

Appendix A– Further essential background / detail on the proposal

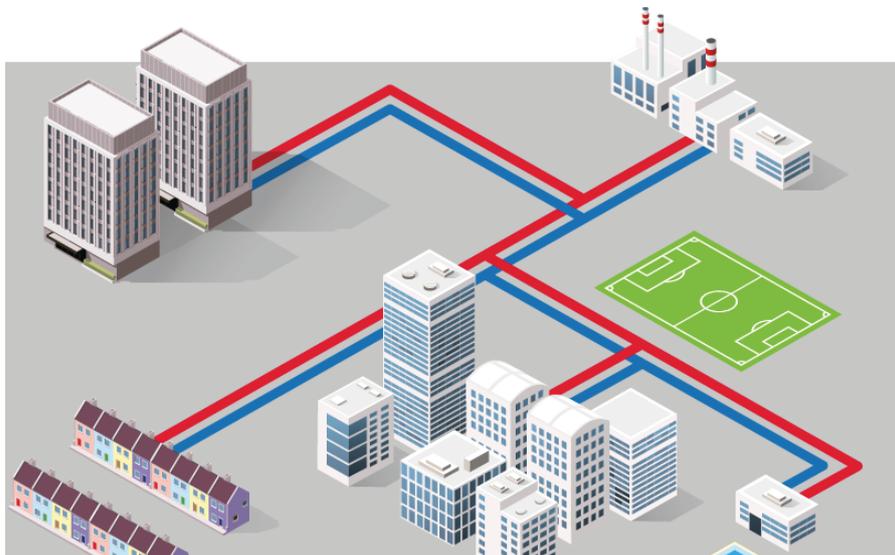
1. This report is seeking further approval following previous Cabinet approval for the Bedminster and Temple heat networks with additional approval required due to an increase in network size and associated increased funding requirements. The grant funding received is also different to that previously agreed due to HNIP funding now being part grant/part loan funding.
2. The previous Bedminster and Temple network project was originally approved at March 2020 cabinet:
 - [3rd September 2019 Bristol Heat Network – further expansion](#)

Contents

1. Rationale for installing heat networks in Bristol
2. Heat networks to date/in progress
3. New heat networks – seeking approval as part of this Cabinet paper:
 - a. Temple
 - b. Bedminster
4. Capital Investment Requirements and City Leap

Why heat networks are being installed

1. 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.
2. 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 water source 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 generation technology available.



3. 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 are being incorporated including water source heat pumps (WSHP) supplying heat from the floating harbour as part of the Old Market Heat network.
4. The Temple network will also be developed to the next stage of detailed design taking waste heat from the floating harbour but also ground source from aquifers as well as be able to take waste heat from data centres.
5. The Bedminster network will be developed to take waste heat from Bristol's sewer network (Bedminster) and/or the air, via a large air source heat pump.
6. Heat Pumps use the same technology as that used in refrigerators. Just as a fridge extracts heat from the food and transfers it into the kitchen, so a water source heat pump extracts heat from the water and will transfer it to the heat network. For every unit of electricity used to power the heat pump, approximately 3-4 units of heat are captured and distributed.
7. At Castle Park Depot for example, the water will be abstracted from the floating harbour. A heat exchanger then extracts the heat from the water and transfers it to the heat pump which uses a fluid that evaporates at a very low temperature. This heat from the water abstracted from the harbour causes the fluid to evaporate and the subsequent gas is then condensed to increase the temperature further. From here the gas moves to a further heat exchanger to release this heat to the network.
8. Although only 2% of heat in the UK is currently supplied by heat networks, this is rapidly increasing, particularly in cities. They are 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.
9. 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 and like Bristol are also installing water source heat pumps.
10. Heat networks are central to achieving the Mayor's goal for Bristol to be a carbon neutral city by 2030 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.

