The Association for Decentralised Energy

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Bringing Energy Together

Combined Heat & Power
District Heating & Cooling
Demand Side Services

Market Report: Heat Networks in the UK

January 2018

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Image courtesy of Veolia

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Introduction

As the UK transitions to a low carbon and digitalised world, new opportunities arise to transform the way we heat our homes and buildings. The Government has identified heat networks as a key technology to decarbonise heat and has allocated £320m of funding out to 2021 to grow the heat networks market. This funding is expected to draw in up to £2 billion of additional capital investment and lead to the construction of hundreds of heat networks in England and Wales. Scotland has set an ambitious target to connect 40,000 homes to heat networks by 2020, representing 1.5TWh of Scotland's heat demand.

Heat networks connect heat sources, including local waste heat, with homes and businesses through a network of pre-insulated pipes carrying hot water. Heat networks are a well-established technology in other parts of Europe. Heat networks provide a number of key benefits:

1. **Local Infrastructure:** As local energy infrastructure, heat networks enable the use of local renewable energy resources (such as biomass and geothermal energy) at a larger scale, and the recovery of waste heat from industries and power stations.
2. **Low carbon:** Low carbon and renewable energy sources for heat networks can significantly lower carbon emissions from heat (between 50 to 100gCO_2/kWh for a biomass network), compared to traditional solutions (above 200gCO_2/kWh).
3. **Planning asset:** Heat networks can be fitted to new or existing buildings as part of local sustainability strategies. The greatest carbon savings can be achieved in the retrofit sector, with research for the Joseph Rowntree Foundation suggesting potential carbon savings of up to 42% per dwelling[1].
4. **Consumer value:** Well designed and operated networks can offer competitive and stable heat prices over the long term, as well as low carbon heat.

This report highlights the opportunities offered by heat networks through developing a clearer picture of the market. Information contained in this report is based on a survey of heat network operators (i.e. ESCOs, housing associations, local authorities). This report also builds on previous research on heat networks in the UK (i.e. Pöyry 2009, Databuild 2013 and AECOM 2015)[2].

Between January and November 2017, the ADE undertook a survey of heat networks in Great Britain. Information on heat networks was collected from a wide range of organisations, including public and private actors, and the information covers about 160,000 domestic and commercial customers on 810 different networks. In light of the BEIS Regulatory data published in February 2017, the sample of networks on the ADE database represents one-third of the overall number of customers connected to heat networks in the UK.

We would like to thank all of the organisations who participated in the survey and provided valuable input and guidance. They include:

The Hyde Group, EON Energy Solutions, BUUK Infrastructure, Bristol City Council, Pimlico District Heating Undertaking, SSE Heat Networks, Engie, EDF Energy Services, Northwards Housing, Miserden Energy, Shetland Heat and Power, Islington Council, Energetik, The Guinness Partnership, L&Q Housing Trust, University of Warwick, Oxford Brookes University, University of Bath and Clarion Housing.

1 District Heating, delivering affordable and sustainable energy, Changeworks for the Joseph Rowntree foundation, April 2017

2 The potential and costs of district heating networks, Pöyry for DECC (former BEIS), April 2009; Summary evidence on District Heating Networks in the UK, Databuild for DECC, July 2013; Assessment of the Costs, Performance, and Characteristics of UK Heat Networks, AECOM for DECC, 2015

