in February 2010, it was anticipated that it would replace steam from what was E.ON's gas fired CHP plant located in Winnington. TCE acquired the CHP Plant in September 2013 and continues to own and operate the CHP Plant. TCE currently utilises the CHP Plant as its primary

source of heat and power for the operation of its chemical manufacturing facility. Since this acquisition, a connection to LSEP is less attractive to TCE, for now TCE has therefore been excluded from this study.

6.2.8 This may be a short-term position for TCE. The CHP units currently deployed will need to be replaced at some point, at this time they may seek to take heat from the LSEP. As the LSEP will be CHP-Ready, this will not require any system overhauls/significant modifications and therefore a connection will always remain a possibility. We consider this further below, see section 6.3.

6.2.9 Northwich High Street (i.e. Witton Street and surrounding side-streets) presents a dense heat consumption from numerous retail and commercial entities. Having a large number of commercial entities with differing requirements and landlords requires numerous, potentially time-consuming negotiations that all parties are required to unanimously agree on.

6.2.10 Whilst DHNs focused around retail high streets/areas have been implemented successfully before, the complex structure of negotiating with numerous landlords and organising the successful delivery of a DHN presents a difficult challenge. These types of projects are often delivered through Local Authorities with access to Public Works Loan Board (PWLB) funds available at a lower rate than those seen in the private market, therefore meaning the project can still be commercially viable at a lower Internal Rate of Return (IRR). Local Authorities also often have close relationships with retail/commercial entities operating in town and city centres, as well as physically owning buildings that are by default already willing to connect to a DHN.

6.2.11 Sir John Deane's College, albeit showing a relatively high heat consumption, is situated too far from the next-closest heat load to be classed as a viable Anchor Load. The distance from the next-closest heat load means the network to reach Sir John Deane's College would be in the region of 1.7km and cost c. £4.25 million. Following analysis of the building's heat consumption, this leg of the network would not be financially viable without further heat loads close-by also connecting.

6.2.12 The Higher Shurlach Business Park consists of 35no. commercial buildings, mostly comprising of office blocks. Following a field visit to the business park, it was noted that the buildings are not currently on a centralised network but instead use their own energy provisions at each plot.

6.2.13 All buildings were of the same design and type, possibly meaning that the whole park would be owned and operated by one landlord. Should this be the case, a negotiation with one landlord to provide low-carbon heat from a DHN to all buildings on the site would significantly increase the likelihood of a successful DHN delivery.

6.2.14 Ener-Vate are currently in the process of determining this factor and will continue to include the business park in the Investigation on the basis that it is owned by one landlord.

6.3 TATA Chemicals

6.3.1 Given the significance of the potential load at TATA Chemicals, more investigation has been undertaken to consider the likelihood of a connection.

6.3.2 The original EP application was submitted in 2012 on the basis that the Facility would export 'up to 100 tonnes per hour of steam' to the nearby to the TCE manufacturing facility. The Facility was considered as a potential option to replace steam that was provided to the chemicals manufacturing facility by a gas fired CHP plant located in Winnington. This CHP was owned by E.ON. Since 2012, TCE has purchased this CHP from E.ON making utilising steam from LSEP less feasible for TCE.

6.3.3 At the time the original EP for the Facility was granted (in 2013), TCE received its steam and electricity supplies under the terms of their agreement with E.ON, who developed, built and operated TCE's CHP plant from its inception. This Steam and Electricity Supply Agreement (SESA) was uneconomic for both E.ON and TCE and was terminated early in September 2013. At that time, the Facility had not been developed and therefore was not able to provide TCE with its steam requirements. Therefore at the point of termination of the SESA, TCE acquired the ownership of the CHP facility from E.ON to ensure continuity of supply of heat/steam to its chemical facility. It continues to own the plant, and to provide its own steam and electricity requirements. As a result, the Facility is not currently required as the primary source of heat/steam for TCE's chemical manufacturing facilities, although TCE is keen to reach an agreement with LSEP Ltd by which TCE can take a volume of steam from the Facility when TCE requires this in the future.

6.3.4 The Facility has been designed to be capable of exporting up to 100 tonnes per hour heat/steam. A steam supply agreement was signed with TCE on 26 March 2019, which obliges LSEP Ltd to supply up to 25 tonnes per hour of steam to TCE's plant, on occasions when it is needed by TCE for their chemical manufacturing facility. Therefore, whilst TCE is unlikely to be a 'guaranteed' baseload user of heat from the commissioning date of the Facility, the Facility will be able to provide steam on those occasions when TCE requires it.