11. BCC's Sustainable City team appointed CSE to identify how Bristol could decarbonise its energy system. In regards to the decarbonisation of Bristol's heat this requires the end of mains gas as the prime heat supply to homes and business and for it to be replaced by either heat networks or individual heat pumps.
12. Installing heat networks will also support the following corporate strategy key commitments:
 - a. Improve our environment to ensure people enjoy cleaner air through supporting the further deployment of renewable heat generation.
 - b. Improve physical and mental health and wellbeing by making residents' homes warmer and cheaper to heat, reducing inequalities and the demand for acute services.
 - c. Tackle food and fuel poverty by reducing energy bills.
 - d. Create jobs, contributing to a diverse economy that offers opportunity to all and makes quality work experience and apprenticeships available to every young person.

Work to date / in progress

a. Old Market Heat Network

13. The Old Market Network is currently supplying heat to new developments in the City including Castle Park View and Box Makers Yard. The network is designed to supply low carbon heat from the Castle Park Energy Centre which will contain a Water Source Heat Pump drawing waste heat from the floating harbour along with peak and reserve gas boilers. The energy centre is currently in construction and is due to be completed in Spring 2022.
14. The Old Market network is also being extended to supply existing buildings including the Central Health Clinic following BCC successfully applying for £6.9 million of Public Sector Decarbonisation Scheme (PSDS) grant funding.

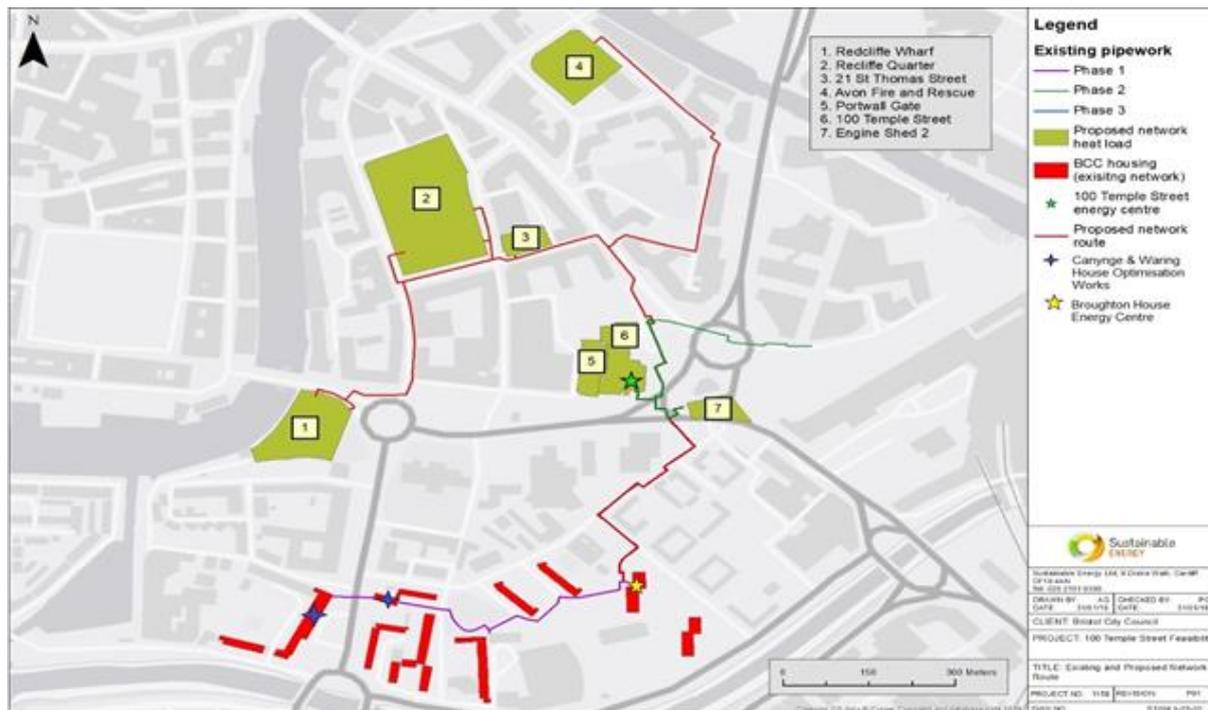
b. Redcliffe Heat Network

15. Phase 1 of the Redcliffe network completed in March 2016, Phase 1 of the Redcliffe heat network was completed which included the installation of a 1MWth biomass energy centre at Broughton House (Redcliffe) supplying low carbon heat via underground heat mains to 13 social housing blocks.

