DISTRICT HEATING

Pipe dreams – a new generation of district heating networks

The UK district heating sector is undergoing a new growth period, fuelled by several new projects showing considerable technological innovation towards low carbon solutions, writes *Andrew Williams*.

In recent years, there has been a gradual increase in the number of heat networks using low carbon generation, in part spurred on by the promise of UK government regulation expected to reduce costs for the market, as well as support from the Heat Networks Investment Project (HNIP), which will invest £320mn in heat networks in England and Wales.

So far, four projects have received funding in the first round of HNIP, one of which is the second phase of the Leeds PIPES project, an interesting example of a strategic district heat network – currently consisting of 16.5 km of pipe providing low carbon heat to homes and buildings across the city, and plans already afoot to grow the network. Those connected to the network are predicted to save between 10% and 25% per year on their energy bills on average.

As Charlotte Owen, Policy Officer at the Association for Decentralised Energy (ADE) explains, innovation is taking off in the heat networks market across the UK, with forthcoming networks expected to make use of heat from rivers, disused mines, and even sewers.

According to Owen, heat networks are also participating in flexibility and balancing services – including projects like the Gateshead heat network, which has partnered with Flexitricity, a demand response company, in the process of unlocking £60,000 per year over the next 15 years by using the network's flexibility to smooth out electricity demand.

According to Paul Steen, Department Manager, UK District Energy at Ramboll, the key benefit of district heating networks is that they effectively utilise waste heat that would otherwise be lost to the environment. In the process, district heating can aid offsetting fossil fuel heating sources and reduce the carbon emissions associated with heat, as well as potentially reducing energy costs to consumers, including those in fuel poverty.

Part of the plant room at Vital Energi's Eden Campus Biomass Energy Scheme
Photo: Vital Energi

'There is still much opportunity for the sector to expand systems and offer associated district heating benefits to more individuals and businesses, which also leads to the creation of local jobs through the construction, operation and maintenance of the system,' says Steen.

Technology agnostic

Broadly speaking, district heat networks tend to be technology and fuel agnostic, and can make use of numerous types of generation technologies, including electric heat pumps, biomass boilers, waste heat, and gas-fired combined heat and power (CHP) stations. Such networks may also make use of one technology or, increasingly, multiple technologies and fuels.

For example, the Leeds PIPES project is connected to Veolia's Recycling and Energy Recovery Facility (RERF), taking steam and converting it to hot water. According to the ADE's Owen, it is also supported by an energy centre that provides resilience to the network at times of high demand from the network or low heat from the RERF. All in all, the Leeds project will reduce carbon emissions by 11,000 tonnes per year – about the equivalent of the carbon dioxide emissions associated with heating over 4,500 homes.

Elsewhere, Gateshead Council's heat network uses a CHP system with private wire, adding 4 MW of capacity to the national grid. The Gateshead network uses thermal storage and the thermal inertia in the pipe work itself to allow Flexitricity to respond to signals from the electricity grid, absorbing energy or exporting electricity as required, without negatively affecting the heat supplied.

'This helps to reduce bills for consumers, and reduce the carbon intensity of the grid by smoothing out demand,' says Owen.

Stirling effort

Another interesting initiative is the Stirling Renewable Heat Project, a collaborative partnership between Stirling Council and Scottish Water Horizons (SWH) – as well as principal contractor FES Energy – to design and build an energy centre and a 2.5 km district heating network to transfer low carbon heat to a number of public buildings.

As James Reid, Divisional Manager at FES Energy, explains, the main heating technologies used in the project are a sewage heat recovery system capable of more than 500 kW of thermal energy, integrated with an existing 300 kW biogas boiler system fed from the local waste water works processes, as well as an 800 kW natural gas CHP unit, together with 6 MW of gas boilers for system resilience and peak loads – and 110 m^3 of thermal storage.