6.3.5 Furthermore, there are a number of circumstances when TCE may, in the future, require the Facility to provide significant baseload quantities of heat, namely:

(1) on the closure (due, for example, to economic or technical life expiry) of the CHP plant; and/or

(2) in the circumstances that fossil fuel or carbon costs increase to the point that the Facility represents a more economic source of heat than the CHP plant.

6.3.6 Due to these criteria having not yet being met, TCE are not considered a potential connection as part of this study.

6.4 Middlewich Cluster

6.4.1 The Middlewich Cluster consists of 89no. buildings with a total projected heat load of c. 35 GWh_{th} per annum. Table 6-2 shows the heat loads split per building type:

Building Type	Projected Heat Consumption (kWh_{th}/annum)
Childcare	0
Commercial	748,654
Healthcare	300,721
Industrial	29,003,291

Nursing Home	155,323
Restaurant	172,844
Retail	509,219
School	4,143,213
Veterinary	0
	35,033,265

Table 6-2 – Middlewich Cluster Projected Heat Consumption per Building Type

6.4.2 Middlewich lies c. 8.5km South from the LSEP as the crow flies and can be reached using the conveniently direct A530 road.

6.4.3 In order to reach the centre of the Middlewich Cluster where most of the industrial loads identified lie and using the aforementioned figure of £2,500 per metre of hard-dig, the network alone would cost in the region of £21 million, not including any plant or ancillary equipment.

6.4.4 A large portion of the proposed route (parallel to the A530 road) could, in theory, use a soft-dig method to reduce the overall cost of the DHN.

6.4.5 Ener-Vate do not have access to landholding maps and as such cannot determine how many landowners would be required to grant easements in order to achieve a largely soft-dig built network down to Middlewich. It can be said, however, that there are likely numerous landowners spanning the c. 8km distance.

6.4.6 Ener-Vate will work with the Facility Operators to try and obtain a landholding map allowing a more granular assessment of the Middlewich Cluster, however for the time being, because the Cluster is situated far from the LSEP, it has been omitted from the Investigation on the basis that the network would not be economically viable using hard-dig methods.

6.5 Winsford Cluster

6.5.1 The Winsford Cluster consists of c. 263 buildings with the largest total projected heat load of the Clusters of c. 127 GWh_{th} per annum. Table 6-3 shows the heat loads split per building type:

Building Type	Projected Heat Consumption (kWh_{th}/annum)
Childcare	1,228,868
Commercial	43,823,415
Healthcare	1,724,061
Industrial	67,581,209
Nursing Home	4,823,628
Restaurant	489,386
Retail	1,376,599
School	5,567,472
Veterinary	859,378
	127,474,016

Table 6-3 – Winsford Cluster Projected Heat Consumption per Building Type

6.5.2 Winsford, another heavily industrialised area along with a variety of commercial activity, lies c. 8km South-West of the LSEP as the crow flies.

6.5.3 Despite being located within a close proximity to the Middlewich Cluster and having nearly four times the heat load, the network route would require an absolute minimum of 2km worth of network over the Middlewich Cluster, as well as the added complexity of having to cross a railway line and two bodies of water in the process.

6.5.4 The network itself would be expected to cost at least £24 million, without any costs incurred through crossing the constraints identified.

6.6 Knutsford Cluster

6.6.1 The Knutsford Cluster is by far the smallest cluster with regards to heat consumption at c. 10 GWh_{th} per annum. Table 6-4 shows the heat loads split per building type:

Building Type	Projected Heat Consumption (kWh_{th}/annum)
Childcare	0
Commercial	6,736,177
Healthcare	0
Industrial	4,061,824
Nursing Home	0
Restaurant	0
Retail	0
School	0
Veterinary	0
	10,798,001

Table 6-4 – Knutsford Cluster Projected Heat Consumption per Building Type

6.6.2 Knutsford lies c. 9.5km so is also the furthest cluster from the LSEP.

6.6.3 Considering the working done so far for the previous three clusters, it can be assumed that the Knutsford cluster does not have sufficient heat demand to justify the capital cost required to implement the DHN and is therefore omitted from the Investigation.

6.7 Conclusions

6.7.1 The Study Area consists of 4no. clusters of buildings situated within the Study Area that have a high heat density.

