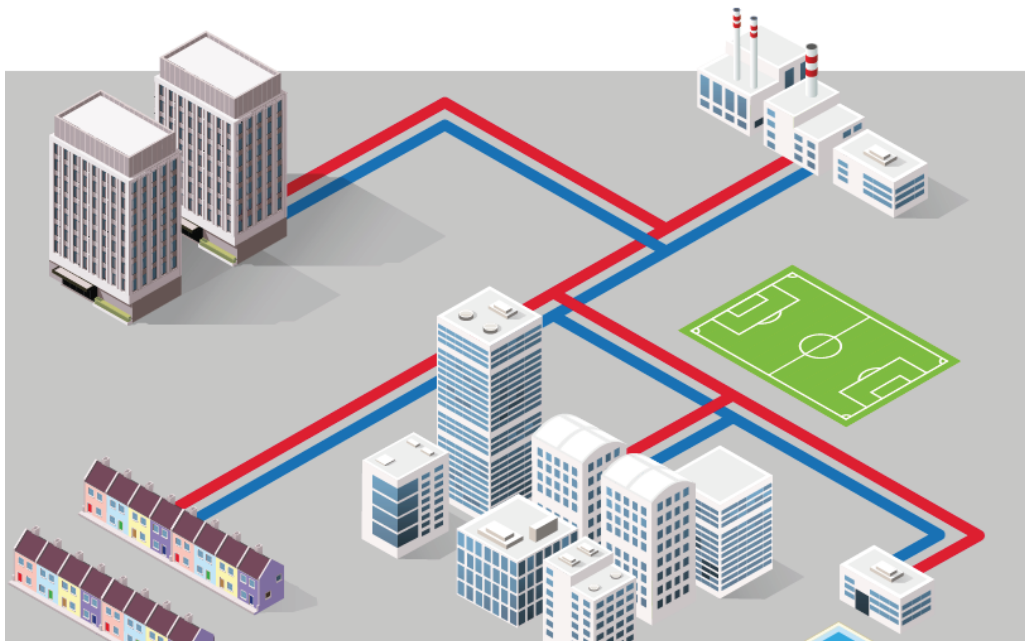


Appendix A – Further essential background / detail on the proposal

1. This report is seeking additional funding and approvals to expand Bristol's heat network and provides an update on heat network installation work carried out to date previously approved by Cabinet (see Cabinet report links below)
 1. [1 July 2014 Cabinet Report 'District Heating Phase 1'](#)
 2. [7 June 2016 Heat Networks Phase 2](#)

Background and rationale for Heat networks

2. Heat networks, also known as district heating, are systems for distributing heat generated in a centralized location via a network of pipes for domestic and commercial space heating and water heating.
3. As the heat network is agnostic to the type of heat generation installed, it can supply heat from a variety of energy generation technologies from Gas combined heat and power (CHP) to heat pumps as well as biomass and waste heat from industrial processes. This ensures heat networks are a 'no regrets' technology able to deliver heat whatever the heat technology available.



4. Heat networks using low or zero carbon energy technologies are amongst the cheapest methods of cutting carbon emissions. In regards to the Bristol Heat network, various low and zero carbon heat sources will be incorporated including water source heat pumps (WSHP) supplying heat from the floating harbour, Gas CHP and the currently operating biomass boiler within the Broughton Energy Centre.
5. Although only 2% of heat in the UK is currently supplied by heat networks, this is rapidly increasing, particularly in cities and is supported by UK government who have

recognised that around 20% of heat could be supplied by heat networks across all five future energy supply scenarios contained in the Clean Growth Strategy, which was published by Central Government in 2017. Major European cities like Vienna and Copenhagen have installed heat networks supplying over 95% of homes. Consequently, Copenhagen is on track to be carbon neutral by 2025.

6. In the UK, almost all cities have either installed or are looking to install heat networks. London currently has the greatest number of heat networks with London boroughs such as Enfield and Islington taking a lead. A number of large towns are also installing heat networks. For example, Gateshead has completed a £25 million heat and power network supplied from a Gas CHP energy centre.
7. Heat networks are central to achieving the Mayor's commitment to Bristol being a carbon neutral city by 2050 as well as help to tackle fuel poverty by providing heat to residents at lower prices. In confined urban areas like central Bristol, it can be argued that heat networks provide the only financially and technically viable solution for zero carbon heat.
8. BCC's Sustainable City team have appointed Element Energy Ltd to assist in developing the evidence base for the policies required to provide zero carbon heat in the city. This is needed to meet the Corporate Strategy commitment (2018-2023) to 'keep Bristol on course to be run entirely on clean energy by 2050', and to continue to reduce CO₂ emissions with the aim to be carbon neutral by 2050, and to provide affordable and secure energy.
9. The findings of the study show that heat networks, distributing renewable and very low carbon heat (including energy from waste from plants located in Avonmouth), in combination with the installation of energy efficiency measures, are critical for achieving zero carbon heat in new and existing buildings. For residential parts of the city located away from the main heat network routes, other forms of renewable heat will be required. These are most likely to be ground, air and water source heat pumps. BCC is currently investigating the use of ground source heat pumps for new residential developments as part of the Alderman Moores development.
10. Installing heat networks will also support the following corporate strategy key commitments:
 1. Improve our environment to ensure people enjoy cleaner air through supporting the further deployment of renewable heat generation.
 2. Improve physical and mental health and wellbeing by making residents' homes warmer and cheaper to heat, reducing inequalities and the demand for acute services.
 3. Tackle food and fuel poverty by reducing energy bills.
 4. Create jobs, contributing to a diverse economy that offers opportunity to all and makes quality work experience and apprenticeships available to every young person.
11. Installing heat networks will also provide the following benefits for the City of Bristol:

- Provide an independent revenue stream to the Council from the sale of heat and power to connected buildings.
- Reduce fuel bills for businesses connected to the network through lower prices
- Provide an opportunity to build partnerships with other public sector bodies and the business community.
- Reduce energy consumption and operating costs for building occupiers, improving Bristol's competitiveness for attracting new businesses to the City.
- Reduce costs for developers as they no longer need to install and maintain expensive heat generation plant and equipment.
- Increase the City's energy security and resilience.

Current focus of Heat Networks

12. BCC are looking to deploy heat networks in Bristol where either:

1. there is a high demand for heat (such as the city centre), or
2. large areas of new build development are planned, or
3. low cost zero carbon waste heat could ultimately supply a heat network.

Bristol Heat Networks

Work to date - previously approved by Cabinet

Temple & Redcliffe Heat Network Phase 1

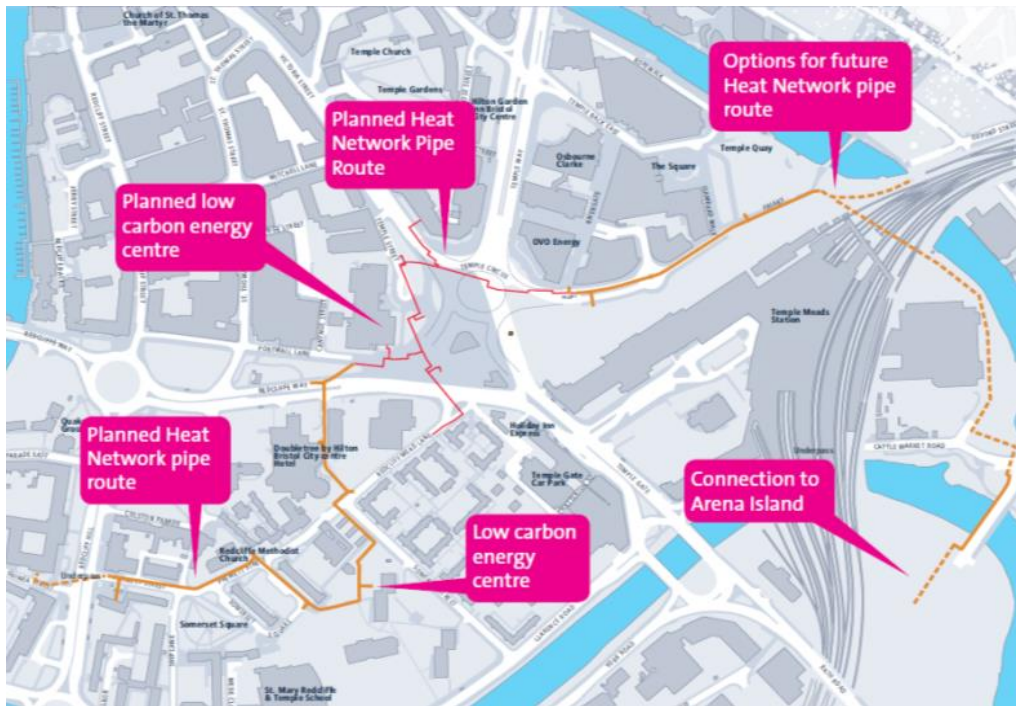
13. The Temple & Redcliffe Heat Network has been operating since 2016. The scheme involved the installation of a 1MW_{th} biomass energy centre in Broughton House (Redcliffe) supplying low carbon heat via underground heat mains to 13 social housing blocks. This work was completed in March 2016 and is currently saving around 1,000 tonnes of CO₂ per annum and a reduction in tenant heating bills by around 10%.

Figure 1 – Broughton House Energy Centre and installation of heat network between Broughton and Canynge.



14. Over the next 1-2 years, the Temple & Redcliffe network will be extended to connect 100 Temple St and the proposed Engine Shed 2 and Temple Square new developments. Part of these works is currently being constructed as part of the Temple Gate highway works to ensure capital costs and disruption are minimised.

