BUROHAPPOLD ENGINEERING

B&NES Sustainable Construction Checklist SPD

Heat Networks Guidance Note

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Contents

1 Introduction

The Sustainable Construction Checklist Supplementary Planning Document (SPD) contains detailed compliance requirements for Policies CP4 and SCR1. This document provides the supporting information to enable applicants to respond to CP4 and complete the Checklist.

2 Policy Context

2.1 Policy CP4: District Heating

Policy CP4 of the B&NES Core Strategy and Placemaking Plan requires that within the District Heating Priority Areas development '*will be expected to incorporate infrastructure for district heating, and will be expected to connect to existing systems where and when this is available, unless demonstrated that this would render development unviable.*'

There are currently two District Heating Priority Areas within B&NES:

- Bath Riverside and Bath Central priority areas, which form the Bath Enterprise Area District Heating Priority Area (discussed in Section 6)
- Keynsham High Street Priority Area (discussed in Section 7)

It should be noted that the District Heat Priority Area diagrams in the Placemaking Plan (see Appendix D) have been superseded by more detailed maps, which are shown within the body of this report and are available at B&NES's online map website[1].

In addition to the District Heating Priority Areas, there are also 12 District Heating Opportunity Areas (Radstock, Midsomer Norton, Paulton, Bath Spa University, Twerton, Kingsway, Bathwick, Moorfields, Odd Down, Lansdown, RUH & Keynsham Somerdale). Maps of these can be found in Appendix D and further information can be found in the 2010 District Heating Opportunity Assessment Study by AECOM. These areas are encouraged to take the same approach as for District Heating Priority Areas and will be expected to connect to any existing suitable district heating systems, unless demonstrated that this would render development unviable.

[1] https://isharemaps.bathnes.gov.uk/atmycouncil.aspx?MapSource=BathneS%2Fplanning&Sta

2.2 Policy SCR1: On-site Renewable Energy Requirement and interface with CP4

Policy SCR1 supports on-site renewable energy generation, and states that major development (above 1,000 square metres or 10 dwellings excluding industrial uses B2 and B8) is expected to provide on-site renewable energy to reduce regulated CO_2 emissions by at least 10%.

It should be noted that gas CHP does not generate renewable energy and therefore connection to a heat network with gas CHP does not count towards the SCR1 target. However, a connection to a gas CHP led heat network is likely to reduce the overall CO_2 emissions of the development which will form the baseline for calculating SCR1 compliance, and therefore the meeting the 10% CO_2 reduction requirement will require a smaller reduction in absolute terms.

If a heat network has a renewable heat source (e.g. biomass boiler or heat pump) then the CO_2 reduction will count towards the SCR1 requirement. If a heat network has a mixture of renewable and non-renewable heat sources, then only the CO_2 reduction from renewable elements will count towards the SCR1 requirement.

A review of renewable and low carbon heating options is presented in Appendix A and details of the potential impact of the decarbonisation of the UK electricity grid on heat networks can be found in Appendix B.

3 Aims and Context of Policy CP4

3.1 Climate change targets

Environmental sustainability and climate change is a key priority for Bath & North East Somerset Council. B&NES Council's Environmental Sustainability and Climate Change Strategy sets a CO_2 reduction target for the area of 45% by 2029, in line with the government's legally-binding target to cut national emissions 80% by 2050.

Development can play an important role in meeting this target, by minimising the emissions that cause climate change and future-proofing to cope with the climatic changes that are likely to take place within the buildings' lifetime. To facilitate this, tackling climate change is a cross-cutting objective within the Placemaking Plan.

3.2 The role of heat networks

Heat networks form a key part of the UK's heat strategy for urban areas[2] and there is a specific Heat Networks Delivery Unit with the Department for Business, Energy and Industrial Strategy. Heat networks can provide a number of benefits for reducing CO_2 emissions in urban areas:

- Aggregating heat demands to allow low carbon technologies that operate best at a large scale to be used or to connect to sources of waste heat (e.g. power plants).
- They can deliver CO_2 savings for existing buildings that are challenging to retrofit or have large hot water requirements (e.g. swimming pools) without significant disruption to building operations.
- There is flexibility for the heat source for the network to be changed as technologies develop or the electricity grid decarbonises. Changing a single heat source is significantly simpler than changing a large number of individual heat sources in buildings.

[2] https://www.gov.uk/government/publications/the-future-of-heating-meeting-the-challenge

4 Completing the Sustainable Construction Checklist for CP4

4.1 Question 1 and 2: Location of the development

No.	Question
1	Is the proposal in a Heat Network Priority Area?
2	Is the proposal in a Heat Network Opportunity Area?

The first two questions are about whether the proposal is within a Heat Network Priority or Opportunity Area. Proposed developments that are within a district heating Priority Area must either include a heat network, include a connection to an existing heat network, or be future-proofed for district heat network connection. This means they must answer yes to at least one of question 3-5. If they are in an Opportunity Area, they must either answer yes to at least one of questions 3-5, or provide a reason for not future proofing for district heating.

These questions require a Yes/No answer. They could be supported by plans showing the location of the proposed development in relation to heat network priority and opportunity areas.

4.2 Questions 3 to 5: Proposed district heating strategy

No.	Question
3	Does the proposal include a heat network? If "Yes" please complete question 8.
4	Does the proposal include connection to an existing heat network? If "Yes" please complete question 8.
5	Is the proposal future-proofed to connect to future heat networks? If so, the answer to Questions 9-12 should be "Yes"

Questions 3-5 ascertain whether the proposed development will include a heat network, connect to an existing network, or be future proofed for connection to a future heat network.

These questions require a Yes/No answer, with further detail provided in questions 6-12.

Full applications or outline/reserved matters applications must provide further detail, by answering questions 6-12.

4.3 Question 6: Connection to existing district heating network

No.	Question
6	If the proposed development is in proximity to an existing heating scheme (e.g. Bath Western Riverside), has the incumbent district heating operator been contacted to discuss the potential for connection to the existing network? Proof of contact may be required.

The locations of existing district heating schemes as of May 2017 are shown in Figure 6—1.

If the proposed development is in proximity (i.e. within 300m) to an existing heating scheme, the incumbent district heating operator should be contacted by the applicant.

This requires a Yes/No answer. Proof of contact can include an email chain of correspondence with the incumbent district heating network operator.

4.4 Question 7: Large scale multi-building development

No.	Question
7	If the proposed development is a large scale multi-building development (e.g. over 500 residential units and/or over 10,000m^2 GIA of non-residential floor space – in particular with hotels, hospitals, leisure centres or student residences), has an open-book viability assessment for district heating been carried out and full report attached? This is required for policy compliance.

Large scale multi-building developments within a District Heating Priority area should assess the viability of building a district heating network for the development as a whole.

Open-book viability assessment for district heating should be provided with a full report. This should include:

- Clear definition of the counterfactual (i.e. base-case) used. This should include low carbon counterfactuals in addition to/ instead of an individual gas boiler counterfactual.
- Explicit assumptions about the price of gas and of electricity
- The feasibility assessment should be in line with CIBSE CP1 : Heat Networks: Code of Practice for the UK[3]
- Service levels and heat pricing should conform to best practice e.g. the Heat Trust scheme[4] or similar.
- Whole life cost analysis over a minimum of 25 years

[3] https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q200000090MYHAA2
[4] http://heattrust.org/index.php

4.5 Question 8: Details of connection to heat network

No.	Question
8	If a heat network or connection to a heat network is proposed, has a document providing further details been attached? If a fossil-fuelled heat source is proposed please summarise below the strategy for switching to a renewable heat source in the future. Where a mix of energy sources is being proposed e.g. biomass with backup gas boilers, please explain the controls which will ensure the mix of energy sources used post occupation will be in compliance with policies CP2 and SCR1.

This requires reference to further details of the heat network or heat network connection. This should show as a minimum:

- Location of intake room with access for district heating operator (if applicable)
- Location of energy centre (if applicable)
- Where more than one heat supply technology is used, details of plant sequencing (if applicable)
- District heating pipework route within the site boundary
- That the building's heating system temperatures are in line with the district heating provider's requirements

If a heat network is proposed as part of the scheme and the primary heat source for the network is fossil fuel based (e.g. gas CHP), then the applicant should provide a high level strategy for ensuring that the network will deliver CO_2 savings in the long term, taking account of the decarbonisation of the electricity grid (as discussed in Appendix B) such as replacement of the CHP at the end of its useful life. For example, identifying alternative heat source opportunities (e.g. river source heat pump) and showing that spatial requirements have been taken account of (e.g. for biomass boiler and fuel storage, or a heat pump).