6.7.2 The Middlewich, Knutsford and Winsford clusters, despite having a large projected heat consumption, are situated too far from the LSEP to, at this stage, deem a DHN to be financially viable. This is because the cost of building large networks requires pipework to be laid, for the most part, in public highways and A roads stretching numerous kilometres.

6.7.3 Instead, Ener-Vate have taken a more pragmatic approach at looking at large projected heat loads situated within a close proximity to the LSEP (2.5 km).

6.7.4 These conditions are fundamental to employing a successful DHN, in which the method of starting small with the focus on expansion is preferred to its counterpart of starting large and ultimately taking on more risk.

6.7.5 It is important to remember that DHNs are still a relatively new concept that the general public are not necessarily educated on. With few instances in which heat loads are obligated to join a network, it may be difficult to get them to do so. Having a smaller network in the area that has been successfully operational for some time instils a sense of confidence and trust in the technology by the general public and facilitates further expansion.

6.7.6 Heat loads situated closer to the LSEP may come at a cost, however. The Northwich Town Centre is congested with physical constraints such as railway lines and river crossings that will require more advanced technical design and implementation than those being implemented in public highways with no constraints.

6.7.7 Following a more granular assessment of the 4no. heat loads proposed in the Northwich (Central) Cluster, Tata Chemicals have been contacted and replied stating that they do not wish to take part in the project, and such will not be included for the remainder of the Investigation.

07

Proposed Networks

7 Proposed Networks

7.1 Introduction

7.1.1 Using all data obtained in the Investigation thus far, it is possible to create indicative network routes to Anchor Loads that show good promise for the implementation of a DHN.

7.1.2 The network routes are plotted using GIS software and have also been travelled along during the field visit. The network routes are fairly conservative in that they mostly follow public highways, and such incur high capital costs. In reality, it *may* be possible to reduce network costs by negotiating with landowners situated adjacent to the network route to use their land. Legal costs associated with obtaining easements are also not fixed and such are hard to speculatively quantify.

7.1.3 A conservative approach has been taken as negotiations with landowners is not within the scope of this Investigation and should be considered at a later stage of the project.

7.2 Network Route 1 (West of LSEP)

7.2.1 The first indicative network route proposed is designed to provide heat to the following heat loads:

Building/Development Name	Projected Heat Consumption (kWh/annum)
Northwich Town Street	7,194,789
Planned Heat Load 1	84,240
Planned Heat Load 4	1,557,810
	8,837,019

Table 7-1 – Network Route 1 Heat Loads

7.2.2 These loads have been chosen within the Northwich (Central) Cluster due to their high heat density, classing them as Anchor Loads. For the purpose of this section of the Investigation, Northwich Town Street has been classed as a single Anchor Load despite consisting of numerous buildings. This is simply for ease of data evaluation and allows quick computations to be run in Ener-Vate's proprietary commercial model.

7.2.3 A further, more detailed study will be required for the Northwich Town Street units before they can be confirmed as eligible to connect to a DHN. As this is not within the scope of this Investigation, we assume that each unit will be suitable to connect to the proposed DHN system.

7.2.4 The Northwich Town Street anchor load consists of 24no. retail and commercial units with a total heat demand of c. 7.2 GWh_{th}/annum. These loads can be found in the Appendix.

7.2.5 Figure 7-1 shows the proposed indicative DHN route East of the LSEP including heat loads.

7.2.6 It must be noted that there is insufficient data on the LA planning portals to design indicative, on-site networks for the planned developments. Therefore the network is only designed to provide heat to the planned heat load site boundary.

7.2.7 The network requires the crossing of constraint number 4 (see Table 5-1). It has been noted that this constraint can likely be crossed by laying pipework within the bridge as it has sufficient depth to do so. This is dependent on a more granular assessment of the utilities already present in the bridge.

7.2.8 The proposed network requires an estimated 3,700 metres of hard-dig pipework to be laid in public highways from the LSEP to all heat loads chosen.

7.2.9 The network has been designed to end at Northwich Town Street at not continue further West due to the constraints that would have to be passed to do so. As previously mentioned, the area further West is not to be classed as 'unviable' but would require further detailed technical evaluations to determine its viability that are not within the scope of this Investigation.

7.2.10 The commercial viability of this route has been assessed using Ener-Vate's proprietary commercial model (see Section 8).

7.3 Network Route 2 (South of LSEP)

7.3.1 The second indicative network route designed travels South of the LSEP to the Higher Shurlach Business Park. The network route itself is fairly direct, requiring c. 4,340m of hard-dig pipework to be laid along the A530 and A556.