Figure 2 - Map showing route of Temple & Redcliffe Phase 1 heat network once complete



Rowan Heat Network

15. This project involved the installation of a biomass boiler energy centre to serve five social housing blocks in the Hartcliffe area of Bristol, previously supplied via a gas heat network. This project has been operational since October 2015 and has reduced the carbon emissions by over 50% to around 300 tonnes per annum.

Figure 3 – Social housing blocks connected to the Rowan Heat Network



St Michaels Hill heat network (formerly City Centre Phase 1)

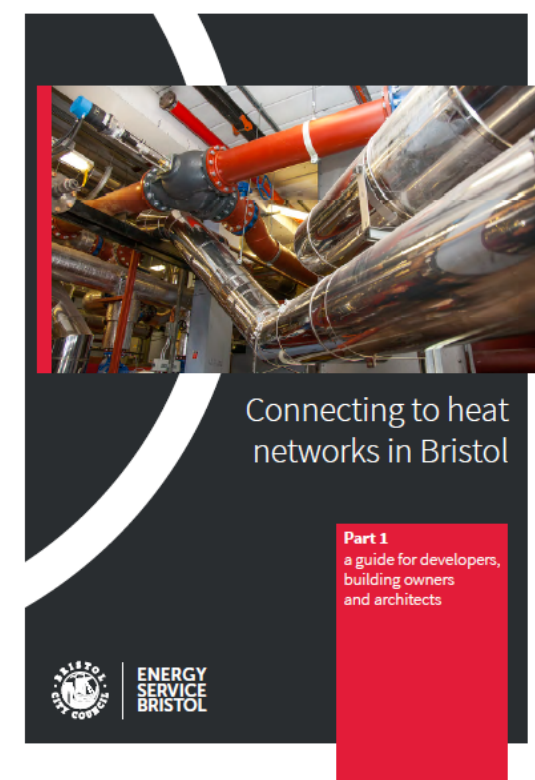
16. In July 2014, Cabinet approved Tier 2 Corporate Capital Programme status for the City Centre District Heating Phase 1 (now known as City Centre Heat Network Phase 1) with an estimated capital spend of £6m. At the time, this project proposed a 2.6MWe Gas Combined Heat & Power unit (CHP) being installed by the Council within the energy centre of the Bristol Royal Infirmary to supply low carbon energy to the United Bristol Hospitals NHS Foundation Trust (UBHFT) and a number of University of Bristol (UoB) buildings. A Memorandum of Understanding in relation to the scheme was signed by all three parties in March 2015.

17. In July 2016, Cabinet approved the decision to allocate £5.0m of capital funding to deliver the project and negotiate heads of terms with the UoB and UBHFT. Further feasibility and legal advice was undertaken to identify a special purpose vehicle (SPV) structure that would enable the project to commence with all parties receiving an appropriate financial return or energy costs savings. However, whilst BCC and the University were keen to progress the project, UBHFT have now withdrawn from the project and will focus on their site only. The BCC funding currently allocated to this project is therefore available to support the expansion of the heat networks as set out within this report.

Bristol Heat Network Design Guidance and BCC Planning Policy

18. Bristol Planning Policy BCS14 expects new developments in the heat priority area to connect to a heat network where technically and financially feasible or where a heat network is not being installed to be 'DH ready' to enable connection at a later date. Where possible BCC are working with developers to provide a 'day 1' heat network connection to enable the benefits of heat networks to be realised sooner rather than later.
19. To ensure new developments connected to the Bristol Heat Network provide residents with low cost heat, the City Council has released a guide for developers, architects and building designers to ensure new developments connecting to the Bristol heat network are designed and operated in line with the latest CIBSE guidance (<https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q200000090MYHAA2>). The CIBSE guidance reduces the likelihood of high heat losses and associated higher energy bills for residents currently not addressed within Building regulations.

Figure 4 – Bristol Heat Network Design Guide



Expanding Bristol’s Heat Networks - seeking Cabinet approval

20. Following heat demand and masterplanning assessments, feasibility and design of the Bristol Heat network is currently focussed on the following areas:
1. Areas of the city with a large heat demand (such as central Bristol),
 2. New development areas of a sufficient size that a heat network is financially viable (such as the TQEZ)
 3. Areas of the City within an acceptable distance from the proposed Strategic Heat main supplying waste heat from industrial processes at Avonmouth to the Bristol heat network.
21. Whilst existing buildings are being investigated for connection, the attention is currently on connecting new private developments to the network through Bristol’s planning policy requirements as they provide an upfront connection fee that helps the financing of the heat network whilst also avoiding the need for new developments to install costly and ultimately redundant fossil fuel heat generation equipment.
22. Heat network routing and associated timescales will be dependent on when new developments are constructed which is outside BCC’s control. This requires a flexible approach to delivery to ensure newly completed developments are supplied by heat from the Bristol heat network in time. This may require temporary or interim energy centres to be installed in the short term until the build out of the heat network is sufficient for them to be removed or retained for resilience purposes only.
23. Bristol’s Energy Service therefore require the ability to re-programme the installation of heat networks and associated energy centres to meet developer timeframes as well as work with BCC Transport teams to ensure disruption is minimised.