Context

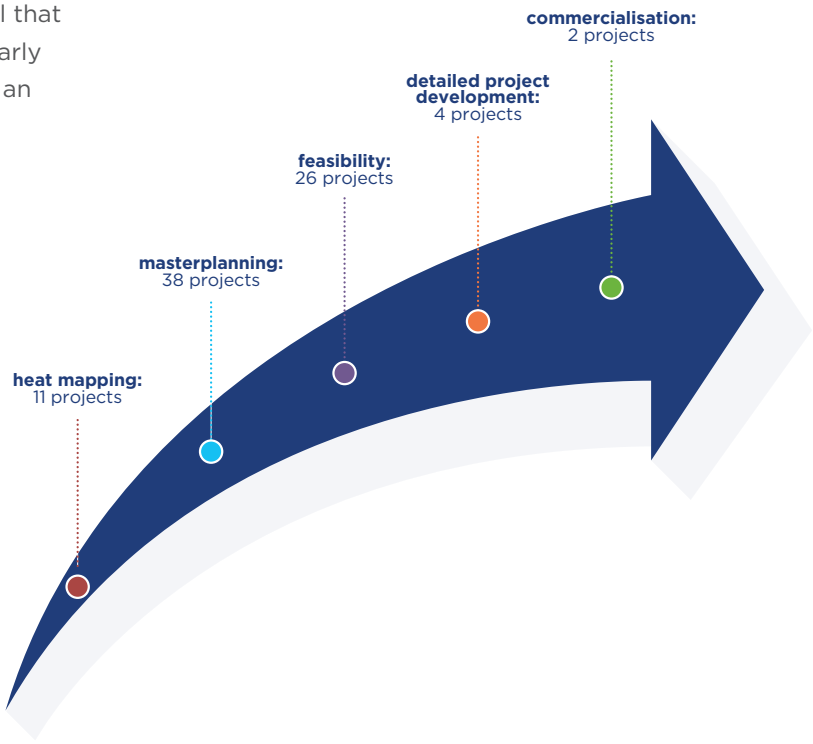
In the UK, almost half of the final energy consumed is used as heat. The domestic, commercial and public sectors account for two-thirds of this final energy consumption. Heat is mainly used for space heating and water heating in domestic and commercial buildings.

The UK has made significant progress in bringing down its carbon emissions in recent years, but challenges remain in the heat and transport sectors. The Committee on Climate Change (CCC) has said that, while the UK is on track to meet its carbon budget up to 2022, more policies are needed to achieve its target after that date. Even though carbon emissions from heating buildings have trended downwards, recently progress has stalled, with carbon emissions higher in 2016 than they were in 2014.

Heat networks provide about 2% of the overall UK heat demand across the domestic, public, industrial and commercial sectors, but a much higher share can be achieved. Government's research suggests that 14-20% of the UK heat demand could be cost-effectively met by heat networks by 2030 and 43% by 2050.

In recent years, new schemes have come to market all over the UK and support local economies, such as the Commonwealth Games Village in Glasgow, and ongoing projects in the cities of Leeds and Bristol aiming to connect new loads to local and low carbon energy sources. The latest figures reveal that around 17,000 heat networks supply nearly 500,000 consumers in the UK, up from an estimate of around 2,000 networks and 211,000 users in 2013[3].

In addition, 81 heat network projects are in the pipeline under the Government's Heat Network Development Unit (HNDU) and are seeking investment. The pipeline reflects a portion of the total projects that HNDU is currently working with. These projects are at different stages of development from heat mapping through to commercialisation.



HEAT NETWORKS PROVIDE ABOUT 2% OF THE OVERALL UK HEAT DEMAND ACROSS THE DOMESTIC, PUBLIC, INDUSTRIAL AND COMMERCIAL SECTORS, BUT A MUCH HIGHER SHARE CAN BE ACHIEVED

3 The Future of Heating: Meeting the challenge, DECC (former BEIS), March 2013 and Heat Metering and Billing Regulations 2014 Notification Data, BEIS, February 2017

Over the period of January to October 2017, there was c. £260 million worth of public contracts spent on heat networks. The industry is one with a rapid pace of change and development. The ADE analysis of the tenders published on the Official Journal of the European Union (OJEU) is as follows:

Heat networks public contracts value

	Number of projects	Value of projects
Planned Scheme	23	£26,685,000
Extension of Existing Scheme	3	£1,330,000
Refurbishment of Scheme	13	£207,030,000
Skills shortage	9	£22,495,000
Unknown	12	£1,280,000
Total	**60**	**£258,820,000**

Contribution of heat networks to the UK's energy requirements: 11 key facts

The following information was obtained through the ADE market survey and publicly sourced data

A heat network is a distribution system of insulated pipes that take heat from a central source and delivers it to a number of domestic and non-domestic buildings. Heat networks form part of the Government strategic plan to reduce carbon and cut heating bills for consumers, both domestic and commercial.