7.3.2 This area has a very high heat density and consists of 35no. office blocks with a variety of tenants. Directly adjacent to the development are 2no. large distribution centres operated by Morrisons. It is unknown at this point if the development is owned by a single or multiple landlord(s). All loads are available in the Appendix.

7.3.3 Close to the development is Rudheath Community Primary School. Due to their proximity to the Higher Shurlach Business Park, the school has been added as a heat load to the network.

7.3.4 Similar to the Northwich Town Street anchor load, the Shurlach Business Park has been classed as a single anchor load for the purpose of this Investigation.

7.3.5 During the field visit, it was concluded that the development does not run off a centralised energy system but instead each building controls their own energy provisions.

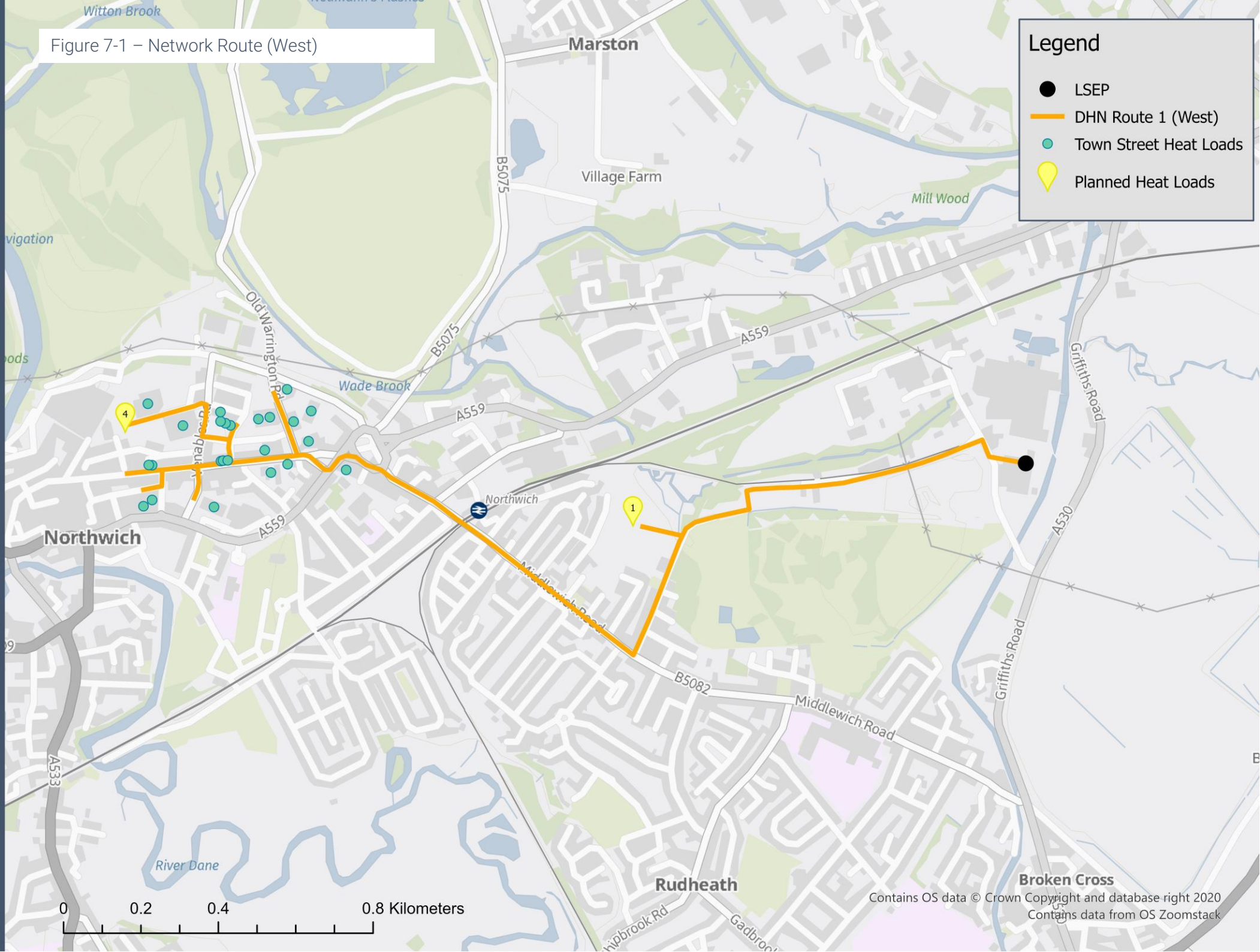
7.3.6 This increases the cost of retrofit as each building's energy provisions would have to be modified to be able to accept heat from a DHN, rather than one centralised system having to be modified.