Capital expenditure & Phasing

24. Capital expenditure is based on a combination of detailed feasibility or masterplanning and so is subject to change as projects progress into the detailed feasibility stage where this has yet to commence &/or procurement and construction. However, contingencies have been incorporated within the cost estimates based on appropriate risk levels. For example, heat network pipe work within a utility congested road includes a higher level of contingency.

Table 2. Summary of grant funding, connection charge and prudential borrowing for each heat network

	Grant funding	Connection charges	CAPEX via Prudential Borrowing	Total CAPEX
Temple & Redcliffe	£1,200,000	£768,000	£2,032,000	£4,000,000
Old Market	£1,225,535	£414,000	£2,445,581	£4,085,116

St Pauls	£830,219	£317,387	£1,619,230	£2,767,397
Old Market Water source Heat Pump (Energy Centre design)			£350,000	£350,000
Total	£3,255,754	£1,499,387	£6,446,811	£11,201,952

Phasing of heat network delivery

25. Given the high upfront capital cost and complexity of installing heat networks without a negative impact on traffic congestion, the Bristol heat network is proposed to be built out on a phase by phase basis, the ultimate end goal being a city wide heat network delivering low cost, zero carbon heat from a number of energy generation sources including waste heat from Avonmouth.
26. Phasing of heat networks is typically carried out as below:
1. Networks that meet the net positive cash flow requirement
 2. New development connections as required by planning
 3. Highest CO₂ saved per £ of expenditure
 4. Critical connection/future proof opportunity lost

Heat networks revenue streams

27. Within Heat Priority Areas, new developments must connect to Bristol's heat network as part of planning requirements (once the financial and technical viability have been demonstrated). As well as providing an upfront connection fee, these new connections will provide long term revenue to BCC through heat sales but only if BCC can demonstrate its ability to connect a new development within the developers timeframe. Failure to do this not only increases the risk of lost revenue but the ability of the heat network to generate associated carbon savings.

Table 1 - Indicative phasing of heat networks (capital expenditure)

	2018/19	2019/20	2020/21
Temple & Redcliffe	£203,500	£3,713,904	£189,300
Old Market	£735,000	£2,100,000	£1,250,000
St Pauls	£75,000	£850,000	£1,730,000
Old Market WSHP	£355,000		
Total	£1,368,500	£6,663,904	£3,169,300

28. Approval is therefore sought for BCC's Energy Service to install heat network extensions and associated activities in line with business opportunities not yet identified up to this spending envelope in order to deliver a financially viable city wide heat network.

Financial viability

29. BCC Energy Service has employed external consultants to produce a heat network financial model to ensure the Bristol Heat Network meets the BCC Finance requirement of generating a positive financial benefit to the Council once prudential borrowing repayments have been taken into consideration. Each of the different heat network first phases meet this requirement.
30. Given BEIS HNIP grant funding is soon to be available for applications, BCC Energy Service are seeking approval under this cabinet report to apply for this capital grant funding in order to deliver an even greater net positive income to BCC.

Bristol Heat Network – Central Bristol

31. Following the completion of master planning studies, detailed feasibilities are currently underway to determine the exact sizing of energy generation equipment, underground pipework and the associated final heat network routing that will provide the most technically and financially viable heat network.
32. Figure 5 below identifies the current areas of investigation. This is mostly confined to areas of high heat demand and new development within the city centre to enable the heat network to provide a net positive income to the council. The likely capital cost for delivering the full build out of this central network is likely to be around £50 million.

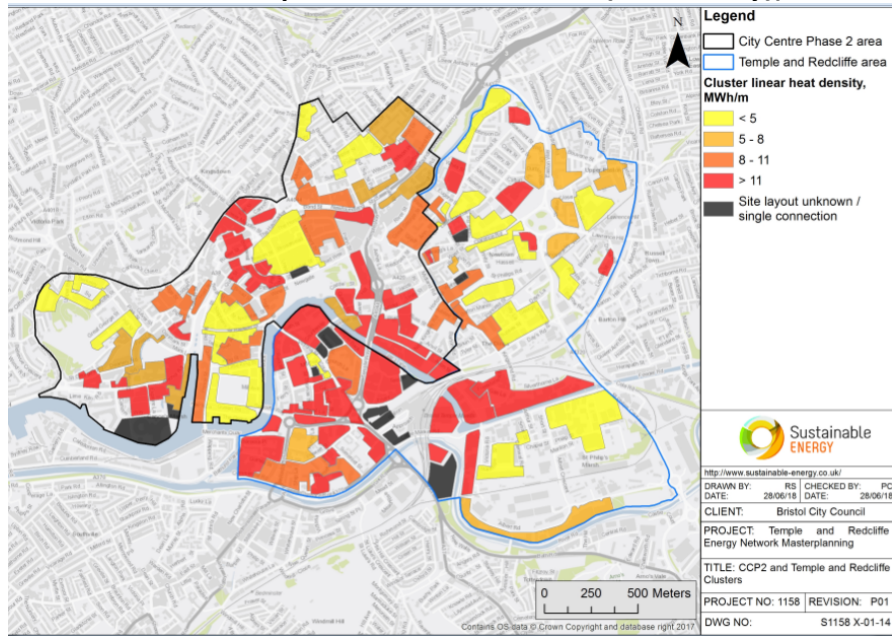
This Cabinet Report is seeking additional funding of £2 million to finance the next phase of the Bristol Heat Network (including extensions of the existing Temple & Redcliffe heat network) and reallocation of £4.5 million of prudential borrowing previously agreed with later phases potentially being delivered as part of the City Leap programme.