Image 1: Biomass energy Centre Broughton House and Laying of Rehau PEX pipe as part of Redcliffe Phase 1



Figure 1: Redcliffe Heat Network Phases 1 - 2



16. Heat network installation has also taken place as part of the Temple Gate highway works in order to enable the Redcliffe heat network to ultimately be connected to a city wide heat network that also includes buildings adjacent to Temple Meads.
17. Redcliffe Phase 2. In September 2018 Cabinet approved the expansion of the Redcliffe heat network to supply a number of new commercial developments in the area and connection of BCC's 100 Temple St office. This project also included the installation of a 1 MW Gas CHP engine (subsequently reduced to 0.55MW following detailed design) which will provide low carbon heat to 100 Temple St and a number of new developments in Redcliffe such as Redcliffe Quarter, Redcliffe Wharfe, and Engine Shed 2.
18. The construction of this phase is currently underway with the energy centre at 100 Temple St set to be complete by September 2021. The heat network is currently being installed in phases depending on the heat requirements of new developments in the area but the majority is likely to be completed by the end of 2021.
19. Similar to Old Market, PSDS grant funding is also being used to connect existing public sector buildings including Temple Back Fire station and St Mary Redcliffe School.

New heat networks and grant/loan funding – seeking approval as part of this Cabinet paper

20. BCC's Energy Service is seeking approval to progress the Bedminster and Temple heat networks as follows:

21. **Bedminster.** Begin the initial design and installation of the first phase of the heat network prior to City Leap in order for the network to be installed in line with BCC Highway works.

Initially the funding for this will come from a BEIS HNIP commercialisation grant of £1.3m and PWLB funding

22. **Temple.** Approval at March '20 Cabinet is sufficient for the proposed next step which is to accept the £1.8m commercialisation grant to progress this project to detailed design ready for City Leap to progress the capital installation.

23. Given that these networks focus on connecting mostly new developments, the timeframe for this capital investment is also subject to changes outside BCC's control and it is likely that installation of some of parts of these networks will be pushed back where new build (such as the new Temple Quarter Campus) proceed later than initially anticipated

a. Temple Heat Network

24. The Temple Heat Network will provide zero carbon heat to new developments in the Temple and St Philips areas of Bristol. Following commercialisation work (utilising the £1.8m HNIP grant) that would progress in 2021/22, construction is anticipated to begin in later years as part of City Leap in time to supply new developments such as the University of Bristol's Temple Quarter Enterprise Campus (dependent on new building heat demand timeframes).

