Avonmouth-Severnside Strategic Heat Network Development Study

Executive summary

This report summarises the findings of the Avonmouth–Severnside Heat Network Development Study (2017).

South Gloucestershire Council (SGC) and Bristol City Council (BCC) have worked with partners including SUEZ and the West London Waste Authority (WLWA), to investigate the potential for a Strategic Heat Network (SHN) to transfer waste heat from the Avonmouth area to homes and businesses in South Gloucestershire and Bristol.

Both Councils have climate change and carbon reduction strategies and corporate and policy commitments to promote the development of heat networks in specific areas. A Strategic Heat Network (SHN) could be fundamental to cutting carbon pollution from energy required for heating and hot water, and securing long-term, very low carbon heat in new developments in South Gloucestershire - to the north of Bristol, and in Bristol itself.

The purpose of the project was to identify sources of waste heat, with a particular focus on the Avonmouth-Severnside area, locations in South Gloucestershire and Bristol where there is a suitable demand for heat, and to evaluate technical issues and constraints and to provide provisional estimates of capital and operational costs and returns.

The work was delivered by Sustainable Energy Ltd in partnership with 3D Technical Design, Sustain-Anthesis and COWI.

Drivers

Key drivers for this project include:

- Improving local air quality through reductions in emissions from heating appliances
- Protection and mitigation against fluctuating gas prices
- South Gloucestershire Climate Change Strategy 2018-2023 that includes targets for CO₂ reduction and locally based renewable energy
- Policy CS4 (Renewable or Low Carbon District Heat Networks) of South Gloucestershire Council’s Core Strategy
- Bristol City Council’s commitment to be on course to be run entirely on clean energy by 2050
- The development of heat networks in Bristol City Centre - supported by Policy BCS13 (Climate Change), and BCS14 (Sustainable Energy) of the Bristol Development Framework - Core Strategy
- National carbon and renewable energy targets

Heat supply

An assessment of potential heat sources was undertaken to identify those which are technically and financially viable for supplying the heat network.
The study identified a variety of key heat sources with a total annual heat output in excess of 40MWth (based on average consumption, enough heat for nearly 30,000 homes). These include heat from planned and operational waste processing plants in Avonmouth and Severnside and other major industrial processes in the Filton area.

Potential routes for phase 1 and phase 2 of a strategic heat network

**Heat demand**

Geographical Information System (GIS) software was used to map current and projected demands for heating and cooling.1

The main areas where there is a suitable heat demand are Bristol City Centre and the south-western perimeter of South Gloucestershire, and comprise residential and commercial buildings in the public and private sectors.

For the purposes of mapping heat demands those in Bristol City Centre were split into three main clusters: Bristol City Centre (west), Bristol City Centre (east) and Temple and Redcliffe.

The heat demands in South Gloucestershire and Bristol were divided into 16 clusters, and ‘Cluster Networks’ (the pipes which link the buildings in each cluster). In some areas, such as Central Park and Westgate, developments are planned but have yet to come forward, meaning there will be a demand for heat in the

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1 Cooling was considered alongside heating because heat can be used to produce cooling using a process known as absorption chilling.
future. In other areas, such as the Avonmouth and Severnside Enterprise Area, the demand for heat from the SHN could be significantly increased by attracting businesses with high demands for heating and cooling to ‘co-locate’ there.

The study assessed the viability of many of the Cluster Networks and concluded that their existence is critical to the viability of the SHN. For assessment purposes, it was assumed that Cluster Networks will be constructed prior to connection to the SHN and will be independently viable.

The drivers for new developments on the route of the network to be designed to take heat from the network include the availability of low cost heat and price security and carbon reduction policies and targets – the need to reduce or eliminate CO$_2$ emissions from heating and hot water.

As with all major infrastructure projects there are varying levels of risk related to the phasing and development of the network. As Cluster Networks are developed and heat demands confirmed this will reduce the range and scope of risks for the SHN.

**Network Assessment**

The SHN would transmit high temperature heat over large distances to substations at the heat clusters, where the temperature of the heat would be reduced to the level required for space heating and hot water in buildings.

The flow diagram below summarises the key stages and elements of the strategic heat main from the heat source to the heat offtake substation.