33. The main reasons for delivering an expanded heat network prior to the completion of the City Leap programme are as follows:
 1. A number of new developments are currently under construction which require heat in 2019/20. Delays in installing the heat network will result in BCC not achieving the required heat-on dates and these new developments having to install fossil fuel boilers instead. Not only will this prevent BCC from receiving a connection fee, it also makes the task of converting these buildings to a zero carbon heat source in the future much more difficult.
 2. BEIS have announced a round of capital grant funding for heat networks (HNIP) opening in Autumn 2018 with a short application window. The Energy Service is seeking approval to apply for this grant funding as this will enable delivery of a larger and more financially secure heat network with greater

income generation to the council.

3. The outcomes of the City Leap programme and the associated timeframe for potential investment/delivery partners are unknown.

Figure 5 – Current area assessment for the Central Bristol heat network (City Centre network + Temple & Redcliffe network {routes only}).



34. Whilst a flexible approach to delivery is required, the current heat network activity is focused in the following areas of central Bristol and capital funding as sought within this Cabinet Report is likely to be used to deliver the heat network and associated energy centres:

- a. **St Paul's heat network** – initially serving new developments and existing BCC social housing blocks
- b. **Old Market heat network** – initially serving new developments in the Avon St and Castle Park area of the city.
- c. **City Centre heat network** - serving mostly existing buildings around City Hall, Harbourside and Trenchard St. Proposals to fund this part of the heat network will be brought to Cabinet at a future date.