Number of schemes and scale

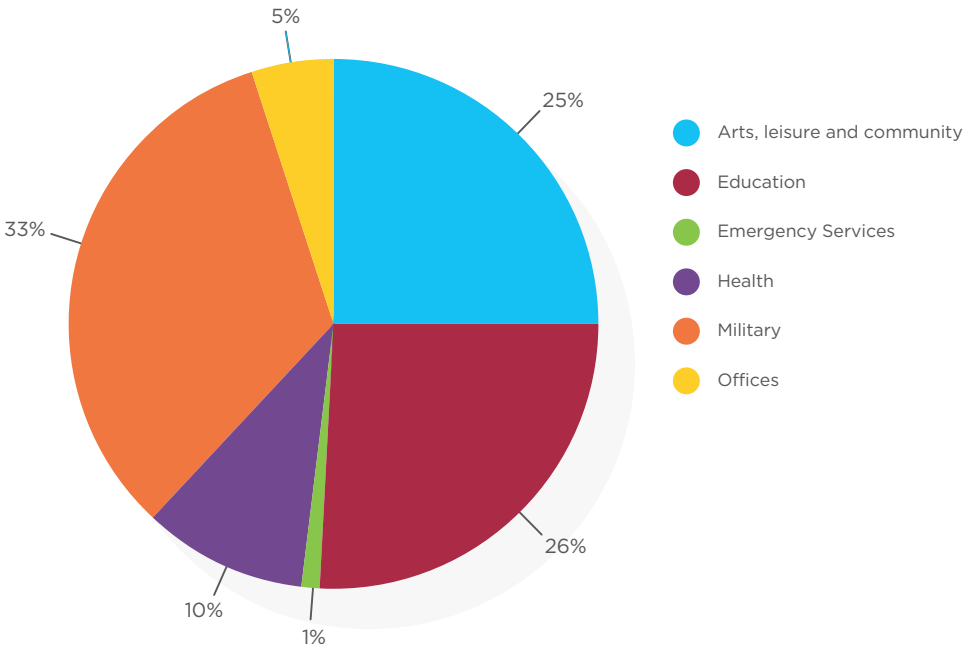
1. There are about 17,000 heat networks in the UK, of which approximately 5,500 are district heat[4] networks and 11,500 are communal heat networks.

Heat demand met by heat networks and sectors

2. Heat networks supply about 12,000GWh of heat annually, of which 6,500GWh is to the domestic sector and 5,500GWh is to non-domestic loads. Altogether, this represents 2% of the overall UK heat demand.

   In the services sector, heat networks provide heat to buildings in the Military (33%), Universities and Colleges (26%), and Art, leisure and community sectors (25%).

Non-domestic loads on heat networks (2016)



Electricity demand met by Combined Heat and Power (CHP) on heat networks

3. Highly efficient combined heat and power plants connected to district scale schemes supply c. 5,800GWh of electricity used by local consumers and exported to the grid. This represents c. 2% of the total UK electricity demand.

