DISTRICT ENERGY

An established solution to a new carbon challenge

Employed to supply both heating and cooling, district energy has been in use for many years, but still has the potential to play an important role in the UK's decarbonisation strategy, says ENGIE's *Nicola Mahmood*.

Inside an ENGIE district heating plant room – large-scale plant can be more efficient and more easily maintained than many smaller units

Photo: ENGIE

District energy isn't a new concept; it has been in use in France since the 14th century and it has been around in a variety of forms since then. In the UK, district energy has been prevalent since the 1950s when the Pimlico District Heat Network became the first of its kind, using waste heat from the then coal-fired Battersea Power Station.

Today there are around 2000 district heat networks in the UK, with a further 12,000 communal heat networks, and there is potential for many more.

So, what is district energy? As defined by the UK District Energy Association (UKDEA), 'district energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't require their own boilers or chillers.'

Many district energy systems today also provide electricity generated from a combined heat and power (CHP) plant.

The benefits of such a system include lower maintenance costs; no up-front cost to the end user for replacement plant such as boilers or heat pumps; space saving through the reduced need for boilers and air conditioning units and, potentially; lower running costs. They are also a good vehicle for reducing the carbon impact of heat, through the use of larger scale renewable heat sources such as rivers, sewers and energy-from-waste plants as an alternative to natural gas.

The use of a centralised energy centre also allows for more creative demand management – using thermal storage to take advantage of surplus heat which can be stored for use at times of peak demand, rather than generating all energy at time of use. This ability to 'time-shift' demand is likely to become more important in a world where the use of fossil fuels will be eradicated and the elecricity grid is more reliant on renewables.

More importantly, district energy networks are 'heat source agnostic' meaning that they can run on any heat or cooling source that is available at scale. The beauty of a heat source agnostic system is that it can be connected to whatever heat source presents the most viable solution, and can be changed to reflect advances in technology. So a heat network that uses gas today can be adjusted to use waste heat from mine water tomorrow or hydrogen (if, or when, it becomes a reality) in years to come.

District energy networks also have an added advantage of being able to operate at different temperatures. Consequently, a network that is currently connected to buildings that require heat at 70°C can support a move to a lower temperature when the fabric of the buildings is improved to enable operation at closer to 60°C or lower. Newer networks will seek to make use of lower temperature waste heat, for example that from data centres and underground rail networks.

So, given the size of the UK and

the current emphasis on reducing carbon emissions – and given that district energy networks could be considered a key enabler to those lower carbon energy sources – why aren't there many more?

Barriers to development

There are several barriers to the successful development of a district energy network and the solutions needed to drive the market forward are not fully developed at the moment.

Despite the fact they have been around for a very long time, heat networks are not a widely understood method of heating or cooling our buildings. As such, there is a resistance to their widespread use, particularly for domestic properties outside London, where there is, in fairness, a much more robust strategy for the use of district heating through the London Plan.

Most local authority planning departments have district heating on their hierarchy of measures with regards to the sustainability of new developments. However, current Building Regulations mean that the use of direct electric heating, despite the fact that it can be very costly to run, meets the carbon criteria and can be significantly cheaper to install than a connection to a district energy network.

Even where there is a desire to build a district energy network, challenges remain. For example, new build developments are ideal environments for the use of district energy networks, and large-scale developments will usually include new schools and public or community buildings to provide good heat demand to the network at different times of the day from domestic properties. This allows the network to run over a longer period of time, increasing the overall efficiency.

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However, district energy networks require large up-front capital investments to service the long-term build out of these developments, and often result in full system capability being installed well in advance of the demand. This means that returning this investment can take much longer and the risk that the development will stop before full build out is usually borne by the network developer rather than the property developer.

One solution to managing this risk is to connect to existing buildings to create 'anchor loads'. However, creating commercial solutions can, in turn, cause further technical problems.

Managing the different temperature requirements of the buildings connecting to the network, where retrofitted buildings will likely operate at a higher temperature than the new build ones, runs the risk of either the new builds overheating or the retrofitted properties being colder than the occupants are used to. This often requires further capital to improve the energy efficiency of the older buildings to withstand a drop in operating temperatures.

Commercially viable networks

The cost of owning and running a district energy network can be high and the current non-domestic rates burden placed on district energy networks has been the final straw, financially, for some very promising networks, with non-domestic rates often outstripping revenues in early years.