Figure 6a - Proposed Bristol Central Heat Networks – Phase 1 only

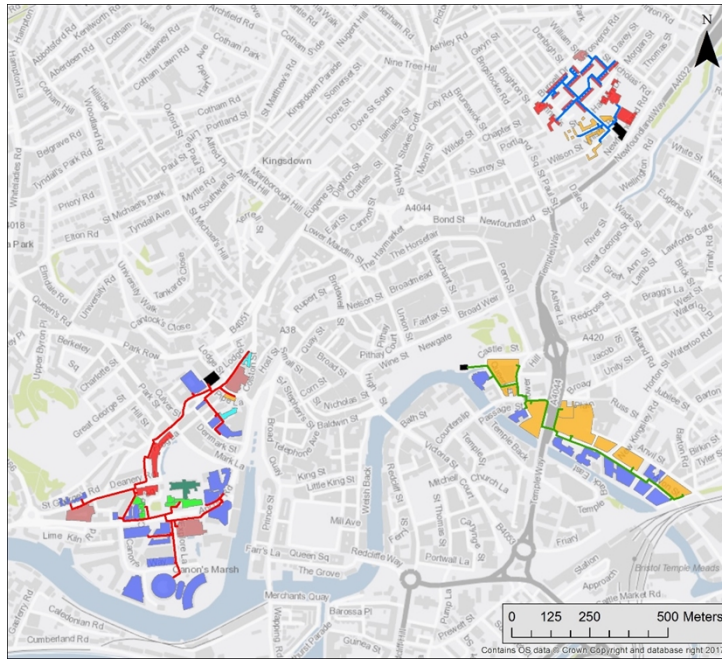
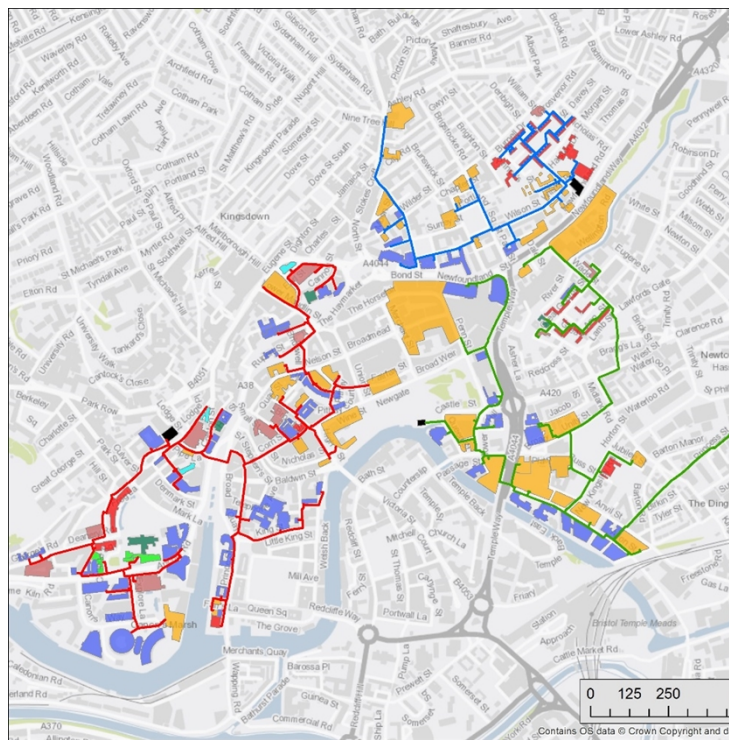
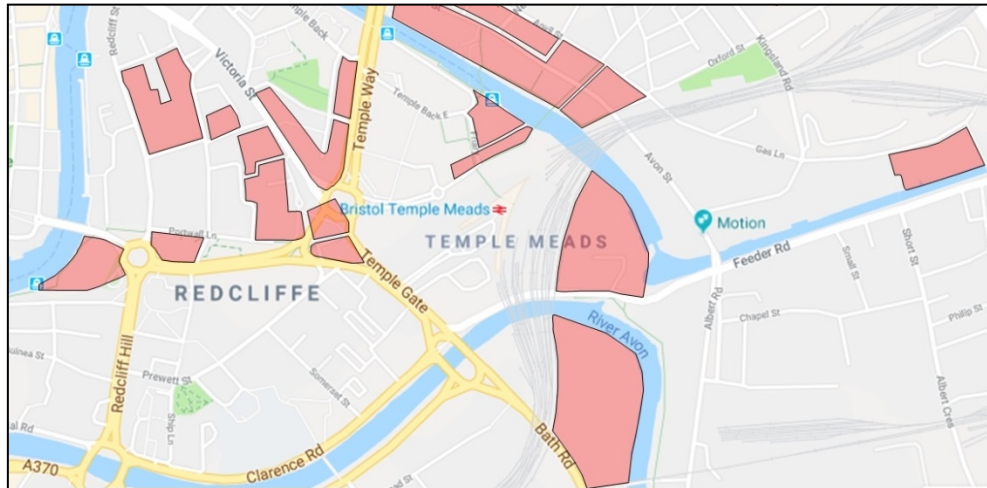


Figure 6b - Proposed Bristol Central heat networks (full build out of heat network)



- d. **Temple and Redcliffe.** This area incorporates a number of new developments including Redcliffe Quarter, Redcliffe Wharfe and the proposed University of Bristol Temple Quarter Enterprise Campus.

Figure 7 – New and large existing developments currently identified for connection to the Temple & Redcliffe part of the Bristol Heat network



Low and Zero Carbon heat generation technology proposals

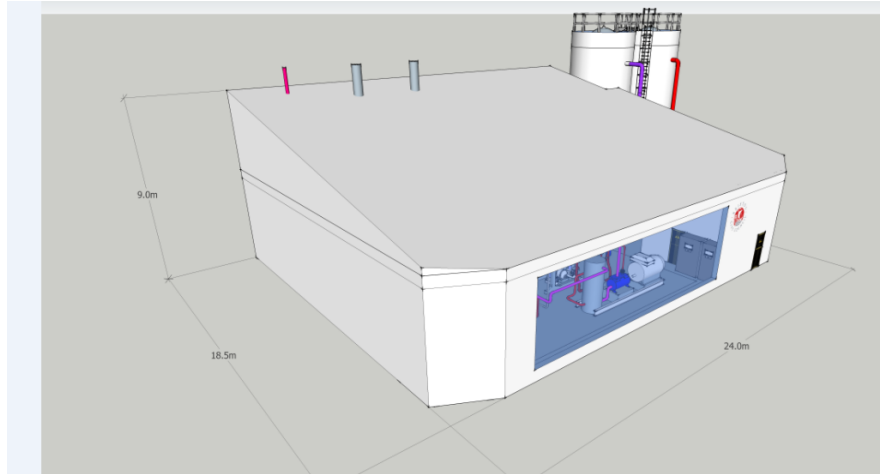
35. Additional Energy Centres generating heat (and potentially power) will need to be constructed as part of the Bristol heat network expansion. In order to provide low carbon heat within the network, these energy centres will need to incorporate low and zero carbon energy generation technologies (subject to financial and technical viability).
36. Feasibility and design is currently underway on the following energy centres:
- 100 Temple St Energy Centre. This energy centre is being investigated for installation of a 1MW low carbon Gas CHP engine (in addition to gas boilers to provide resilience and peak demand generation)
 - Trenchard St energy centre. A 2.1MW Gas CHP energy centre in or around the Trenchard St multi storey car park is also currently being investigated.
 - Floating Harbour heat generation. 3MW Water source heat pumps are currently being investigated on two sites utilizing **zero carbon** heat from the Floating Harbour.