4.6 Questions 9 to 13: Future proofing

4.6.1 Key considerations

Building types important for futureproofing

In general, the following building types have significant heat demands and therefore it is particularly important that they are adequately future-proofed:

- Sports centres and swimming pools
- Hotels
- Student accommodation
- Large blocks of flats
- Hospitals

Building systems

A building is unlikely to be able to connect to a district heating system in the future if:

- the building heating system is described as Variable Refrigerant Flow (VRF) or Variable Refrigerant Volume (VRV)
- direct electric heating is used
- direct electric hot water is used

In all these cases compliance with CP4 will be jeopardised and justification for this choice of heating system will be required from the applicant. In some situations the approach may be acceptable, such as the building has a very low heating demand (e.g. Passivhaus) and/or hot water is provided from a central system compatible with future-proofing.

Apartment buildings

The key requirement for future-proofing apartment buildings is that there is a central heat source rather than individual boilers for each apartment.

Plant room locations

If there is no plant room adjacent to a façade and on the ground floor then the applicant should make it clear how a district heating connection will be made in the future.

Future proofing delivery considerations

Details of delivery and operational considerations can be found in Appendix C.

4.6.2 Checklist futureproofing questions

No.	Question
9	**Single heat source:** If the development includes residential apartment buildings, is heating provided to the apartments from a single central heat source as opposed to heating plant for individual units? Please explain in Question 13 if the answer is "no".

This requires a yes/no answer.

In multi-residential buildings, a communal heating system with centralised boilers and heat exchangers in each dwelling should be used to future-proof the building for a district heating connection. This is shown in Figure 4—2 , in contrast with Figure 4—1, the normal approach with individual gas boilers.

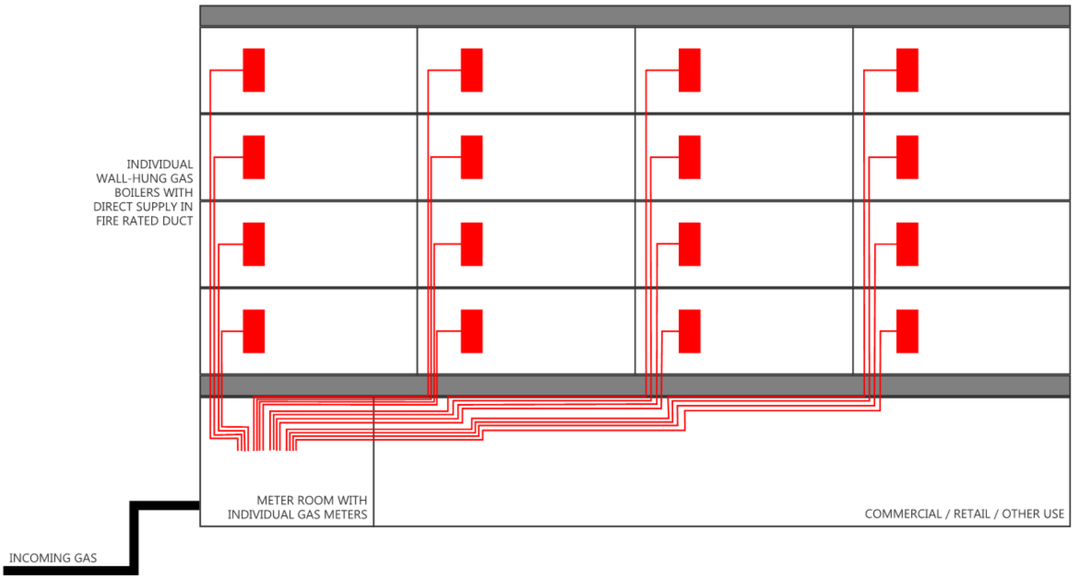

Figure 4—1 Residential – normal approach with individual gas boilers, not future-proofed for district heating.

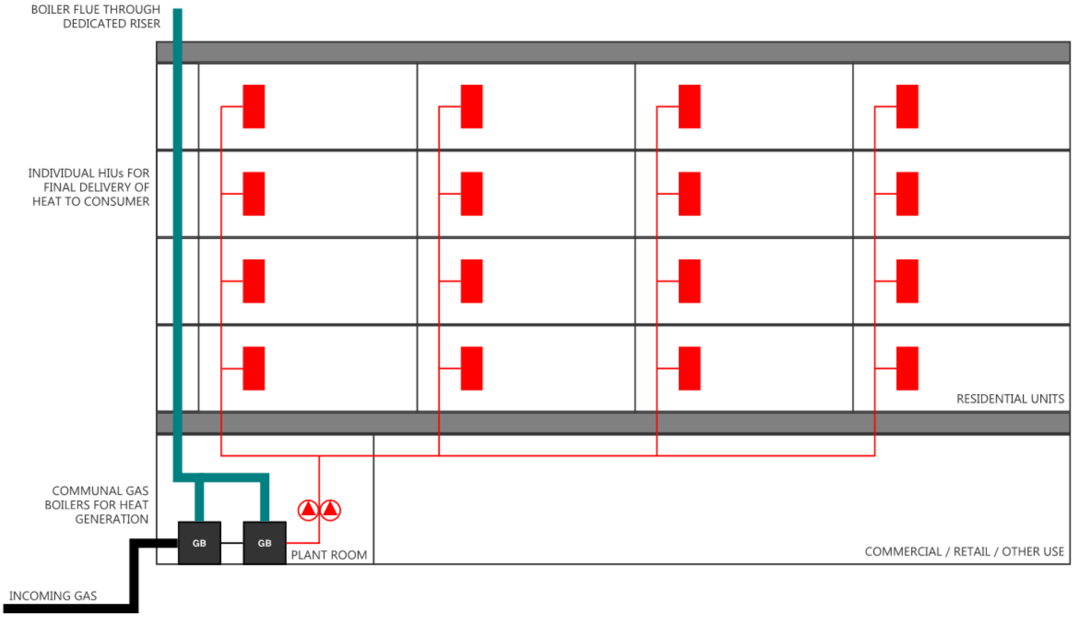

Figure 4—2 Residential – District heating ready

No.	Question
10	**Protected Pipe Routes**: (a) Has a potential intake route for district heating pipe to the building(s) been identified and safeguarded? (b) Have the pipe routes been safeguarded to connect from the building plant room to the route of the district heating network. Enterprise Area applications please reference the "Potential District Heating Cluster" map in the Heat Networks Guidance Note. Please note below the document and page number containing the drawing/s upon where these measures are identified.

This requires reference to the drawings showing the route of the intake pipe from the district heating main to the building.

Outside of the buildings, routes must be safeguarded to connect from the building plant room to the route of the district heating network. A safeguarded route should be designed to minimise the cost and disruption of a future district heating connection. This should include consideration of:

- A route planned through soft landscaping that can be easily excavated and/or surfaces that can be easily removed and reinstated.
- Sufficient space for access, trench and spoil during excavation i.e. 3m wide trench with 2.5m access. If smaller widths are proposed the applicant should provide justification.
- A route that does not conflict with other below ground utilities and services.
- Straight pipe runs with 90° bends where possible.
- Planned building entry below or above ground.

Potential pipe routes for district heating within the Enterprise Area are shown in Figure 6—2.

An example of a drawing showing safeguarded pipework route is shown in Figure 4—3.

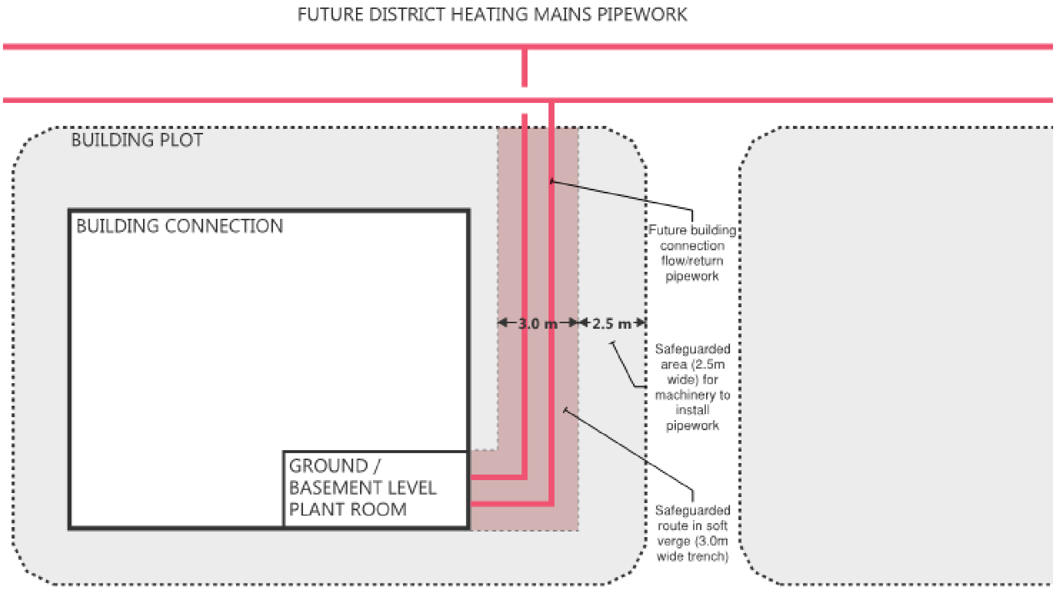

Figure 4—3 Plan of safeguarded route from plant room in building to district heat main

No.	Question
11	**Plant room location:** Is the heating plant room(s) in a location that allows access for district heating pipe (e.g. located on ground floor, adjacent to public highway) Please note below the document and page number containing the drawing/s upon where these measures are identified.