7.3.7 Nevertheless, the development has a high heat load and only requires the crossing of Constraint number 2 (see Table 5-1) which can likely be crossed fairly easily through the erection of a pipe bridge.

7.3.8 Figure 7-2 shows the proposed indicative DHN route South of the LSEP.

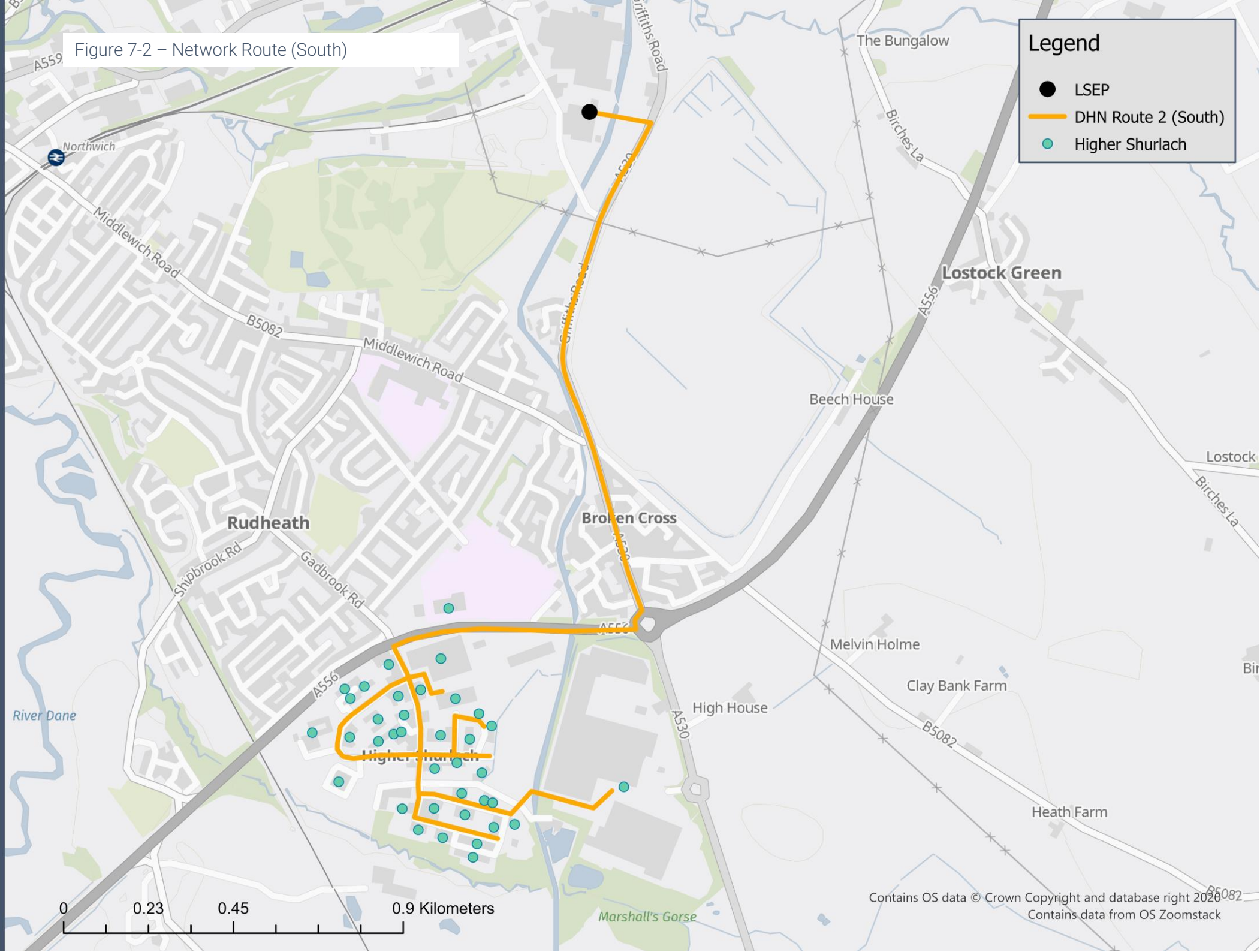
Network Route 1 (West)

Figure 7-1 – Network Route (West)



Network Route 2 (South)

Figure 7-2 – Network Route (South)



08

Commercial Modelling

8 Commercial Modelling

8.1 Introduction

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

8.1.2 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.