Figure 2: Phase 1 of Temple Heat Network

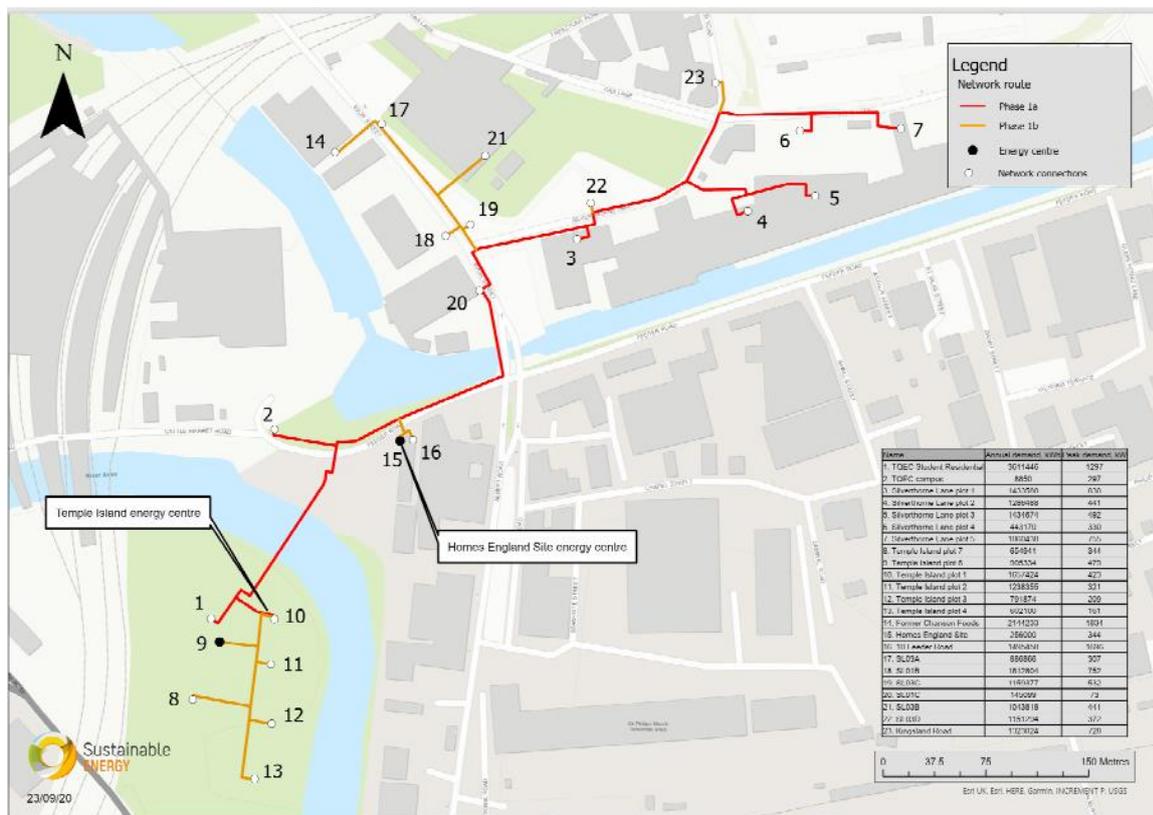


Table 2. Temple Heat Network (Phase 1) – Key Facts

	Phase 1
Phase start year	2021
Network length	1980 m
No. heat connections	23
Network heat demand	26,547 MWh
Network linear heat density	18 MWh/m
Renewable Heat capacity	3.1 MW
Total capital costs (including previous phases)	£20.5m
NPV (40 years at 3.5%) (with HNIP funding)	£10.2m
Indicative IRR with HNIP grant & loan funding – 40 year	12.5 %
Carbon savings (CO ₂ e savings – tonnes) over 25 years	101,333

25. Subject to further on-site resource assessment, the heat network will initially be supplied from an aquifer supplied ground source heat pump energy centre on Temple Island. A second water source heat pump energy centre will then be built using heat from the floating harbour.

26. Dependant on timing of network demand and energy centre construction a temporary

containerised gas boiler solution might be required (as currently being used on the Old Market heat network) but will be removed once the permanent energy centres are operational.

27. Waste heat generated from the University of Bristol's TQEC cooling demand could also potentially supply the heat network with further heat being supplied by an additional water source heat pump.

b. Bedminster Heat Network

28. The Bedminster heat network will initially supply new developments in the Bedminster Green area in addition to existing BCC heat loads such as Bristol South Pool with capacity to also supply adjacent social housing blocks if required.