This requires reference to the drawings showing location of the plant room and entry point to the building.

Considerations should include:

- Plant room located so it accessible from ground floor and there is not a requirement for the district heating provider to run pipes through the building
- Soft points in building walls which could be pierced to install district heating pipework.
- External doors into plant rooms or a suitable access route for the district heating provider to inspect and maintain the heat exchanger(s).

Plans showing the location of the plant room should be provided. For example, a single drawing with the safeguarded route and location of plant room could be provided, such as those shown in Figure 4—3.

Details should be given on how the plant room could be accessed by a district heating operator in the future, e.g. through an external door in the façade.

No.	Question
12	**Plant room design:** Does the plant room design allow for future connection e.g. space allowed for installation of a plate heat exchanger and additional plant as required? Please note below, including the calculations for space allocated, and reference the document and page number showing where this is included in drawings.

It should be demonstrated that:

- **Floor area in plant rooms is sufficient for plate heat exchanger(s) (in addition to gas boilers if these are to be retained for security of supply).**
- **Any retained gas boilers should eventually be connected in series to the district heating system, such that the district heating remains the primary heat source and gas is only used as backup/top-up**

An example of calculations demonstrating sufficient space has been allocated:

- A 280kW heat exchanger with spatial requirement 2.0m L x 1.5m W x 2.0m H (including allowance for free space around units and redundant plate for resilience)
- The proposed boilers for the development occupy 3.0m L x 2.0m W x 1.5m H (including allowance for free space around units and redundant boiler for resilience) and therefore the removal of these provides sufficient space for the installation of a heat exchanger

Alternately, if the proposed boiler plant is to be retained to provide a back-up source, it should be shown that there is sufficient space to install additional heat exchangers with safe access.

The District Heating Manual for London provides spatial requirements of plate heat exchangers for different heat capacities (Table 4—1).

Table 4—1 Plate heat exchanger spatial requirements per heating capacity (reproduced from the District Heating Manual for London)[5]

Item	Heat exchange substation details						
Output (kW)	250	500	800	1000	1500	2000	3000
Number of heat exchangers	1	1	1	2	2	2	2
Length (mm)	1500	2250	2250	2750	2750	3000	3000
Width (mm)	500	750	750	1500	1500	1500	1500
Height (mm)	2000	2500	2500	2500	2500	2500	2500
Approximate dry wieght (kg)	750	1050	1300	1725	1800	1925	2000

[5] https://www.london.gov.uk/sites/default/files/london_heat_map_manual_2014.pdf

Total communal plant space for a multi-residential apartment block would be ~60m^2 (~7.5m x ~8.0m, see Figure 4—4). The plant room is future-proofed for district heating connection. Once the district heating becomes available the plate heat exchangers can be installed on the dedicated plinths and the boilers either removed or retained (depending on requirement for resilience in supply for the block).

The plant room floor area for a multi-residential apartment block would be approximately 1.5-2.0% of the total apartment floor area.

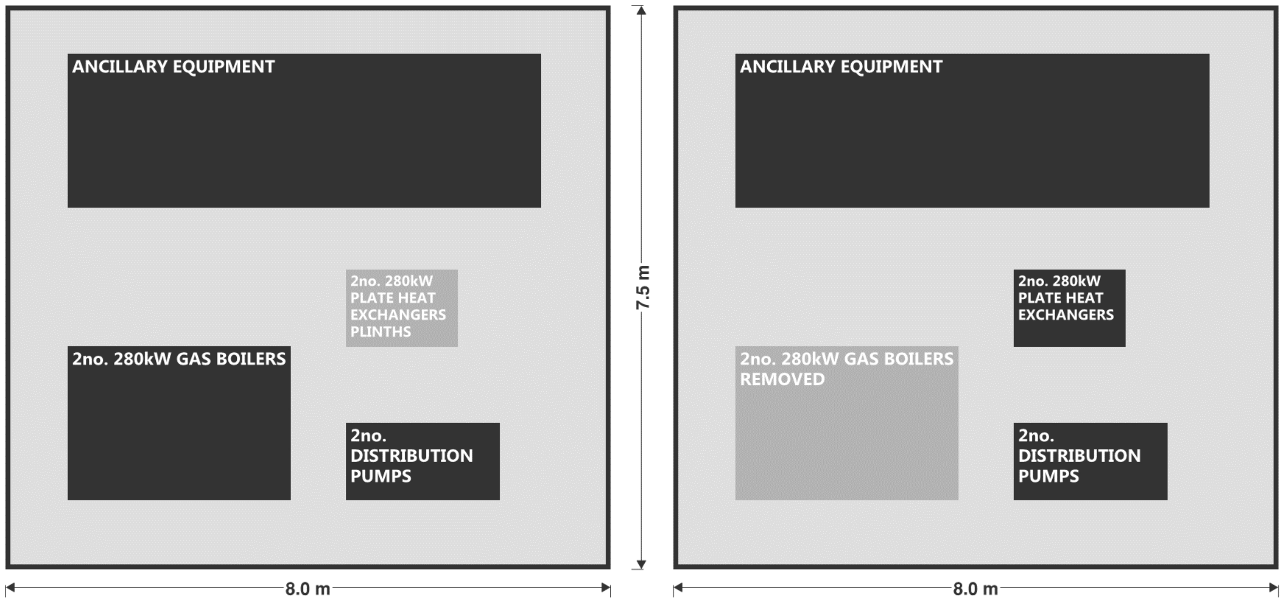

Figure 4—4 Initial future-proofed boiler plant room installation (left) and plant room for district heating connection (right)

5 Sample Future Proofing Planning Condition

A sample planning condition to ensure appropriate future-proofing of new development is shown below.

No construction of the walls of the development shall commence until a document demonstrating how the building has been futureproofed for connection to a district heating network has been submitted to and approved in writing by the Local Planning Authority. The document should state the preferred intake route for the district heating pipework to the heating plant room(s). The document should show how the building design follows the relevant clauses of Objective 3.4 To Design or Modify Suitable Space Heating and Domestic Hot Water Services Systems of the CIBSE & ADE Heat Networks: Code of Practice for the UK (or any document modifying or superseding this). Where a clause is not relevant the document should state why. Multi-residential buildings should also demonstrate how the design follows the relevant clauses of Objective 3.9 To Achieve an Efficient Heat Distribution System Within a Multi-residential Building and Reduce Risk of Overheating. The development shall thereafter be carried out strictly in accordance with the approved details.

Reason: In the interests of sustainable development and in order to show compliance with Policy CP4 of the Bath and North East Somerset Core Strategy.

CIBSE/ADE CP1: Heat Networks: Code of Practice for the UK is available from CIBSE at https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q200000090MYHAA2.