8.1.3 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.

8.1.4 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 Facility Operators.

8.1.5 For example, if the Facility Operators 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.

8.1.6 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.

8.2 Commercial Structure

8.2.1 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 3.3.

8.2.2 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.

8.2.3 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.

8.2.4 Figure 8-1 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.

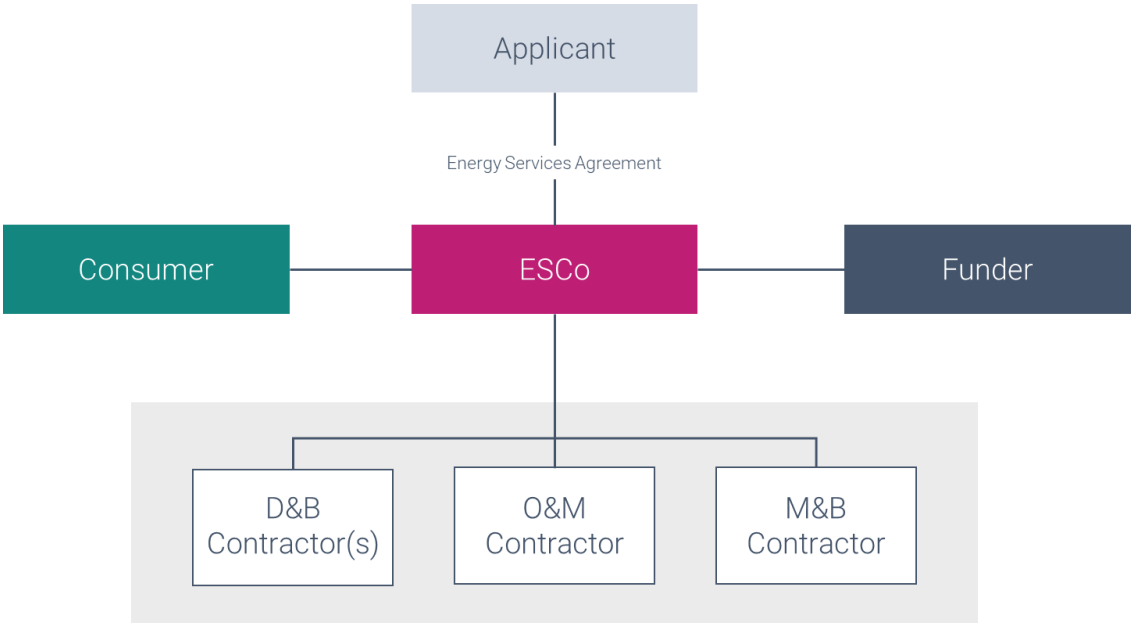


Figure 8-1 – Typical Commercial Structure

8.2.5 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.

8.2.6 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.

8.2.7 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.

8.2.8 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).

8.2.9 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.

8.3 Model Assumptions

8.3.1 Included in the commercial model assumptions are the projected heat demands previously quantified along with those outlined in Table 8-1 below:

Item	Value	Unit
Concession Period	40	Years
Weighted Average Cost of Capital (WACC)	8	%
Domestic Heat Tariff	6.9	p/kWh_{th}
Domestic Standing Charge	325	£/dwelling
Domestic Connection Fee	2,500	£/unit
Non-Domestic Variable Heat Tariff	4	p/kWh_{th}
Non-Domestic Fixed Heat Tariff	2.50	$£/m^2$
Non-Domestic Connection Fee	20	$£/m^2$
Thermal Purchase Agreement	0.75	p/kWh_{th}

Table 8-1 – Commercial

8.3.2 The Thermal Purchase Agreement (TPA) relates to the cost of heat that the ESCo entity will be required to pay the Facility Operators per kWh_{th}. Therefore, in this instance, the

ESCo will be required to pay 0.75p to the Facility Operators for every kWh_{th} delivered to consumers.

8.4 Model outputs

8.4.1 Considering both networks (and therefore commercial models) consist of an anchor load with numerous connections, Ener-Vate have run a series of sensitivities around the total load required.

8.4.2 These sensitivities take the total projected heat load and apply a percentage value to show how the ESCo will perform should only, for example, 90% of the anchor load buildings connect to the DHN.