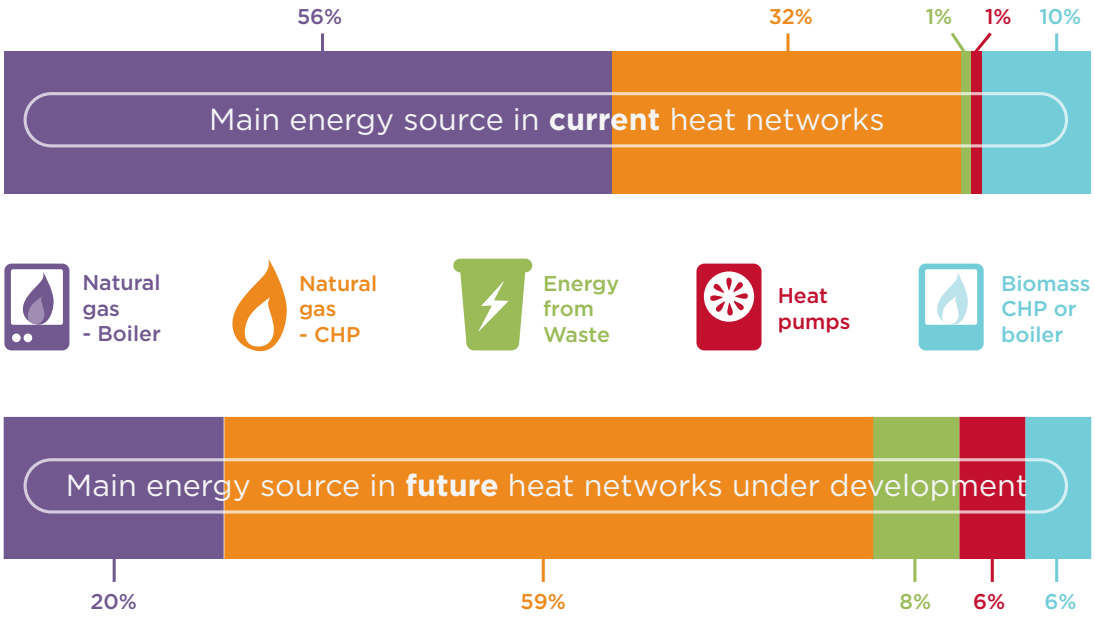
4 District heat networks supply at least 2 buildings and at least 1 customer while communal heat networks supply 1 building occupied by more than 1 customer.

Current energy mix and future trends

4. Heat networks can accommodate any source of heat of sufficient temperature, which enables renewable energy sources to connect over time as the network connects more buildings. Diverse energy sources are used on heat networks: mostly gas (56%) and efficient gas CHP (32%), but increasingly other energy sources form part of heat networks' energy mix, such as large-scale biomass (10%), energy from waste and large-scale heat pumps.

   Heat networks are moving to lower carbon heat solutions and future heat networks (i.e. networks in planning or under construction) suggest new gas generation will mainly be efficient gas-fired CHP (59%), and will also use more heat pumps and energy from waste.

   The industry will have to continue to decarbonise. The Heat Network Investment Project (HNIP)[5] has a requirement to consider and plan for low carbon heat (beyond gas CHP).



Connections by customers and sectors

5. There are around 500,000[6] customers connected to heat networks in the UK (precisely 491,898 cited in the Regulatory data). Of these a large majority are domestic customers (446,517 connections), commercial and retail customers (37,943 connections), and the remaining 7,438 connections are found in universities, hospitals, public buildings and light industries.

   The majority of domestic sector connections are to small flats and maisonettes, while a connection in the commercial sector or in a university covers many more users and a higher heat load.

Length of insulated pipework

6. The total heat network infrastructure is calculated to measure about 1,800 kilometres, which is still a small share of the UK energy infrastructure. By way of comparison, the GB gas infrastructure represents 282,000 kilometres of pipework.

5 Heat networks investment project pilot, Applicant guidance, BEIS and Salix, October 2016

6 Precise data are 491,898 connections (cited in the Regulatory data)

Current use of thermal storage and future potential

7. Heat networks allow large scale energy storage systems to be used, enabling the disconnection of heat production and heat use, and enabling the opportunities for networks to use heat generation (heat pumps and CHP for example) to offer balancing services to the grid. Just over 7% of operational schemes in the UK are known to use a thermal store currently, but this is expected to increase. If the UK meets 14-20% of its overall heat demand with heat networks by 2030, it could deliver 32-46GWh of thermal energy storage annually. 46GWh of thermal storage is the equivalent of 4 hours of space heating and hot water demand in winter time for a million households (i.e. with a 12kW thermal load).