6 Bath Enterprise Area District Heating Priority Area

6.1 Enterprise Area district heating opportunities and constraints

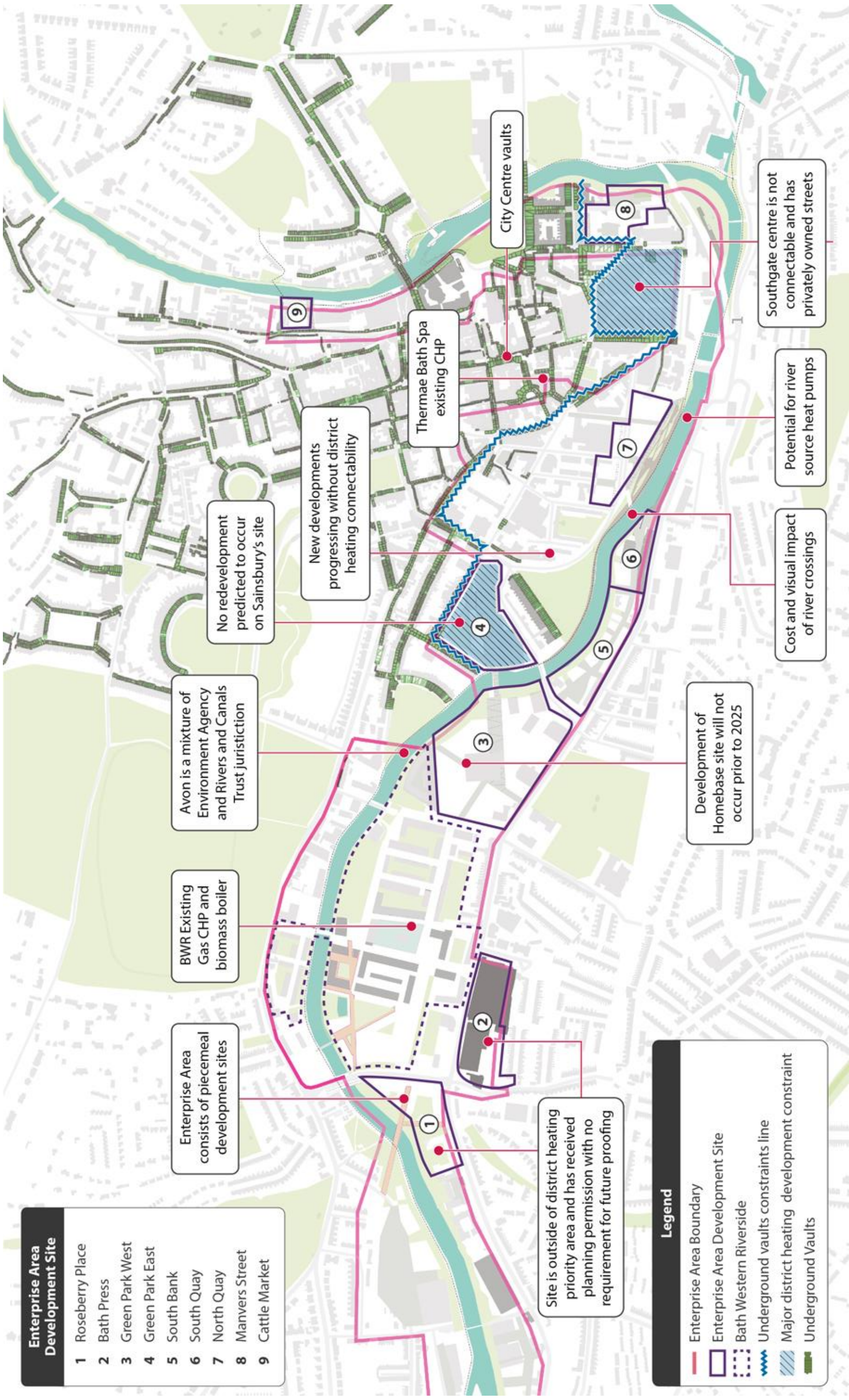

Figure 6—1 Enterprise Area opportunities and constraints

Enterprise Area development sites

There are nine Enterprise Area development sites, eight of which lie within a District Heating Priority Area as defined by Core Strategy Policy CP4. This allows a district heating connection to be compelled at these sites. However, the sites are disparate, separated by existing development and many will be developed in a piecemeal fashion. The sites are too small to support an independent district heating network and so coordination will be required across the Enterprise Area to deliver district heating networks.

Bath Western Riverside

Bath Western Riverside (BWR) is a large, partially constructed residential development located adjacent to three Enterprise Area development sites. BWR has an existing energy centre and district heating network for which E.ON is the operator until 2030. The Energy Centre is housed in a heritage building and contains gas CHP, a biomass boiler and gas boilers. It is BuroHappold's understanding based on meetings with E.ON that the energy centre has sufficient space available to expand to serve the full BWR development but is constrained beyond this. Therefore, although the network could potentially expand to serve adjacent developments, this would require new energy centre(s) and interconnection to the existing network. The existing DH pipework running to the east of the development is at capacity. The Destructor Bridge has an 80mm twin pipe installed within it. This has the capacity to serve around 1MW of heat demand.

BWR has a planning target of a 10% of energy to be provided through renewable energy as required by the BWR SPD; this may not be able to be met for the fully developed site by the existing biomass boiler capacity and there is little room to add additional renewable heat capacity. This presents an opportunity for a new energy centre with a renewable heat source, which could serve adjacent developments.

Green Park West (Homebase site)

The Enterprise Area masterplan envisaged that Homebase would end their lease on the Green Park West site and close, and Sainsbury's would close their Green Park store and create a new larger store on the Green Park West site. Homebase have signed a long term lease on their site (owned by British Land). Therefore, redevelopment is unlikely to occur on this site until at least 2025-2030.

Also, the Enterprise Area masterplan showed that the Pines Way roundabout would be remodelled to allow development of the area. Since the completion of the masterplan, planning permission was granted in November 2015 for an office, educational facility and student accommodation on the land in the centre of the roundabout, which mean the roundabout stays as is.

Until there is redevelopment of the Homebase site there is unlikely to be any significant opportunity for connecting the Bath Western Riverside site and the South Bank and South Quays sites with district heating.

Green Park East (Sainsbury's site)

The Enterprise Area masterplan envisaged that Homebase would end their lease on the Green Park West site and close, and Sainsbury's would close their Green Park store and create a new larger store on the Green Park West site. Following the masterplan, Homebase have signed a long term lease on their site (owned by British Land) and Sainsbury's are very unlikely to close Green Park and build a larger store in Bath. Therefore, the site is unlikely to see any further development and creates a large 'sterile' area for district heating. As well as this, the bridge at the Sainsbury's site is one of the few potential river crossing points for district heating.

River Avon

The River Avon is a physical constraint on district heating network development as there is a significant cost (in the region of several hundred thousand pounds) and visual impacts to routing district heating pipe over the river. Crossing at Windsor Bridge and the new South Quays footbridge have been ruled out for this reason.

The river also presents an opportunity in that it can be used as a heat source for a heat pump.

City centre vaults

Many of the public streets in central Bath have privately owned vaults beneath them. This means that there is very little depth of soil available for burying utilities and routing district heating pipes through the city centre will be very costly and in many areas impossible. The vaults are owned by the building owners along the street and therefore it would only take one vault owner in a street to refuse to allow heat networks to pass through the vaults to make a network route impossible. In addition, if agreement could be reached with all owners then the number of different parties involved would be likely to be seen as a significant risk to the installation contractor. This risk would be reflected in the price of pipe installation.

Some vaults are owned by the Council and it may be possible for district heating pipes to run through these vaults, however, the potential for this is understood to be limited.

Southgate Centre

The Southgate Centre's heating and cooling is provided by tenant fitted-out systems, which are generally electrically operated reversible heat pumps. These are not compatible with connection to a district heating system because the building heat distribution is via refrigerant rather than hot water.

Recent development without district heating connectivity

A number of new building and refurbishment projects in the city centre were granted planning permission after the 2010 AECOM study but prior to the adoption of the Core Strategy. Therefore Policy CP4 was not enforceable and a number of these new developments are not suitable for a district heating connection (for example Green Park House, which has electric panels providing heating). Also, two significant Enterprise Area sites (Bath Press and Roseberry Place) were shown as outside the District Heating Priority Area in the Core Strategy as such have no planning conditions relating to district heating.