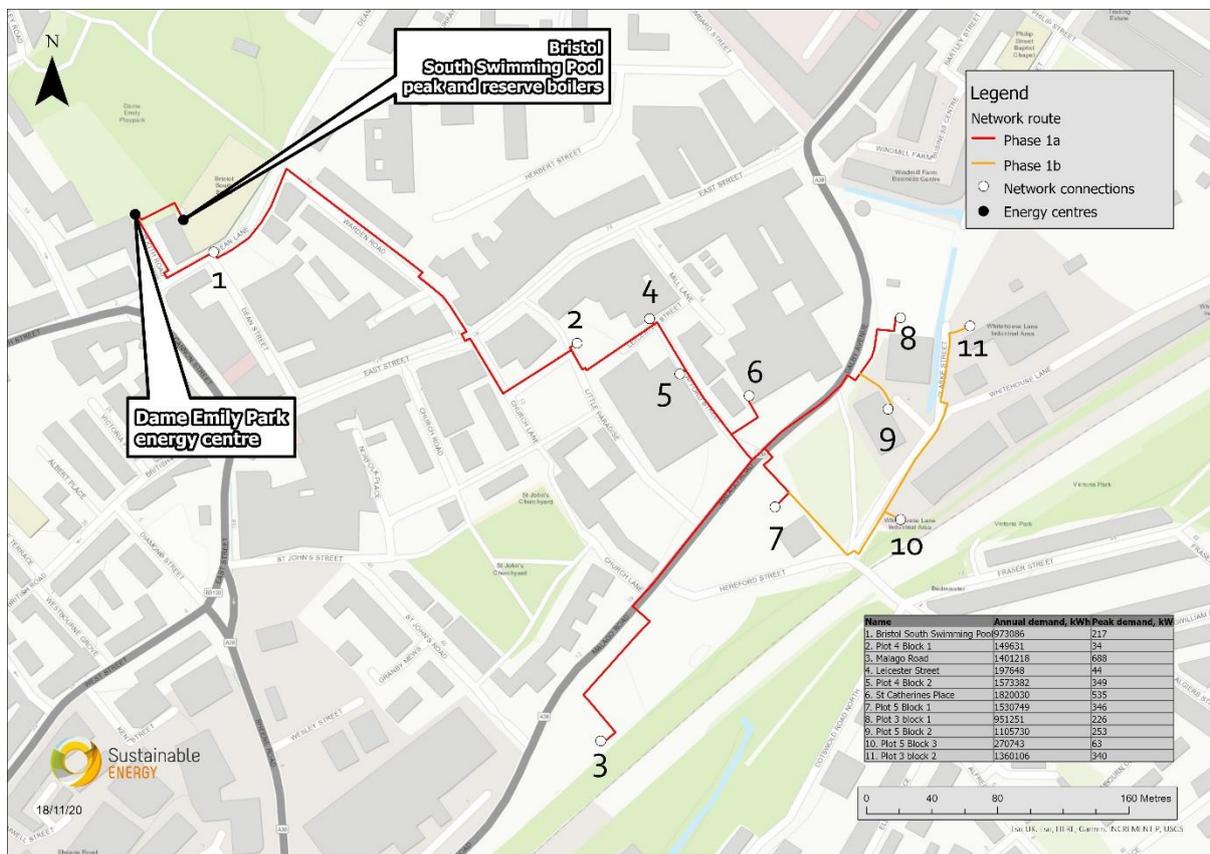


Table 3. Bedminster Heat Network (Phase 1) – Key Facts

Bedminster Heat Network	Phase 1
Phase start year	2021
Network length	1,541 m
No. heat connections	11
Network heat demand	11,334 MWh
Renewable heat generation capacity	1.5 MW
Capital cost	£11.7m
NPV (at 3.5% - 40 years) (with HNIP funding)	£1.9m
Indicative IRR with HNIP grant & loan funding – 40 years	7.1%
Carbon savings (CO ₂ e – tonnes) – 25 years	46,000

29. The preferred energy centre will be supplied with waste heat from Bristol’s sewer system. BCC Energy Services are currently in negotiations with Wessex water

(owner/operator of the sewer network) for the joint development of a sewer heat energy centre on land owned by Wessex water adjacent to Dame Emily Park

30. Should Wessex and BCC not be able to agree terms for the use of this heat, BCC will progress a large air source heat pump energy centre to serve the heat network instead. Given the increased heat demand from new developments it is likely that this will need to be developed anyway as part of a later Bedminster network phase.