3MW Water Source Heat Pump Energy Centre

A vital part of delivering zero carbon heat as part of the Old Market heat network is the installation of a 3MW Water Source heat Pump (WSHP) within the floating harbour. This WSHP could receive government Renewable Heat Incentive (RHI) income over 20 years totalling £12 million as long as an application was submitted

prior to 2020/21. Approval is therefore sought to carry out the design and procurement of the WSHP to ensure the 2020/21 deadline for funding is achieved.

Figure 8 - Image of Potential Old Market Heat Network WSHP Energy Centre



37. Other technologies such as ground source heat (including from old mine workings) have been investigated in central Bristol and have been discounted as being financial unviable. However, during the research, areas outside the current review boundary could be financially viable and will be looked at as part of further feasibility study work (subject to HNDU grant funding).

A further waste heat source with potential to provide zero carbon heat is Bristol's sewage system. A large sewerage pipe adjacent to the Temple Quarter Enterprise Campus site could provide waste heat in addition to a Floating Harbour water source heat pump.

CO₂ Savings

38. Assuming the first phase of each of the heat networks supply the existing and new developments as proposed, the total CO₂ savings will be greater than 5,500 tonnes per annum.
39. A key reason for installing the Bristol Heat Network is to reduce the carbon emissions of the city and ultimately provide zero carbon heat as part of the Mayoral target of carbon neutrality by 2050.
40. The Bristol heat network already provides low carbon heat due to the installation of a 1MW biomass boiler within the Broughton House energy centre with water source heat pumps also providing significant zero carbon heat generation as part of the proposals set out in this cabinet report.
41. However, delivering a zero carbon heat network from Day 1 for all the proposed heat networks is currently not financially viable given the low cost of fossil fuels versus

limited government grant funding and other financial incentives available to offset the installation of zero carbon energy installations. In the short term, parts of the Bristol heat network will therefore need to rely on mains gas to supply low carbon heat and power but this may need to be replaced as gas is removed from the City.

42. In the medium and long term, the Bristol Heat network will be supplied from zero carbon heat generation sources as part of the installation of the Strategic Heat Main.

Bristol Heat Network Phasing

43. Phasing of the central heat networks is proposed as below. However these are only indicative at this stage and are dependent on heat-on requirements of new developments and co-ordination with BCC Transport to ensure disruption is minimised

Network	Phase 1	Phase 2	Phase 3
Old Market	2018-21	2021-23	2023-25
St Pauls	2018-20	2020-22	2022-25
City Centre	2020-22	2022-24	2024-26
Temple & Redcliffe	2018-20	2020-22	2022-25

Capital and Feasibility Grant funding – Cabinet approval to apply

44. UK Government’s Business, Energy & Industrial Strategy department (BEIS) has identified heat networks within the [Clean Growth Strategy](#) as key to delivering on its Paris climate commitments and has made available both feasibility and capital grant funding to support heat networks.
45. BCC has already successfully applied for £540,000 of BEIS Heat Network Delivery Unit (HNDU) funding to finance the feasibility of the Bristol Heat Network proposals and is seeking approval to apply for further HNDU funding when further rounds are announced. This funding would cover further feasibility and design of the network expansions and, subject to BEIS approval, the potential for geothermal heat to supply the Bristol Heat Network.
46. BEIS also recently announced details of the Heat Network Investment Project (HNIP) capital grant fund. This grant funding could enable further expansion of the Bristol heat network whilst still maintaining a net positive financial return to the council. The Energy Service is seeking permission to apply for HNIP grant funding of potentially up to £12 million, the final figure being dependent on the outcome of ongoing design and feasibility work and further guidance from BEIS on the HNIP funding application conditions.