6.2 Potential district heating clusters

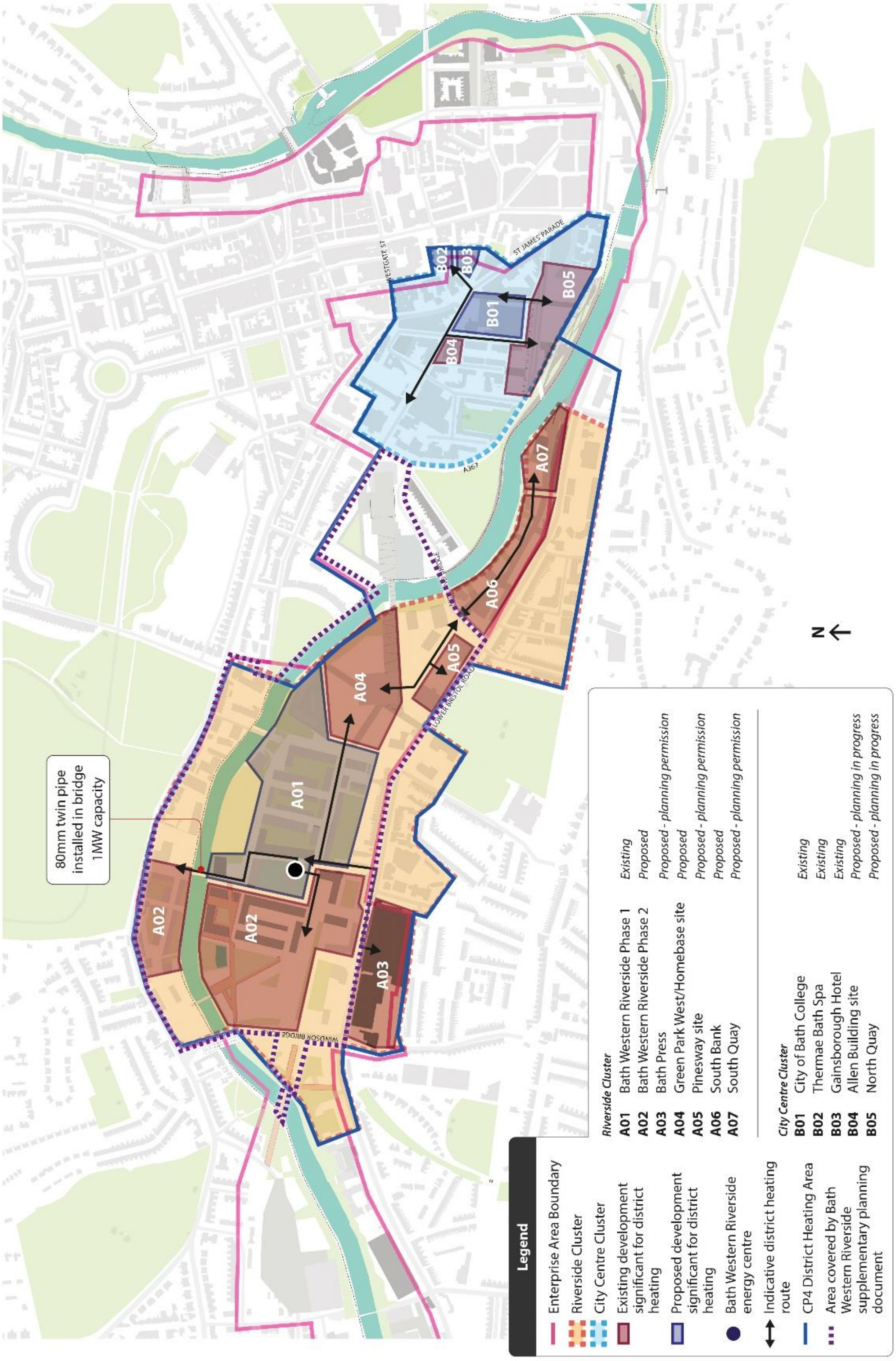

Figure 6—2 District heating clusters

6.2.1 Riverside Cluster

The Riverside Cluster is centred on Bath Western Riverside (BWR) a large residential development that will contain 2,000 homes when complete. The first phase has been constructed and is served by a district heating network, the second phase is also planned to be served by this heat network. The existing energy centre at BWR has sufficient space to install plant to serve Phase 2 but after this has no ability to expand further due to heritage constraints. Therefore, any further development of the heat network for the cluster will require additional energy centres.

The planning application for the Bath Press development to the south of Lower Bristol Road states that the development will have a central boiler house. This could allow interconnection of the Bath Press system to the BWR energy centre with the Bath Press boiler house providing the additional capacity needed to meet peak demands at Bath Press.

To the east of BWR the only development site of sufficient size to support an energy centre is the Homebase site. However, due to the lease that Homebase have for the site, it is unlikely to be developed until at least 2025-2030. Until this happens the development of a heat network at the east end of the Riverside Cluster is unlikely to be possible. After the redevelopment of the Homebase site it would be possible have a district heating corridor running parallel to Lower Bristol Road through the South Quay and South Bank areas connecting to the Pinesgate site and Homebase site. An energy centre on the Homebase site could interconnect with the BWR energy centre. The location of the Homebase site adjacent to the river means a water source heat pump could potentially be used as low carbon heat source.

Development triggers

A key short term trigger for action is the development of BWR Phase 2. The proposals for district heating should be compatible with future connection to the Green Park West sites. This could be reviewed by the BWR Sustainability Development Review Panel.

Any planning framework or masterplanning work carried out for Green Park West or pre-application submissions for the Homebase site should result in a feasibility study for district heating being carried out.

Key pipe routes

Key pipe routes that should be considered in future development proposals and may require safeguarding (e.g. pipe corridors identified, preferably soft dig or easy to reinstate surfaces) are:

- Connection from existing BWR energy centre to Homebase development site. This would most likely be via Stothert Avenue. E.ON have stated there are currently no significant below ground constraints that would prevent pipe routing along this route.

- Connection from Homebase development site to South Bank site. This could occur along the Pines Way public highway. If the Pinesway Industrial Estate is developed, it should be ensured that a pipe route is safeguarded to allow for the option to minimise disruption to Pines Way.
- South Bank route – the Placemaking Plan shows a public realm route running adjacent to Lower Bristol Road. As development plots come forward, it should be ensured that district heating pipework could be easily installed here at a future date. This will avoid the need for disruptive works on Lower Bristol Road.

Table 6—1 Riverside Cluster significant potential customers

Ref.	Name	Status	No. of resi units	Non-resi floor area (m^2)	Annual heat demand (MWh/ year)	Comments
A01	BWR Phase 1	Existing	813	Unknown	2,500	Connected to existing BWR district heating system Heat demand estimated from development schedule
A02	BWR Phase 2	Proposed	1,187	Unknown	4,500	Heat demand estimated from development schedule
A03	Bath Press	Proposed – planning permission	244	1,500	1,000	Outside of District Heating Priority Area at time of planning application. The Energy Statement submitted as part of the planning application proposed a single plant room serving all the buildings on the site to facilitate future connection to a heat network. Heat demand taken from Energy Statement in planning application.
A04	Green Park West – Homebase Site	Proposed	515	27,000	2,500	Based on Enterprise Area masterplan assumptions for whole Green Park West area less Pinesway site Heat demand estimated from Enterprise Area masterplan development schedule

Ref.	Name	Status	No. of resi units	Non-resi floor area (m^2)	Annual heat demand (MWh/ year)	Comments
A05	Pinesway Site	Proposed – planning permission	358	21,800	2,200	Office, teaching spaces and student residences. Planning condition to futureproof the building for connection to a heat network. Heat demand taken from Energy Statement in planning application assuming 90% efficient boiler.
A06	South Bank	Proposed	~150	~23,000	1,200	Based on Enterprise Area masterplan assumptions. Non-residential space is primarily office. Likely to be piecemeal development due to land ownership. Heat demand estimated from Enterprise Area masterplan development schedule.
A07	South Quay	Proposed – planning permission	59	11,500	550	Non-residential space is a mixture of office and ground floor commercial space. Heat demand taken from Energy Statement in planning application.
Total heat demand					**14,450**	

6.2.2 City centre cluster

The City Centre cluster is primarily centred on three existing buildings with significant heat demands in close proximity: City of Bath College, Thermae Bath Spa and Gainsborough Hotel. City of Bath College has an existing energy centre serving its building but this is not large enough to accommodate plant to serve the cluster. An energy centre of approximately 500m^2 would be required. The most viable location for an energy centre would be the North Quay development site as this is owned by B&NES Council and B&NES Council will remain part of a joint venture to develop the site.

Development triggers

Development of the North Quay site should either include a heat network (subject to further viability work and the final development mix, e.g. the inclusion of a hotel) or be futureproofed for district heating.

A key trigger for creating the heat network would be an agreement from two of the existing buildings to connect to the network. Safeguarding the ability to build an energy centre will be a key part of retaining the potential for a heat network in this location. This could be through identifying how an energy centre could be retrofitted in car park areas or ground floor commercial units within North Quay.

Key pipe routes

Key pipe routes that should be considered in future development proposals and may require safeguarding (e.g. pipe corridors identified, preferably soft dig or easy to reinstate surfaces) are:

- Avon Street – this most viable route for connecting North Quay to Thermae Bath Spa and Gainsborough Hotel. A route via the City of Bath College car park is unlikely to be viable as it would place significant constraints on the College’s ability to develop parts of the site in the future.
- James Street West – connection from Avon Street to Thermae Bath Spa and Gainsborough Hotel would be via this road. Although no sites are currently identified to the west of Milk Street, it could be the site of future building development or connection to existing buildings such as the Apex Hotel. The road is largely free of underground vaults.

Table 6—2 City Centre cluster significant potential customers

Ref.	Name	Status	No. of resi units	Non-resi floor area (m^2)	Annual heat demand (MWh/ year)	Comments
B01	City of Bath College	Existing	-	10,000-15,000m^2	2,000	All buildings apart from Roper Building and part of Forge building served from central boiler house. Heat demand estimated from existing bill data.
B02	Thermae Bath Spa	Existing	-	Unknown	3,100	Spa with pools. Heat demand estimated from DEC.
B03	Gainsborough Hotel	Existing	-	Unknown	Unknown	90 bed spa hotel with pools and conferencing facilities
B04	Allen Building site	Proposed – planning in progress	-	7,700	2,100	Heat demand taken from Energy Statement (DHW only)
B05	North Quay	Proposed – planning in progress	70-270	16,400 – 33,000	1,500	Non-residential consists of office, hotel and/or ground floor commercial units Heat demand taken from Energy Services Phase 2 study as no demand in North Quay Outline Planning Application
Total heat demand					**>8,700**	

7 Keynsham District Heating Priority Areas

7.1 Keynsham High Street District Heating Priority Area

In 2015, a feasibility study was undertaken in to district heating options at Keynsham town centre. This concluded that at the present time, district heating is not economically viable in central Keynsham, mainly due to the energy efficiency improvements at the new Civic Centre and proposed leisure centre resulting in a lower projected heat demand than in the 2010 AECOM study.