Delivering Heat networks

Information relevant to all networks:

31. Following heat demand and master planning assessments, feasibility and design of the Bristol Heat network is currently focused 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.
 4. City Centre Renewable Energy Centres to provide low carbon heat onto the network (WSHP)

32. 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.

33. 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.

34. 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 and Phasing

35. Capital expenditure is based on a combination of detailed feasibility or master planning 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.

Phasing of heat network & Energy Centre delivery

36. 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.

37. 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

Financial viability

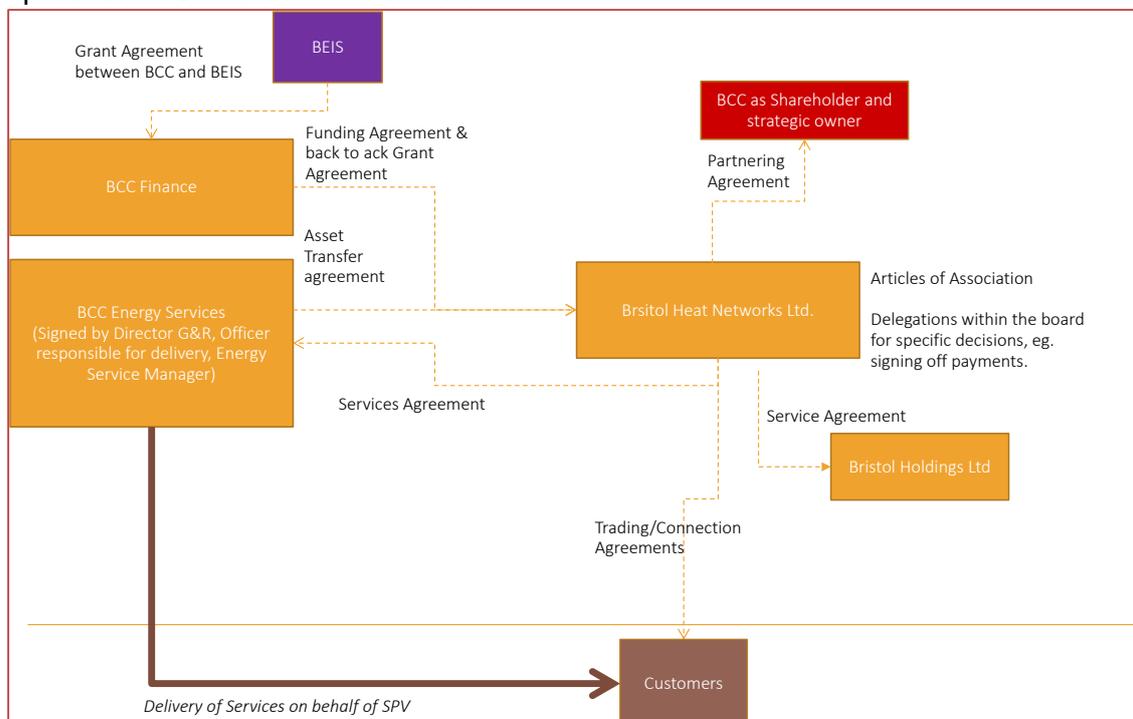
38. BCC Energy Service has employed external consultants to produce a heat network financial model to ensure the Bristol Heat Network meets the BCC Finance requirement of generating a positive financial benefit to the Council once prudential borrowing repayments have been taken into consideration. Each of the different heat network phases and Energy Centres meet this requirement.

The role of Bristol Heat Networks Ltd

39. It is a requirement of BEIS HNIP funding for assets to sit within a special purpose vehicle (SPV) commercial entity. Bristol Heat Networks was set up as the SPV for the Old Market and Redcliffe heat networks and will act as the same for Temple and Bedminster.

40. Bristol Heat Networks Ltd currently sits under Bristol Holdings Ltd and contracts with BCC Energy Services team for the provision of all services.