The use of gas CHP and private wire electricity has been a way of keeping energy networks commercially viable and delivering carbon savings, by displacing 'dirtier' power generation such as coal and gas. As the electricity grid decarbonises over time and cleaner sources of generation come on stream, these carbon savings will gradually erode, most notably in the 2030s.

As part of an integrated energy network providing energy storage and balancing services, gas CHP can continue to offer an important contribution to district scale schemes – exporting to the grid at times of low wind/solar or providing local power to electric heating at times of peak demand. However, appropriate systems of carbon accounting are needed to properly capture the carbon benefits that arise from operating a cogeneration plant in this way, using 'marginal' rather than 'grid average' emissions factors.

This has been a long-standing industry position, though not yet

Birmingham District Energy Scheme

Birmingham's District Energy Scheme was conceived in 2003, and the first 25-year energy supply agreement with Birmingham District Energy Company was signed in 2006. The scheme plays a pivotal role in Birmingham City Council's climate change strategy, which aims to reduce carbon dioxide emissions by 60% by 2027.

The scheme is a working partnership between ENGIE and Birmingham City Council and includes three district energy networks, all built and operated by ENGIE, under the name of Birmingham District Energy Company (BDEC).

The overall network comprises three schemes, Broad Street, a trigeneration – heat, power and cooling – led system, and two Eastside schemes, Aston and Birmingham Children's Hospital – both CHP-led systems. Customers include the International Convention Centre, Barclaycard Arena, Library of Birmingham, residential and educational buildings on Aston campus and council housing.

The scheme makes extensive use of highly efficient large-scale CHP units and uses conventional boilers for 'top up', standby and increased resilience.

BDEC's three core schemes initially involved the supply of energy to ten prestigious users from both the public and private sectors. However, due to the scheme's significant delivery of financial and carbon savings to its consumers, it has rapidly expanded to supply several third-party private developments as well.

Inside Birmingham District Energy scheme plantroom
Photo: ENGIE

implemented by the UK government. Alongside the ending of the Renewable Heat Incentive (RHI) in March 2022, forgoing the electricity revenues that result from CHP operation will create a sizeable gap in the funding required to make an energy network commercially viable.

The right environment

There is a need to create the right environment for the district energy market to grow and flourish if it is to achieve the aim of providing 18% of the UK's heat by 2050. Much of what is required comes in the form of legislation or policy, as recently set out in the government's proposals for a heat networks market regulatory framework.

It is true that, until we remove the country's reliance on individual gas boilers, there is little hope that the goal stated above will be achieved. Progress has been made on this front, with a consultation on proposals to remove new fossil gas connections as a fuel for new build properties from 2025. However, that doesn't address the significant number of properties that currently have gas boilers installed and will not achieve the necessary decarbonisation targets for heat in the timeframe we have left.

Creating district energy zones and ensuring an obligation to connect to a district energy network if you are inside that zone is one way of creating the impetus to change. This was the tactic used in Denmark when the concept of district heating zones was first implemented and was used as a driver to ensure that there was no 'opt out' from the district heat network by individual buildings. Although the obligation to connect is still enshrined in law today, it is rarely called upon as the change in behaviour has been completed successfully.

Government support to help establish the networks and grow the industry is essential. The lack of a successor to the RHI has had a very clear impact on the number of district energy network developments that have been brought forward in the last year. Without the income from private wire electricity and with the confused market signals regarding the future for gas CHP, UK energy network developers are increasingly exploring the use of heat pumps to deliver large scale projects.

However, natural gas is the current fuel of choice for the masses and the cost of this gas is significantly less than the cost of electricity, even with electricity's high performance efficiency. As such, it is difficult to make the business case for a heat pump-led district energy network without some form of gap funding. We welcome, cautiously, the confirmation from the government that there will be some form of successor to RHI and hope that it can be combined with further regulation to remove the use of fossil gas for heating.

Whatever the individual challenges to the widespread implementation of district energy in the UK, it remains an effective way of providing low carbon heat in dense urban and suburban areas. From a policy perspective, there is a way to go to create the right environment for this form of heating (and cooling) to become accepted as the norm. The good news is that the industry has been engaged in helping to shape the policy and the impetus for change exists. And that is more than we could have hoped for a year ago.

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