Although the study suggested that a heat network is not viable for the current building mix in the district heating priority area, future high density developments with the ability to connect will impact the viability of a scheme. Therefore CP4 has been retained as a material consideration for Keynsham town centre. The priority areas is shown in Figure 7—1.

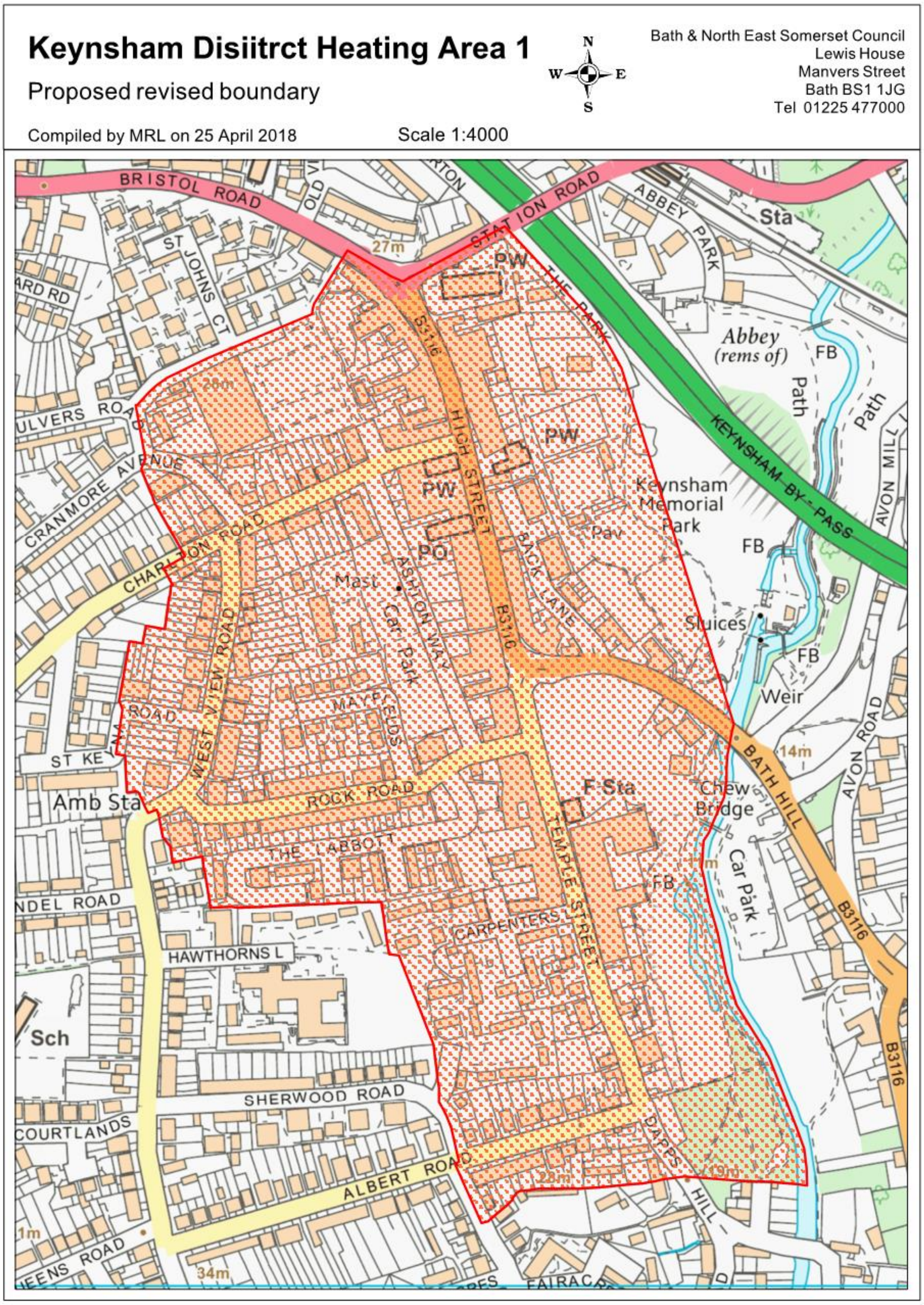

Figure 7—1 Keynsham High Street District Heating Priority Area

Appendix A Review of Heat Technologies

Table 7—1 Review of heat technologies

Technology	Description	Key considerations
Gas combined heat and power	Co-generation engine recovering heat from electricity generation. Carbon savings are based upon total emissions of the engine being less than the emissions of using a gas boiler and grid electricity to supply the same energy. Not a renewable technology and therefore does contribute towards Policy SCR1. However, does reduce overall emissions, which means the capacity of renewable energy technologies (e.g. PV) can be reduced.	• Air quality impacts (NOx), particularly in Air Quality Management Areas, such as within central Bath • Requires a steady heat baseload throughout the year to operate effectively • Business case depends on the ability to utilise or sell electricity generated
Water source heat pump	Uses electricity and a low temperature heat source to output higher temperature heat through the refrigeration cycle. More efficient when the source temperature and output temperature are closer. Typical inland source for water source heat pumps are rivers and lakes. Systems can be closed loop (heat exchangers placed within the water body) or open loop (water is abstracted from the water body, pass through heat exchanger and then discharged). Eligible for the Renewable Heat Incentive.	• The River Avon is the primary potential source • Consultation will be required with the Environment Agency. Abstraction and discharge licences will be required for open loop systems. • The Canals and Rivers Trust have jurisdiction over some parts of the Avon. They are likely to require a one-off fee for access for construction works and an ongoing annual charge. • Large capacity heat pumps are generally required to generate at output temperatures high enough to supply a heat network. • Impact on waterway navigation needs to be considered.

Technology	Description	Key considerations
Ground source heat pump	Uses electricity and a low temperature heat source to output higher temperature heat through the refrigeration cycle. More efficient when the source temperature and output temperature are closer. Heat exchange with the ground can be via boreholes (more efficient, more expensive and smaller ground area required) or shallow trenches (less efficient, cheaper and larger ground area required). Closed loop systems place heat exchangers in the ground, while open loop system abstract and discharge water from an aquifer.	• The ground in central Bath is warmed by the hot springs aquifer that lies beneath the city, which would improve the efficiency of a ground source heat pump system. • The Avon Act is in place to protect this aquifer, which is at artesian pressure. This limits the depths of boreholes that could be drilled for a GSHP system. Therefore, additional area for a borehole field is likely to be needed compared to a system in other areas. • Eligible for the Renewable Heat Incentive.
Air source heat pump – typical	Uses electricity and a low temperature heat source to output higher temperature heat through the refrigeration cycle. More efficient when the source temperature and output temperature are closer. Not typically used with district heating systems as the distribution temperature requirements mean that the efficiency is relatively low. However, some manufacturers do provide suitable units.	• Large capacity heat pumps are generally required to generate at output temperatures high enough to supply a heat network. • Efficiency at output temperatures typically required for heat networks is low, particularly at times of low ambient temperature. Reinforcement of local electricity network may be required. • Eligible for the Renewable Heat Incentive if units produce heating only.
Air source heat pump – CO_2 refrigerant	Use CO_2 as a refrigerant, which produce different characteristics to regular heat pumps.	• Requires very low return temperatures therefore generally suited to domestic hot water rather space heating.

Technology	Description	Key considerations
	Can output water at higher temperature (>60°C) than regular heat pumps but has different operating characteristics, that make it more suitable for the provision of hot water rather than space heating.	• Systems require a relatively constant output to operate effectively, most suited to supplying domestic hot water systems with significant amounts of water storage. • Eligible for the Renewable Heat Incentive if units produce heating only.
Sewage source heat pump	The temperature of sewage in a sewer network is typically at 10°C to 20°C, which is a good intake temperature for a heat pump. Heat can be extracted by removing sewage from a sewer passing it through a heat exchanger and then returning it to the sewer. Heat recovery can also take place at waste water treatment works.	• Depends on acceptability to Wessex Water • Limited number of available suppliers • Maximum output temperature of system is around 60°C • Suitable for development adjacent to major sewer routes • Eligible for the Renewable Heat Incentive.
Process and waste heat source heat pumps	Waste heat recovery as a result of large industrial power generation processes. Requires district heating network to transport heat to buildings.	• No significant scale sources of process or waste heat have been identified within the District Heating Priority Areas • Not classed as a renewable heat source. • Not eligible for the Renewable Heat Incentive.