The system is split into an east and west district heating network. The west network distributes heat

at 60°C, supplied by the sewage heat recovery system and biogas boilers – and serves a number of commercial office buildings, allowing for future expansion. The east network distributes heat at 85°C to serve an existing leisure centre, stadium and high school – and is served by the gas CHP unit. Both east and west circuits have been integrated to allow the CHP to provide heat to the west network and natural gas boilers also serve both networks for resilience and peak load requirements.

'It's worth noting that the combined use of these technologies make this project the first of its kind in the UK to deliver heat in this way,' says Reid. 'I think the Stirling Renewable Heat Project is a fantastic example of public sector collaboration to reduce energy and carbon emissions. It also provides a great opportunity for the local economy and community by creating and supporting jobs during design and construction but also has a long term legacy of job development to manage the maintenance of the schemes,' he adds.

Aerial view of the Guardbridge Paper Mill conversion project under construction in 2016 – now the energy centre of the Eden Campus Biomass Energy Scheme

Photo: Vital Energi

Central role

Elsewhere, Vital Energi has recently completed installation of an innovative district heating project at the University of St Andrews' North Haugh campus. The project forms part of the university's £25mn Eden Campus Biomass Energy Scheme – and plays a key part in helping it work towards achieving an ambitious target of becoming the UK's first university that is carbon neutral for energy.

As part of the undertaking, the university acquired the disused Guardbridge Paper Mill and appointed Vital Energi to transform part of it into a state-of-the-art energy centre, which generates and pumps hot water through a 23 km district heating network to serve 47 buildings on the campus. The centrepiece of the energy centre is a 10 m high, 6.5 MW Jernforsen boiler manufactured in Sweden, and using around 17,000 tonnes of locally sourced, biomass material each year.

In addition to the energy centre and district heating network, the project also involved updating the surrounding infrastructure and included the creation of a new bridge and a wood chipping facility.

The heat generated from combustion of the biomass is converted to hot water and pumped through the heat network to the North Haugh Campus, where it feeds 47 plant rooms within the various teaching and research buildings, plus 4,000 student bedrooms to deliver domestic hot water and heating. The boiler burns woodchip to generate hot water, which is pumped through the underground district heating network where it connects to a range of plate heat exchangers. These separate the primary and secondary side of the system to deliver heat and domestic hot water.

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'We are also delivering a range of energy conservation measures to reduce the University's energy usage. These measures include upgrades to the lighting system, installation of solar panels and smart building management systems as well as upgrades to the air handling unit fans and fume cupboards,' says Gordon Coates, Communications Executive at Vital Energi.

In addition to the University of St Andrews project, Vital Energi has also been working on a number of other large-scale district heating schemes throughout the UK. One interesting example is the Queen's Quay project, where the company is currently installing Scotland's first large-scale water source heat pump for district heating, which will extract heat from the River Clyde. Heat is boosted via a series of heat pumps until it reaches a useable temperature, before hot water is distributed to nearby homes and businesses.

Meanwhile, as part of the Glenrothes Heat & Energy Network, the company is working with Fife Council and RWE to take the waste heat from the Markinch Biomass CHP plant – and has constructed an energy centre and 6.3 km district heating network to serve nearby businesses and blocks of housing.

Other large schemes Vital Energy has recently delivered, or is currently delivering, include: the Glasgow 2012 Commonwealth Games Athlete's Village, Manchester Civic Quarter Heat Network, Battersea Power Station, the King's Cross Development and Leeds PIPES (see above).

In Coates' view, district heating networks are particularly effective by virtue of the fact they are capable of delivering what he describes as the twin benefits of lower energy costs and lower carbon emissions when compared to traditional heating such as individual gas boilers.

'Traditionally we have used CHP engines and gas-fired boilers, but now are using lower carbon fuels such as biomass – and as the electricity grid decarbonises due to increasing renewable generation, heat pumps are increasingly becoming a preferred technology. As lower carbon technologies, such as hydrogen fuel cells, continue to be developed and become more affordable they can also be integrated into district heating systems,' says Coates.

'It is worth mentioning that both UK and Scottish governments regard heat networks as a preferred solution and have been supportive of the industry in general. If the UK is to meet its decarbonisation targets then the district heating industry will have a central role to play,' he adds.