8.4.3 The commercial model outputs are displayed in Table 8-2 as IRR and NPV values.

Network	IRR	NPV
Route 1 (100% connectivity)	3.96%	-£3,812,309
Route 1 (75% connectivity)	2.00%	-£5,219,817
Route 1 (50% connectivity)	-0.68%	-£6,662,403
Route 2 (100% connectivity)	7.29%	-£753,608
Route 2 (75% connectivity)	5.25%	-£2,773,947
Route 2 (50% connectivity)	2.79%	-£4,817,295

Table 8-2 – IRR and NPV Model Outputs

8.4.4 The commercial model shows that, at this moment in time, neither of the indicative networks are commercially viable at a WACC of 8%, even if all loads commit to taking heat from the DHN.

8.4.5 As previously mentioned in this report, capital costs for the system can potentially be reduced allowing a more attractive return over the concession period of 40 years.

8.4.6 The commercial viability of the project could benefit from such things as soft-dig alternative network routes, having access to a lower WACC, identification of new heat loads en-route, injection of government grants/loans applicable to DHNs, along with a number of other factors. These factors require further technical design that is not applicable at this stage of the project.

8.4.7 Figures 8-2 and 8-3 show the projected costs and revenues for each network route respectively.

Figure 8-2 – Projected Costs and Revenues for Network Route 1 (West)