Technology	Description	Key considerations
Biomass boiler	Biomass boilers typically burn either wood chip or wood pellets to provide energy for space heating and hot water. Although burning biomass releases carbon dioxide to the atmosphere, this is offset by the carbon dioxide absorbed in the original growth of the biomass, or captured in the growth of new biomass to replace the materials used. This means that the only net CO_2 emissions for biomass heating are associated with growing and transporting the fuel. Consequently emissions from biomass boiler are ~70% lower than conventional gas boilers.	• Air quality impacts (NOx and particulates), particularly in Air Quality Management Areas, such as within central Bath • Suitable space for fuel storage and delivery required • Requires frequent deliveries • Eligible for the Renewable Heat Incentive.
Biomass combined heat and power	Biomass CHP uses wood fuel to generate heat and power. There are three main biomass CHP technologies: Steam turbines; Organic Rankin Cycle; and Gasification. Systems typically need to be more than 2MW to operate effectively.	• Unlikely to be sufficient heat demand to support a large scale system. • Immature technology expensive and unreliable at a small scale owing to the high temperatures and pressures required. • Eligible for the Renewable Heat Incentive.
Anaerobic combined heat and power	Biogas produced from the anaerobic digestion process can be burnt in a CHP engine to produce heat and power. Feedstock for anaerobic digestion is typically food waste or animal manure.	• Anaerobic digestion plants are generally located away from urban areas due to odours and feedstock availability. • Direct injection of biogas from anaerobic digestion into the gas grid is often the preferred approach rather than burning it in local CHP engines. • Eligible for the Renewable Heat Incentive.

Appendix B Decarbonisation and Heat Networks

The UK electricity grid is predicted to decarbonise significantly over the next 30 years as coal and gas generation is replaced by renewable and nuclear sources. The Department of Business, Energy and Industrial Strategy (BEIS) have produced grid decarbonisation projections up to 2050, shown in Figure 7—2. These include a consumption based scenario (annual average emissions intensity) and displaced emissions from CHP, which takes account of the time of day/year that CHP generates. BEIS recommend the latter is also used to calculate CO_2 emissions from heat pump systems.

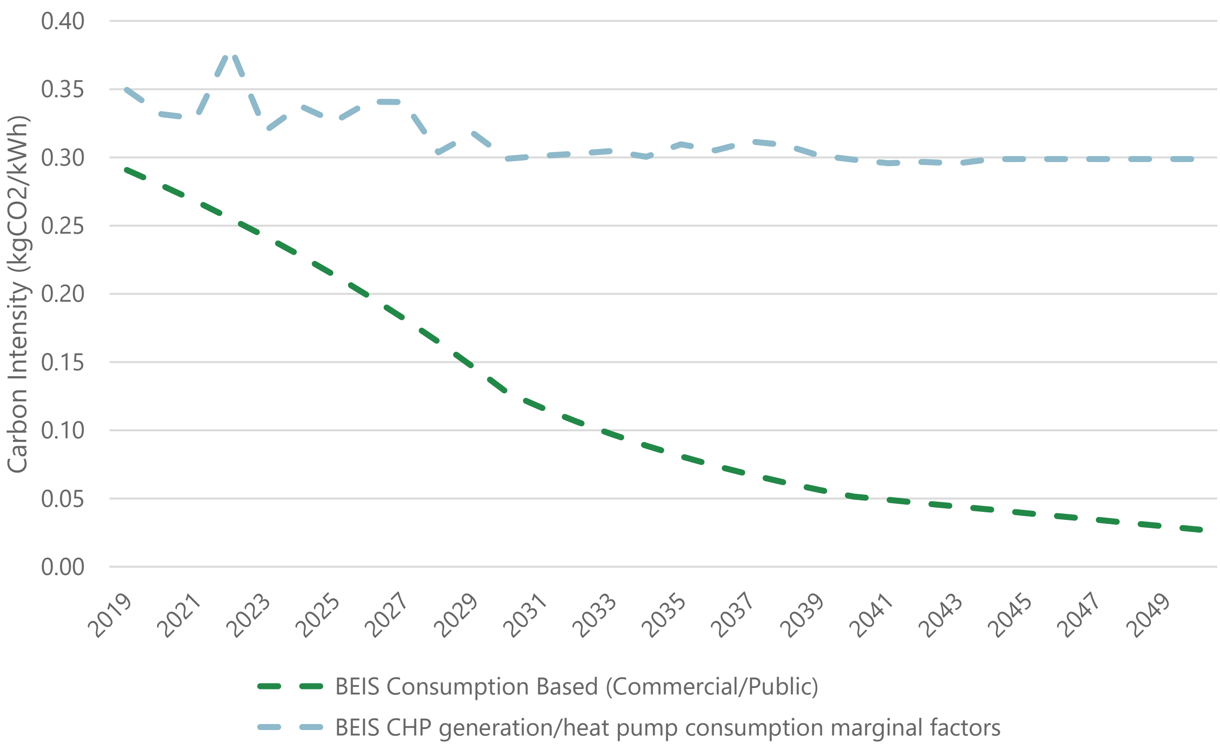

Figure 7—2 Electricity grid decarbonisation projections for general consumption and CHP generation/heat pump consumption

7.1.1 Impact of decarbonisation of heat technologies

The decarbonisation of the electricity grid has a significant impact on CO_2 emissions of two major low carbon heat technologies used with heat networks:

- Heat pumps
- Gas fired combined heat and power (CHP)

Gas CHP has historically provided significant carbon savings compared to gas boilers, due to the high emissions associated with grid electricity. However, these savings will reduce as the grid decarbonises and by 2034 it is anticipated that there will be no CO_2 saving compared to a gas boiler as shown in Figure 7—3.

Conversely, the CO_2 emissions for heat pumps improve as the grid decarbonises. Figure 7—3 shows the emissions from a heat pump system with a seasonal efficiency of 300% using both the BEIS CHP generation factor (i.e. assumes that heat pumps are mainly used at time period when the grid has higher carbons emissions than the average) and the annual average grid CO_2 emission factor. Even using the poorer emission factors, a heat pump would match the emissions of gas CHP from 2023 and have lower emissions from 2027 onwards.

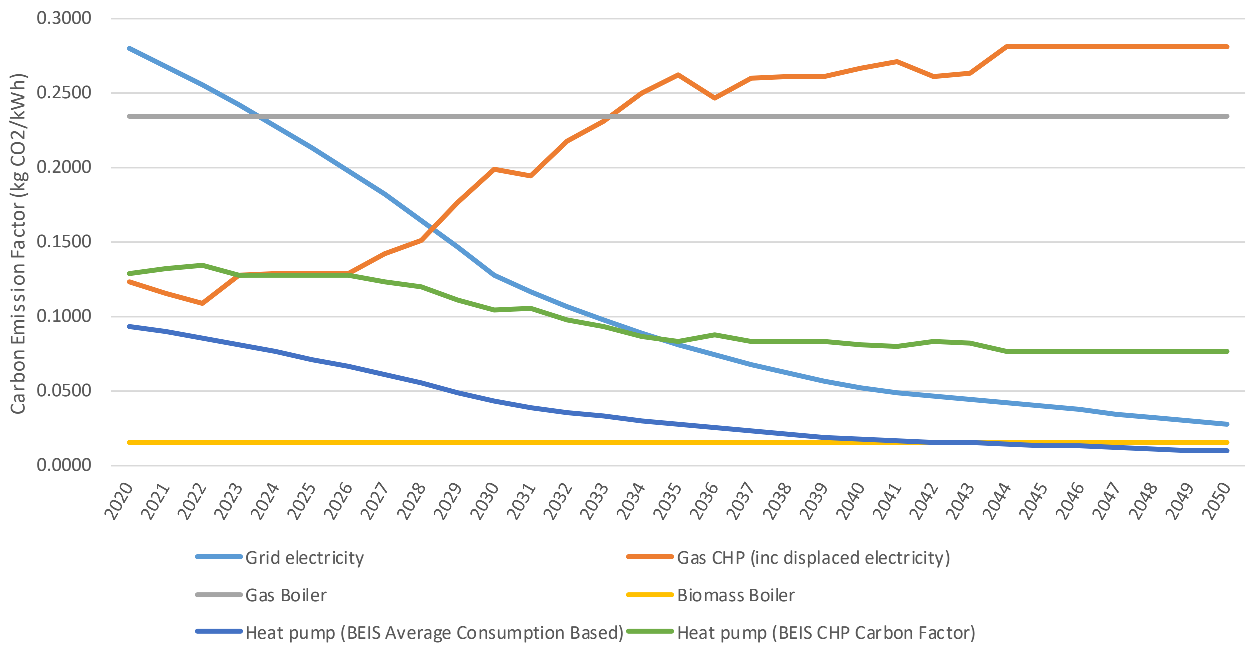

Figure 7—3 Carbon emission intensity projection for heat technologies (based on BEIS scenarios)[6]

[6] Gas and biomass: https://www.gov.uk/government/collections/government-conversion-factors-for-company-reporting
Grid electricity: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
CHP electricity: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/389070/LCP_Modelling.pdf

It should be noted the CO_2 emission intensity of electricity assumed by the current version of Part L of the Building Regulations (2013) is 0.519kg/kWh, which is significantly higher than the projections discussed earlier. This disadvantages heat pumps and advantages gas CHP compared to the likely emissions in reality. The proposed value for the next update to Part L is 0.398kg/kWh[7], which is higher than the predicted average emissions over the next three years. Therefore, Part L calculations currently present higher electricity emissions intensity than is likely to be the case over the lifecycle of the project. Heat source selection will need to consider short term requirements of Building Regulations and the longer term CO_2 reduction aspirations.

