Research Briefing

November 2019

Potential Heat Networks in Scotland's Seven Cities

Executive Summary

District heat networks are a proven and low-regrets solution that can scale up the use of low-carbon heat. The Scottish Government has committed to bring forward a **Heat Networks Bill** to regulate the sector and with the right policies to de-risk investment, this could stimulate the creation of new networks across the country. Scottish Renewables commissioned research[1] to identify and quantify potential projects in Scotland's seven cities.

A total of 46 potential projects in development were identified which could:

- **Deliver 600 GWh of heat per year, the equivalent to 45,000 households**
- **Avoid 100,000 tonnes of carbon emissions per year, if built using low-carbon heat from day one**
- **Grow to serve 8% of Scotland's heat demand by 2030, the equivalent to 460,000 households**

Our analysis cast a wide net for projects, ranging from those with firm business cases to more notional projects in the very early stages of development. Nonetheless, it provides a useful snapshot of the potential market activity that could be stimulated if the right policies are put in place by the Scottish Government.

Introduction

The Scottish Government has proposed to bring forward a **Heat Networks Bill**[2]. With effective policies to de-risk investment in long-lived pipework and associated infrastructure, the Scottish Government could encourage the construction of new networks in urban centres, where they are most efficient. Scottish Renewables commissioned research to quantify the number and scale of potential projects that could be brought forward if the right conditions for investment are created.

[1] Conducted by CAG Consultants in August 2019
[2] Scottish Government, 2019, Programme for Government

Analysis & results

Method

Scottish Renewables hired CAG Consultants to survey the type and volume of potential heat networks in Scotland's seven cities: Glasgow, Edinburgh, Aberdeen, Dundee, Stirling, Inverness and Perth. Heat networks are defined here as those serving more than one customer and more than one building, excluding 'communal' networks that serve one building but multiple customers (for example a commercial building with several tenants). These systems are smaller in scale and not usually used to form the basis of district energy networks.

Information about potential projects was gathered from interviews with local authorities and industry, analysis of planning applications, public tenders and other publicly available information. The majority of the information was gathered from work carried out by local authorities, many of whom have appraised opportunities for heat networks in all or part of their areas through schemes such as the Stratego project and Local Heat and Energy Efficiency (LHEES) pilots.

Potential projects

The projects range from firm prospects with detailed information to more notional areas of opportunity or expansion from existing networks. Projects under construction or with firm financing in place were excluded. **A total of 46 potential projects were identified,** ranging from those being actively developed at present (six) to more notional opportunities being progressed at different rates (40). The bulk of projects fall into this latter category given the uncertain policy, regulatory and funding environment at present. This compares with 113 heat networks thought to be in operation in Scotland today[3].

It is likely that the analysis has not captured all commercially led projects (i.e. those being explored by private building owners or new developments at an early stage of planning) as this information cannot be easily obtained or may be commercially sensitive.

Project characteristics

The majority of the projects identified are being developed by local authorities. This reflects the fact that in the current market, only the public sector is able to assess large, long-term opportunities given the uncertainty regarding future demand and the recouping of early development costs. Private companies largely focus on firmer opportunities from private or public sector building owners seeking to construct a network to serve their own buildings.

Type of developer	Number	
Local authority	18	40%
Public sector building owner/organisation	11	24%
Private sector building owner/developer	11	24%
Other	1	2%
No information available	5	10%

Two-thirds of the identified projects would serve existing buildings, with most local authority led projects focussing on these opportunities.

[3] BEIS, 2018, Energy Trends

Types of building served	Number	
Existing	18	40%
New build	10	22%
Both existing & new build	9	19%
No information available	9	19%

Energy & Carbon

Key findings

To understand the contribution of the potential heat networks to climate change targets, we provide estimates of the total heat served per year, and the carbon savings that could be achieved if using low-carbon heat from day one. We found that the 46 projects would:

- **Deliver 600 GWh of heat per year, the equivalent to heating 45,000 households**
- **Avoid 100,000 tonnes of carbon emissions per year, if built using low-carbon heat from day one**

Data and method

We did not have access to complete information regarding most projects – this data was either not available, or in many cases, was not shared given the early stage of development of many projects. The availability of information was as follows:

- Cost, energy & carbon values based on project data: 9 (20%)
- Cost, energy & carbon values estimated: 37 (80%)

The lack of detailed information primarily reflects the varying approaches and scale at which local authorities have assessed potential for heat networks. For projects with incomplete data, gaps were filled using estimates based on the available information. Where too little information was available or shared, values for these projects were estimated by classifying them as either small/medium/large and using the values set out in the table below.

Estimated values for projects

Size	Low Carbon Generation capacity	Heat supplied GWh/yr	Annual CO^2 emissions saved (tonnes)	Total capex cost
Small	1.4 MW	7	1200	£6.4m
Medium	1.6 MW	12	1900	£12m
Large	7.4 MW	30	4500	£18.9m

The low carbon generation capacity, heat supplied and cost figures above are averages taken from available data about projects in the UK Government's HNDU programme (active in England & Wales). This was thought to provide a good basis for comparison given that projects in both the HNDU programme and in this Scottish list are primarily local authority led and will serve existing buildings. With the bulk of project information derived in this manner, the results of this survey should necessarily be treated as high-level estimates rather than definite figures.

We assume that the modelled projects are built using large-scale heat pumps to provide heat. This has increased the capex cost relative to building these networks with gas boilers or gas CHP. The annual CO^2 emissions savings for the modelled projects were calculated relative to a counterfactual of providing the same heat demand with individual gas boilers, including for heat network loss impacts. For the heat pump emissions, the consultants used an average grid electricity emission factor[4] for the next 20 years and assumed a coefficient of performance of three.