![Flow Diagram](image)

The study considered a number of potential routes for the strategic heat main in terms of technical viability, network length, network heat losses and network capital costs, and the impact of complex infrastructure crossings and structures. This analysis included an assessment of heat demands, peak demands, pipe sizes, diameter and length, heat losses, ground conditions, routing through publicly owned land i.e. highways, land in the public realm, and physical barriers.

The key risks associated with the routing of the network include crossing the M49, crossing the Bristol Parkway to Avonmouth railway line, crossing the M32 and negotiating the Central Avenue Fuel Pipeline and Rail Crossing Ashley Hill/B4052.

**Heat pricing**

In order to make an initial assessment of the financial viability of the network, and a comparison between the heat clusters, the study included a counterfactual cost of heat (i.e. the price of heat should the SHN not be
developed) based on best estimates at the time. As discussed above the financial analysis assumed that heat clusters and cluster networks will be constructed and operational prior to the SHN.

Financial Assessment

The table below summarises the financial assessment of the partial and full network over a 25 and 40 year period\(^2\).

<table>
<thead>
<tr>
<th>Time period</th>
<th>Partial network</th>
<th>Full network</th>
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<tbody>
<tr>
<td>Heat demand</td>
<td>206,400 MWh</td>
<td>353,140 MWh</td>
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<tr>
<td>Key clusters</td>
<td>- Southmead UWE - Former Filton Airfield, east</td>
<td>- Bristol City Centre, west - Southmead - Temple and Redcliffe</td>
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<tr>
<td>Network length</td>
<td>13km</td>
<td>22km</td>
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<tr>
<td>Heat losses</td>
<td>5.3%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Total CAPEX</td>
<td>£51,635,700</td>
<td>£79,800,600</td>
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<tr>
<td>Heat offtake</td>
<td>20MW</td>
<td>40MW</td>
</tr>
<tr>
<td>IRR 25 years</td>
<td>4.81%</td>
<td>6.60%</td>
</tr>
<tr>
<td>NPV 25 years</td>
<td>-£3,125,000</td>
<td>£5,543,000</td>
</tr>
<tr>
<td>Payback 25 years</td>
<td>17.1 years</td>
<td>17.3 years</td>
</tr>
<tr>
<td>Lifetime carbon savings 25 years</td>
<td>588,300 tonnes</td>
<td>992,300 tonnes</td>
</tr>
<tr>
<td>IRR 40 years</td>
<td>6.88%</td>
<td>8.78%</td>
</tr>
<tr>
<td>NPV 40 years</td>
<td>£8,504,000</td>
<td>£29,739,000</td>
</tr>
<tr>
<td>Payback 40 years</td>
<td>17.6 years</td>
<td>17.8 years</td>
</tr>
<tr>
<td>Lifetime carbon savings 40 years</td>
<td>1,000,000 tonnes</td>
<td>1,744,200 tonnes</td>
</tr>
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</table>

The increased heat demand for the full heat network requires a heat source in excess of 20 MW to be viable, implying the need for more than one source of heat in Avonmouth or by one or more additional heat sources elsewhere along the network route.

\(^2\) Costs rounded to nearest £100, heat demands rounded to nearest 100MWh, carbon savings rounded to nearest 100 tonnes. Network lengths rounded to nearest km.
The study identified additional potential heat sources in Avonmouth and Filton. Implementation of South Gloucestershire Council’s policy CS4\(^3\) which requires applications for thermal generating capacity or which generate significant waste heat to include heat recovery and reuse means there is potential for the total heat supply to increase over time.

Negotiating physical barriers such as railway lines and the M32, and land not owned by South Gloucestershire Council or Bristol City Council, will have a significant impact on the capital cost (CAPEX) of the SHN. The cost of doing this has been estimated using the best information available with an additional 30% added for contingency. More detailed costing work will be required at the feasibility stage.

The financial assessment assumed no contributions from developers and that the contractual point of delivery is for the bulk supply of heat to a secondary network.

Development of the SHN would provide opportunities to coordinate works with on-going infrastructure projects.

*Carbon savings*

The study has reviewed the carbon savings from the SHN and found these would be significant when compared to a business-as-usual gas heating scenario. The calculation of the carbon savings takes account of the displacement of electricity from the grid and plant ‘z-factors’.

*Sensitivities and risks*

A sensitivity analysis was undertaken to test the relationship between potential risks, the internal rate of return (IRR) and social net present value for the Strategic Heat Network. Key sensitivities are identified below.