41. The diagram below sets out the contractual structure for the management and operation of Bristol Heat Networks.



Capital Investment Requirements and City Leap

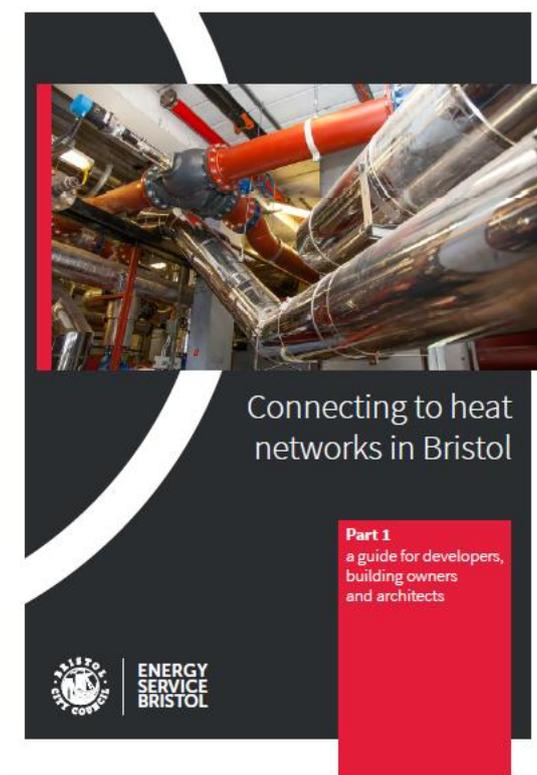
42. The current areas of investigation are mostly confined to areas of high heat demand and new development within the city centre to enable the heat network to provide a net positive income to the council. The final capital cost of delivering these fully built out heat networks is likely to be in excess of £50 million. Given the limited BCC prudential borrowing funding available to finance this, ultimately this will need to be delivered as part of the City Leap programme.
43. However, early phases of the Bristol heat network will need to be commence prior to the completion of the City Leap programme for the following reasons:
 - i. A number of new developments are currently under construction which will require heat in 2020/21. 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.
 - ii. Through BCC signing connection agreements with new build developers and commencing the early phases of heat networks means that potential City Leap investors view City Leap much more favourably as their investment would be in part de-risked.
44. However, the CSE net zero study identified a much larger heat network that would need to be installed if Bristol were to achieve its 2030 ambition. Early findings of the study identify over 65,000 homes and businesses that would need to be connected to the Bristol Heat Network with a resulting capital cost of this likely to be in excess of £500 million.
45. A key reason for installing the Bristol Heat Network and renewable technologies, such as WSHPs, is to reduce the carbon emissions of the city and ultimately provide zero carbon heat as part of the Mayoral goal of carbon neutrality by 2030.
46. 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 low carbon heat generation as part of the Old Market heat network.
47. 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 cost peak and reserve energy centres which will need to be replaced as gas is removed from the City.
48. In the medium and long term, the Bristol Heat network will also be supplied from zero

carbon heat generation sources as part of the installation of the Strategic Heat Main.

Bristol Heat Network Design Guidance and BCC Planning Policy

49. 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.
50. 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



Notes

Heat Network Delivery Unit (HNDU)

51. The Heat Networks Delivery Unit provides grant funding and guidance to local authorities in England and Wales for heat network project development. In January 2019 Bristol City Council were successful in obtaining a further £500k of funding from this department to support the feasibility and design work to develop the Bristol Heat Networks.

Heat Network Investment Project (HNIP)

52. The Heat Networks Investment Project (HNIP) is a government funding programme that aims to:

- increase the number of heat networks being built
- deliver carbon savings
- help create the conditions necessary for a sustainable heat network market to develop

53. HNIP will provide £320 million of capital funding to gap fund heat network projects in England and Wales. This funding is available to support the commercialisation and construction stages of heat network projects. Bristol City Council has made two applications to date, one for Redcliffe network and one for the Old Market Network.