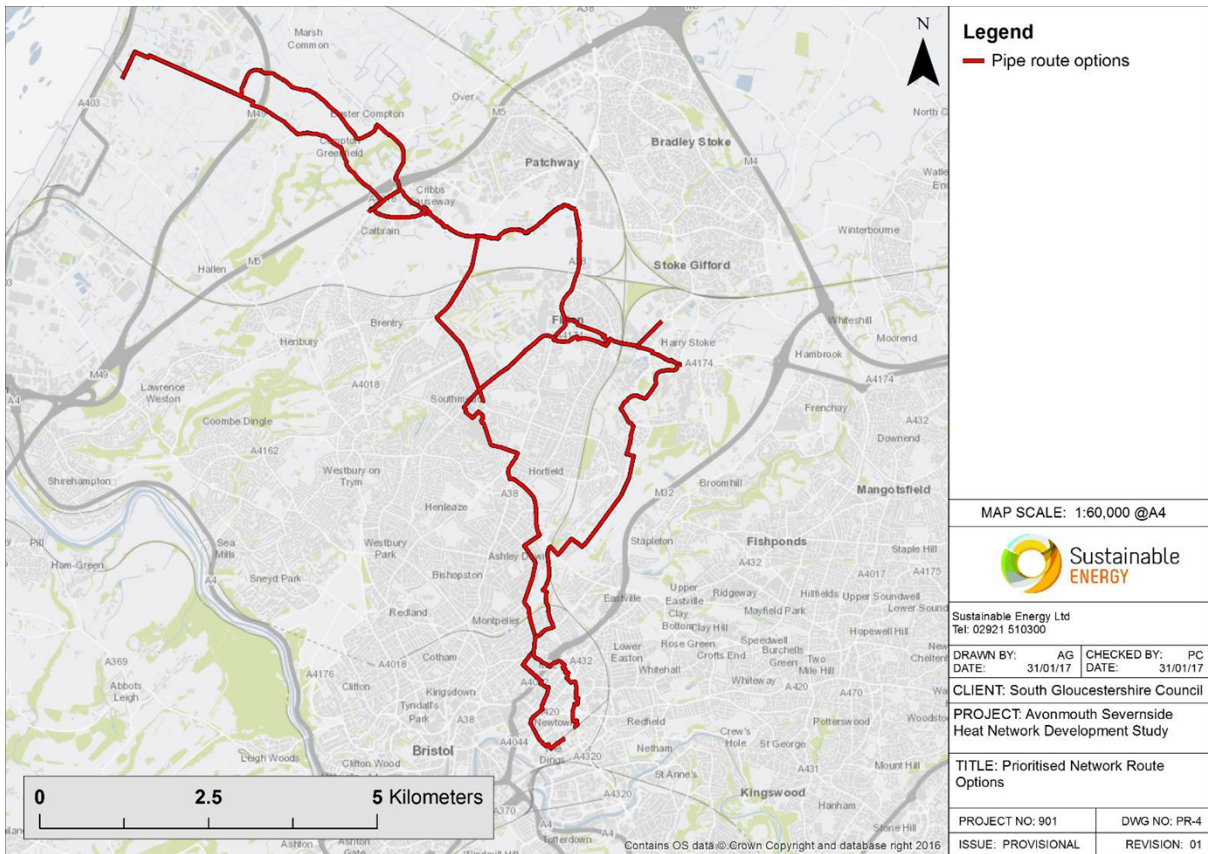
Other funding for heat networks

47. It is likely that additional grant funding from a number of sources will be made available for heat network related activities that might have a short window of application such as Innovate UK funding. The Energy Service are seeking the ability to apply for this funding as and when required where it would contribute to supporting the expansion and improved financial viability of the Bristol Heat Network.
48. Where HNIP, HNDU or other grant funding has been successfully applied for, Cabinet approval is also sought for this grant funding to constitute additional funds in addition to the Prudential Borrowing sought within this Cabinet report.

Strategic Heat Main

49. The long-term ambition of the Council to decarbonise Bristol is critically dependent on the delivery of a city-wide heat network supplied with zero carbon heat. Whilst there are zero carbon energy opportunities within the central area of Bristol, these are not sufficient to supply all central buildings therefore the construction of a strategic heat main connecting the Bristol Heat Network to Avonmouth and Severnside areas of Bristol and South Gloucestershire is vital.
50. This would enable significant quantities of waste heat to be transported and distributed through the north of the City and into the City Centre. Initial feasibility investigations have been carried out in conjunction with South Gloucestershire Council and indicate that the project is financially viable, however further work is needed to develop a robust business case.
51. Feasibility work is currently ongoing identifying the likely capital costs and network route connecting the Bristol central heat network to a 'strategic heat main.' The most viable route will pass through Bristol's northern fringe so will require further engagement and support from South Gloucestershire Council which is currently underway.
52. Whilst this Cabinet Report is not seeking approval to construct the strategic heat main, it is seeking approval for small sections of the SHN to be installed as part of other infrastructure projects where the business case for carrying out this work now rather than in the future as separate works is made.
53. Please note, South Gloucestershire Council as main sponsors of the Strategic Heat Main study are currently undertaking internal consultation on the report prior to it being made available to members of the public.

Map 1. Proposed route of strategic heat network



Non BCC Heat networks in Bristol

54. As well as the BCC heat network, there are currently proposals for a privately operated heat network within the Bedminster Green new development area (South Bristol Energy). BCC Energy Service are supporting BCC’s Sustainable City team as to how the council might licence this private network to ensure it delivers affordable and low carbon heat to Bristol residents and businesses connected to the network and that it is future proofed to enable it to provide zero carbon heat.