A review of renewable and low carbon heating options is presented in Appendix A.

[7] https://www.bre.co.uk/sap2016/

Appendix C Future Proofing Delivery Considerations

Operation and billing in future-proofed multi-residential buildings

In a normal individual gas boiler system, the occupier pays fuel bills directly to the energy supplier, and it is the occupier's responsibility to maintain and replace boilers at their own risk. Future proofing for district heating means the occupier buys heat from an operating company of communal boiler plant, and a third party operator assumes risk for operation and service guarantee. It is recommended that the Heat Trust scheme[8] requirements are followed in order to provide customer protection for occupiers.

The cost of future-proofed buildings compared to non-future-proofed buildings

A high level capital cost comparison between buildings future-proofed for district heating and buildings that have not been future-proofed for district heating has been carried out by BuroHappold, the results of this are summarised below.

Non-residential buildings

For non-residential buildings, there is not considered to be any capital cost difference between futureproofed and non-futureproofed buildings as it is usual for heating plant to be provided in a single central location. Differences could relate to the location of the plant room or layout for the plant room, however, these are not considered to have significant capital costs if considered in the early stages of a project.

Multi-residential buildings

Apartment buildings could have significantly different heating system designs as discussed earlier in Section 4.6 and shown in Figure 4—1 and Figure 4—2. The cost comparison assumed a 64 apartment block, which is assumed to be of a scale typical of construction in B&NES. This block was four storeys tall, with sixteen 60m^2 apartments on each floor.

Table 7—2 shows the details of the systems within each option. Costs were taken from Spon's Mechanical and Electrical Price Book (2017) where possible, otherwise costs were taken from industry and previous BuroHappold experience.

Overall, this study found that in capital cost terms these approaches were broadly cost neutral with a difference of under £50 per apartment.

[8] http://heattrust.org/index.php

Table 7—2 Multi-residential building system comparison

<table>
<tr><th>Normal approach – not futureproofed</th><th>District heating ready</th></tr>
<tr><td>

Central incoming gas connection in the incoming gas mains room,
Individual gas meter per flat,
Individual vertical distribution pipework from meter direct to boiler in fire-proof risers (30 minutes fire proofing),
One wall-hung 35kW boiler per flat for space heating and domestic hot water generation,
Secondary space heating distribution network and heat emitters.

</td><td>

No gas supply to flats (electric cooking)
Central incoming gas connection in the incoming gas mains room with gas meter,
Communal heating plant room, including:

Two 250kW central boilers to allow for modulation and redundancy,
Flue,
Distribution pumps,
Water treatment,
Pressurisation / expansion vessel,
Buffer vessel.

Low temperature hot water distribution pipework in vertical risers with high levels of insulation
Heat interface unit (HIU) per flat for space heating and DHW generation:

Automated isolation valves,
Heat meter,
Direct heating connection with thermostatic valve,
DHW plate for instantaneous hot water generation,

Domestic hot water peak demand assessed based on DS439. When there is a hot water and heat demand within a flat at the same time, the hot water is prioritised similar to a combi-boiler.
Secondary space heating distribution network, heat emitters and controls assumed as per non-future proofed heating.

</td></tr>
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Appendix D Placemaking Plan District Heating Priority and Opportunity Areas

Please note that the District Heating Priority areas shown with the Placemaking Plan and below are superseded by the more detailed maps contained within this document.

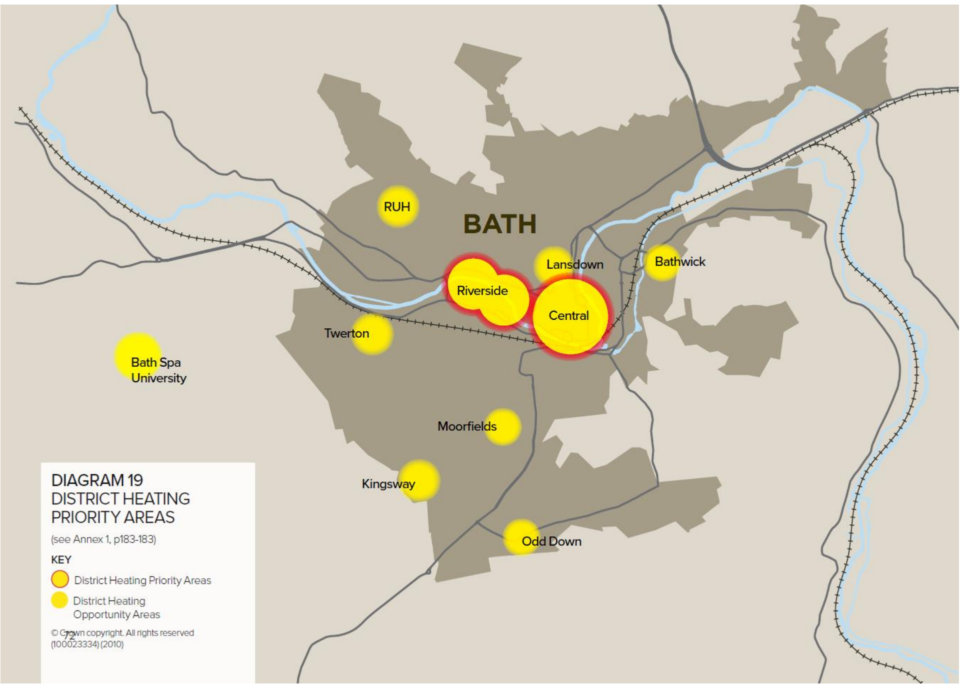

Figure 7—4 Bath District Heating Priority and Opportunity Areas

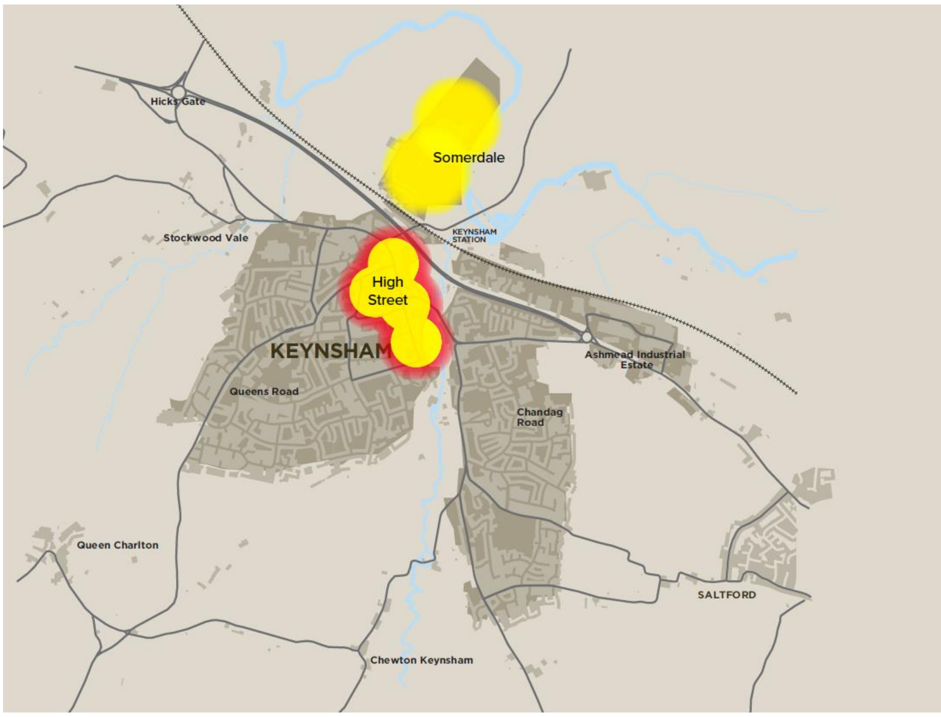

Figure 7—5 Keynsham District Heating Priority and Opportunity Areas

Figure 7—6 Somer Valley District Heating Opportunity Areas

Appendix E Glossary

Term	Definition
AD	Anaerobic Digestion
AQMA	Air Quality Management Area
ASHP	Air Source Heat Pump
B&NES	Bath and North East Somerset
BEIS	Department of Business, Energy and Industrial Strategy
BHE	BuroHappold Engineering
BWR	Bath Western Riverside
CHP	Combined heat and power
DECC	Department of Energy and Climate Change (now defunct, replaced by BEIS)
DH	District heating
DHW	Domestic Hot Water
ESCo	Energy Services Company
GLA	Greater London Authority
GSHP	Ground Source Heat Pump
HNDU	BEIS Heat Networks Delivery Unit
HIU	Heat Interface Unit
O&M	Operations and Maintenance
PV	Photovoltaic
RHI	Renewable Heat Incentive
WECA	West of England Combined Authority
WoE	West of England
WSHP	Water Source Heat Pump

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