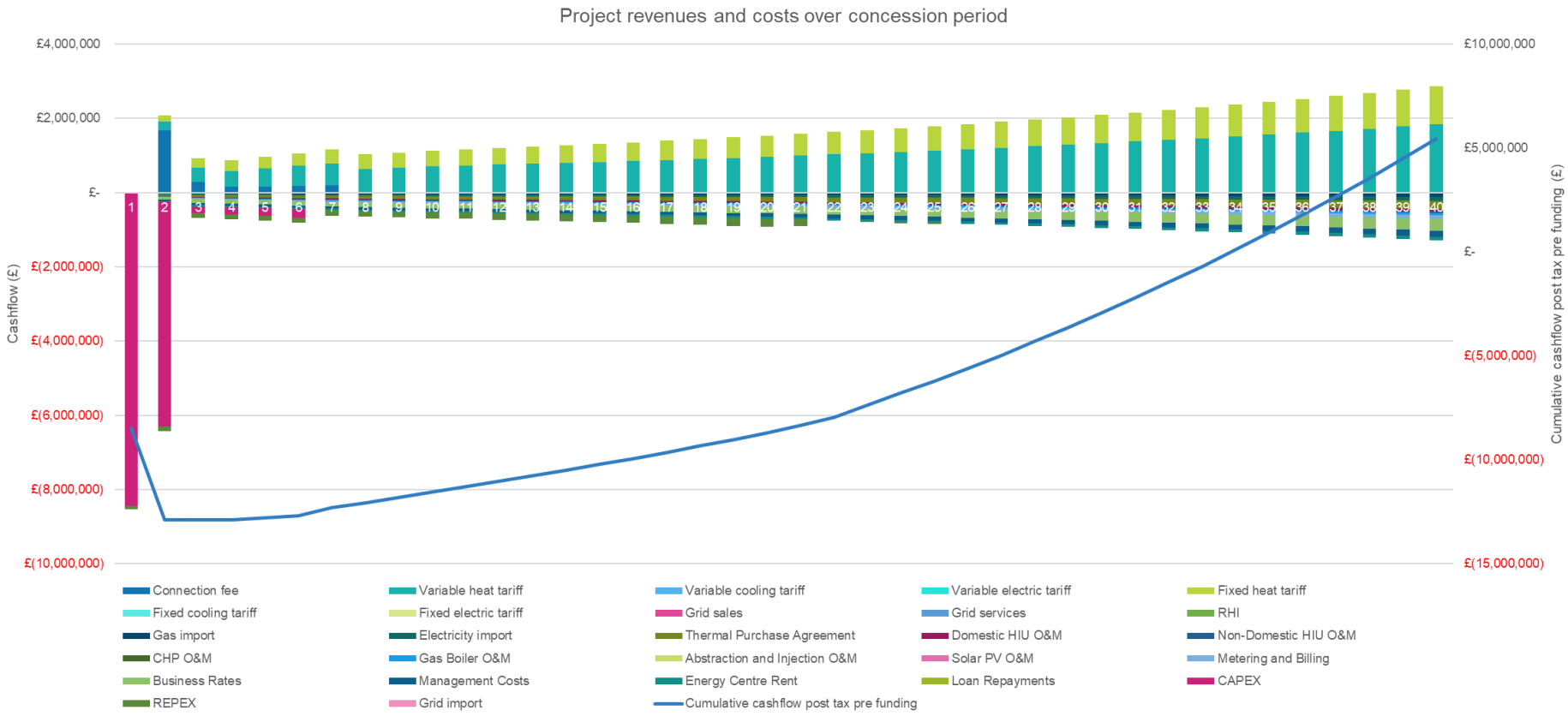
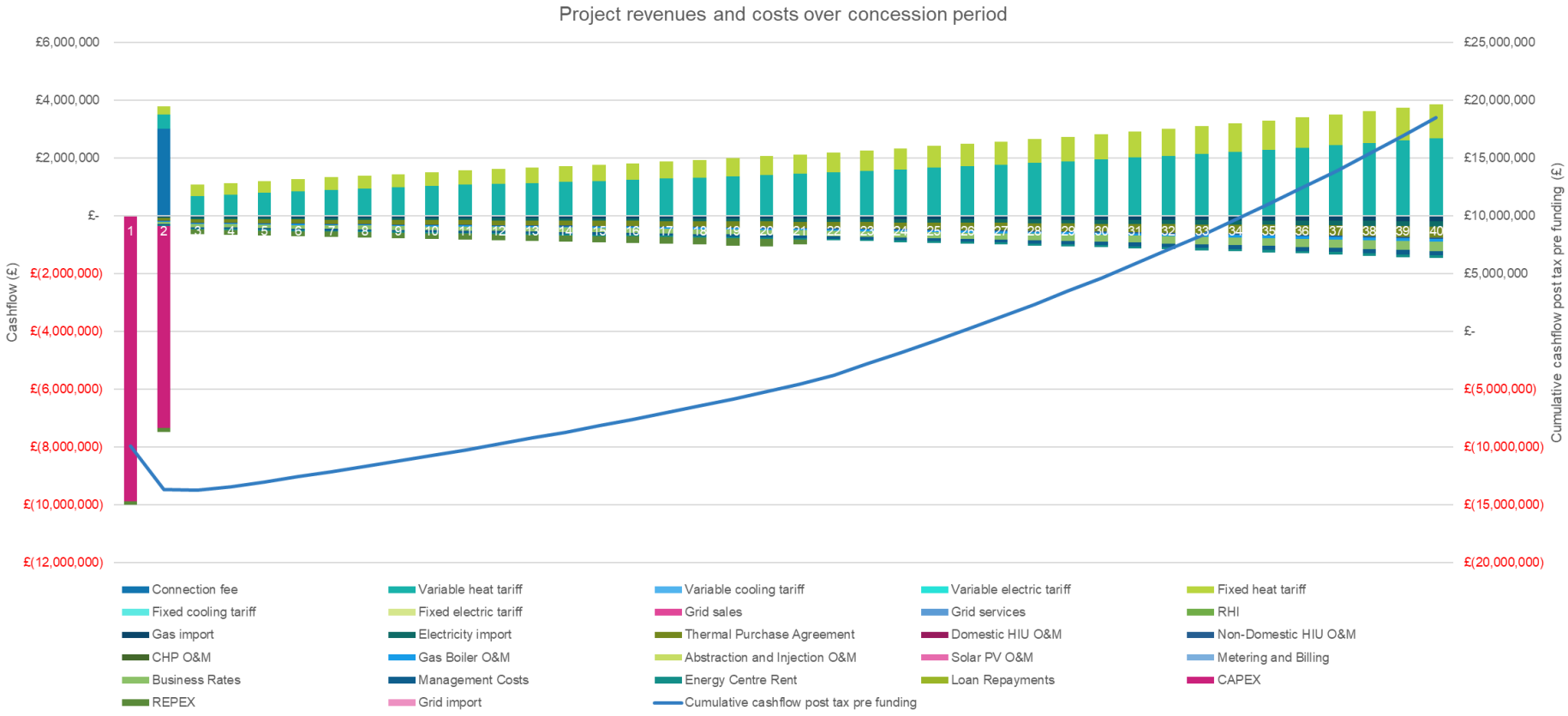


Figure 8-3 – Projected Costs and Revenues for Network Route 2 (South)



09

References

9 References

[1] The Association for Decentralised Energy Heat Market Report: Heat Networks in the UK 2018