The total volume of carbon dioxide saved by the 46 projects is estimated to 103,000 tonnes per year. Please note that this includes some non-modelled projects where gas is will be the main fuel; assuming that these projects are also built fully low-carbon from day one would result in higher overall carbon savings.

It should be noted that low-carbon heat generation such as large heat pumps require market interventions (either subsidy or a tax on gas) to compete against heat from natural gas. The Renewable Heat Incentive (RHI) has funded the use of these technologies in heat networks but is closing in 2021 with no successor scheme as yet in place. Without future support, the networks identified in this survey will not be able to compete for customers if using low-carbon heat and will therefore only be economically viable if they use gas boilers.

Expansion potential

The figures above provide an estimate of the initial energy and carbon savings that the identified projects could provide. The majority of these would serve existing buildings, typically in city centres, with good opportunities to expand and connect to additional surrounding buildings.

We estimate that with the right policy environment the heat networks identified in our survey **could grow to meet 8%** of Scottish Heat demand[5], saving one million tonnes of carbon emissions per year – the equivalent to c.**10% of emissions from buildings in Scotland[6]**. It was not possible to obtain detailed information on the networks' expansion potential (although some of this information is available, it was not shared with us) so potential growth was instead estimated using growth scenarios based on the real-world experience of Aberdeen Heat & Power.

Case study: Aberdeen Heat & Power

Aberdeen Heat & Power Ltd (AH&P) was set up by Aberdeen City Council in 2002 to develop and operate district heating and CHP (Combined Heat & Power) schemes in the area. It is one of the most successful examples of a growing heat network in the UK and we have used it as the basis for our growth scenarios.

The Aberdeen heat network has grown the heat it serves per year by an average 3 GWh since its launch 17 years ago. The first CHP District Heating scheme started in 2002 serving 288 flats in four multi storey blocks and today four schemes distributed across the City serve 2600 flats in 48 multi story blocks. The annual growth in heat supply from 2002 to the present is listed below. AH&P plans to expand its coverage based on CHP heat generation and a potential connection to the new Aberdeen Energy from Waste (EfW) centre. It is estimated that known opportunities to expand would see AH&P providing 300 GWh of heat per year.

- Heat served in 2002: 3 GWh per year
- Heat served today: 60 GWh per year
- Near term potential from known opportunities: 300 GWh per year

[4] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/666406/Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2017.xlsx
[5] Assumed to be 80 TWh (domestic & commercial sectors), see Scottish Government, Energy in Scotland 2018
[6] CCC, 2018, Progress report to Scottish Parliament 2018. Emissions from buildings were 8.8 million tonnes.

Growth Scenarios

We use the example of AH&P as the basis for our growth scenarios below. It is important to note that growth in Aberdeen has taken place largely in the absence of supportive policy. Incentive support has been start/stop (e.g. through the Energy Company Obligation) and planning and building policy has been weak in driving the adoption of heat networks. These barriers as well as those of ownership (e.g. where a network is owned by an institution that does not wish to become an energy supplier to other buildings) and economic viability have prevented most existing heat networks in Scotland from expanding. Two key factors behind the success in Aberdeen have been: the creation of an arms-length body dedicated to operating and expanding a heat network, and close working with the city council which provided access to customers. These are some of the conditions that our proposals to Scottish Government[7] are seeking to re-create.

Heat Network Growth to 2030 - Scenarios

	Aberdeen Case Study	SR Scenario	Policy	Results
Low		No growth assumed – Aberdeen is an exception as today, most heat networks rarely seek or struggle to expand.	Assumes no additional policy support is forthcoming from Scottish Government.	600 GWh served by the projects in total per year. This equates to **0.7%** of total Scottish heat demand[8].
Medium	Heat served by the network grew twenty-fold in 17 years (3 to 60 GWh/yr).	Networks in the surveyed cities grow five-fold, roughly equivalent to the growth achieved to date in Aberdeen.	Most policy & economic barriers addressed but difficulties remain securing customers.	3,000 GWh/yr **4% of heat demand** Equivalent to 230,000 households 500,000 tonnes CO^2 avoided per year.
High	Expects to grow five-fold compared to today (60 GWh/yr to 300 GWh/yr) based on known opportunities. Connection of nearby buildings to the expanding network could further double this growth leading to a total ten-fold increase on today (600 GWh/yr).	The growth assumed in our medium scenario is doubled. This is lower than potential future growth in Aberdeen but reflects the more advanced starting point in that city.	All policy & economic barriers are addressed, including connection of anchor loads and new customers, with a focus and drive from Government.	6,000 GWh/yr **8% of heat demand** Equivalent to 460,000 households 1 million tonnes CO^2 avoided per year.

[7] See Scottish Renewables, Piping Hot report
[8] Assumed to be 80 TWh (domestic & commercial sectors), see Scottish Government, Energy of Scotland 2018

The Aberdeen growth rates were adjusted down before being applied to the projects in our survey to account for the larger average heat network size in our list (of 16 GWh heat served per year compared to 3 GWh in Aberdeen) and to reflect the size of the cities and number of potential projects within them – AH&P have developed over a whole city of 200,000 inhabitants whereas the projects in our survey would grow alongside others.

It is important to note that these are estimated figures, intended to give an indicative range only. In reality each heat network's expansion opportunities will be governed by specific local circumstances and will differ; some may be higher or lower than these estimates. We provide these figures as a guide to the potential that could be unlocked from constructing the projects identified in our survey. Similarly, there will be heat network opportunities outside of the seven city areas that we surveyed that would further increase the total heat network potential in Scotland.