The study found that there is scope to mitigate risks and strengthen the financial model, rate of return and incentives to connect. For example the length of the network, diversity of potential heat sources, and number of heat clusters needing heat mean there may be scope to reduce the sale price of heat thereby improving the incentive to connect.

- The estimates of heat demand are high level and could be larger or smaller than those assumed in the model.
- The cost of heat sold to the Network Clusters assumed in the financial model could change for a variety of reasons including increases or reductions in the counterfactual cost of heat and the availability and cost of alternative, non-gas, sources of heat and power with which the SHN would need to compete.
- The techno-economic model also tested the impact of grant funding on meeting the hurdle rates (minimum return on investment) needed by the public and private sectors (assumed to be 5% and 12% respectively). It found that to be feasible, both the partial and full network will require grant funding in the region of 10-20% for the public sector and over 30% for the private sector to meet required hurdle rates. South Gloucestershire Council and Bristol City Council would need to identify appropriate sources of funding given the scale of investment required.

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Potential sources of grant funding include:

- HNIP – Heat network infrastructure programme
- EIB – European Investment Bank
- BEIS – Department of Business Energy and Industrial Strategy
- WECA – West of England Combined Authority

**Key risks for the development of the heat network include:**

- Lack of engagement with potential heat sources or loss of interest from generators about supplying the network.
- Physical barriers preventing the expansion of the network, or leading to significant increases in the capital cost.
- A reduction in heat demand and revenue caused by:
  - Cluster Networks not being developed, funding for Cluster Networks not being available or Cluster Networks not connecting to the SHN.
  - Cluster Networks installing alternative sources of low carbon heat and power.
  - Residential developments being brought forward before a Cluster Network is developed – and using alternative heat sources.
  - Lack of engagement with specific developers, or lack of interest from developers in offering to connect from the network.

**Recommendations**

The key recommendations for the development of the SHN are:

- Planners should encourage any new potential energy generation plants to locate in the vicinity of the SHN with requirements to connect to viable network opportunities.
- Areas around viable Cluster Networks and areas surrounding the SHN should be allocated as Heat Priority Areas (this is already the case for Bristol City centre) or similarly defined to ensure that future developments operate communal heating systems and are future-proofed for connection (‘district heating ready’).
- Planners and Economic Development officers should encourage and facilitate the location of new heating and cooling intensive businesses in heat priority areas with planning requirements to connect to viable heat networks.
- Identified network routes and energy centre or substation locations should be safeguarded.
Next steps

Priority actions for the development of the SHN include:

<table>
<thead>
<tr>
<th>Action</th>
<th>Timing</th>
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<tr>
<td>Set clear objectives for what the SHN is to achieve, linked to corporate priorities.</td>
<td>Short term</td>
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<tr>
<td>Effectively communicate project benefits to develop a strategy (with senior level endorsement) for the project to be further developed in collaboration between SGC and BCC.</td>
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<tr>
<td>Develop a stakeholder engagement plan (key stakeholders include potential heat sources and heat demands).</td>
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<tr>
<td>Develop, facilitate and enable the SHN transmission main:</td>
<td>Short and medium term</td>
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<tr>
<td>• Identify resource and financial assistance to deliver further feasibility work for network route proving activities.</td>
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<td>• Ensure opportunities to coordinate network implementation works are assessed where on-going</td>
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<tr>
<td>Develop, facilitate and enable appropriate Cluster Networks:</td>
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<tr>
<td>• Identify resource and financial assistance to deliver further feasibility work for key potential network clusters including industrial heat sources, Southmead Hospital and Former Filton Airfield.</td>
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<tr>
<td>• Set local policy requirements for decentralised energy that relate to the network options identified in this report.</td>
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<td>• Encourage, enable and/or incentivise heating and cooling intensive businesses to locate in close proximity to the heat sources and potential cluster networks.</td>
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<tr>
<td>• Ensure that the design of all Cluster Networks meets Best Practice Standards in construction and operation and is aligned to the CIBSE Heat Networks Code of Practice, and Bristol City Council's Heat Network Connection Pack[^4]</td>
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[^4]: [https://www.energyservicebristol.co.uk/business/heat-networks/](https://www.energyservicebristol.co.uk/business/heat-networks/)