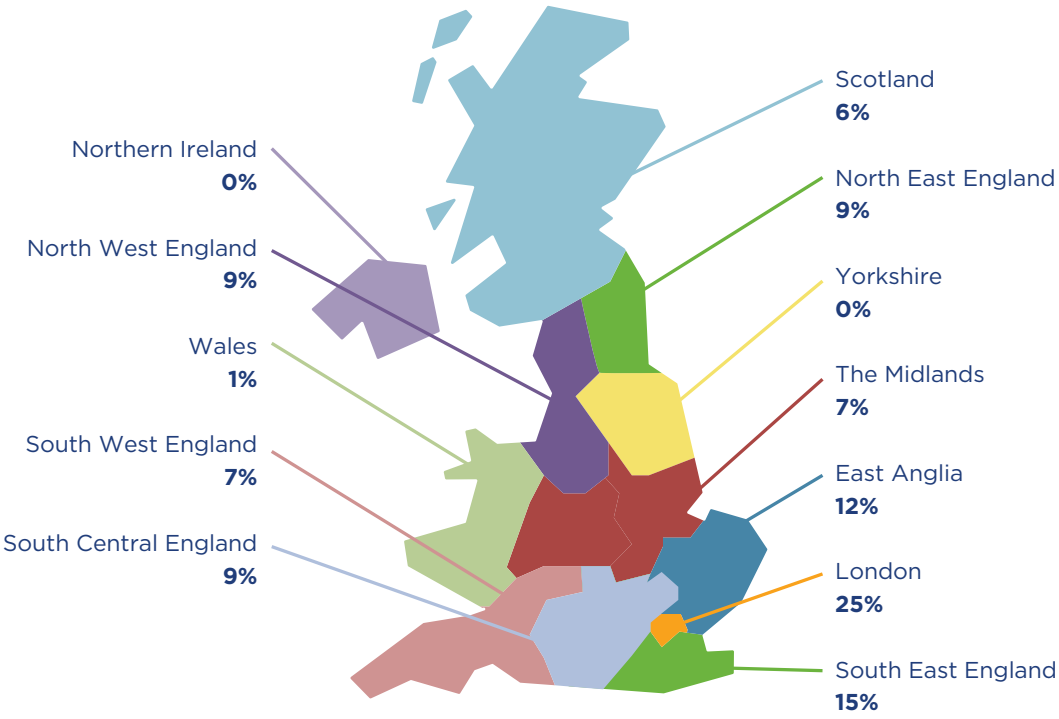
   On heat networks with thermal storage and CHP serving district heating, thermal storage can save heat when the plant is generating electricity but there isn't a demand for heat. This heat can be deployed later when it is needed but when the turbine isn't running because there isn't a demand for electricity. The waste heat can come from other technologies such as industrial processes or heat pumps.

   There are 49 schemes using thermal storage in the ADE sample. In addition, 60 projects on the HNDU pipeline indicate they will use a thermal store if they secure investment.

Location of schemes by regions: England, Scotland, Wales and Northern Ireland

8. The ADE sample of heat networks covers one-fifth of the total number of UK domestic connections. A majority of heat networks are located in London and many more sustain growth all over the UK.

Heat networks in the UK, ADE sample



The chart above portrays only a limited picture as it does not account for the varying size of each region. To allow for this, heat networks' heat capacity have been compared with the level of economic activity (measured in Gross Value Added) in each region. Heat networks are an important part of the local economies in London, the North West, the North East and the Midlands.

In terms of future potential, many criteria influence the development of heat networks: building density, regeneration areas and coordination with other networks. Therefore, an integration of energy planning with the urban planning framework can help bring forward long-term, sustainable heat network infrastructure projects.

Region of the UK	Density of heat networks in different areas (kWt/£mGVA)
East Anglia	0.4
The Midlands	1.4
North East England	1.6
Yorkshire and the Humber	0.0
North West England	1.7
London	1.7
South East England	0.5
South West England	0.5
Wales	0
Northern Ireland	0.1
Scotland	0.5

London Opportunity Areas

The Greater London Authority's (GLA) 'opportunity areas' have been earmarked as spaces of housing growth. Opportunity areas are London's major source of brownfield land which can accommodate at least 5,000 jobs and/or 2,500 new homes alongside other supporting infrastructure. At a level just below opportunity areas, 'Intensification areas' are built areas that can support higher densities.

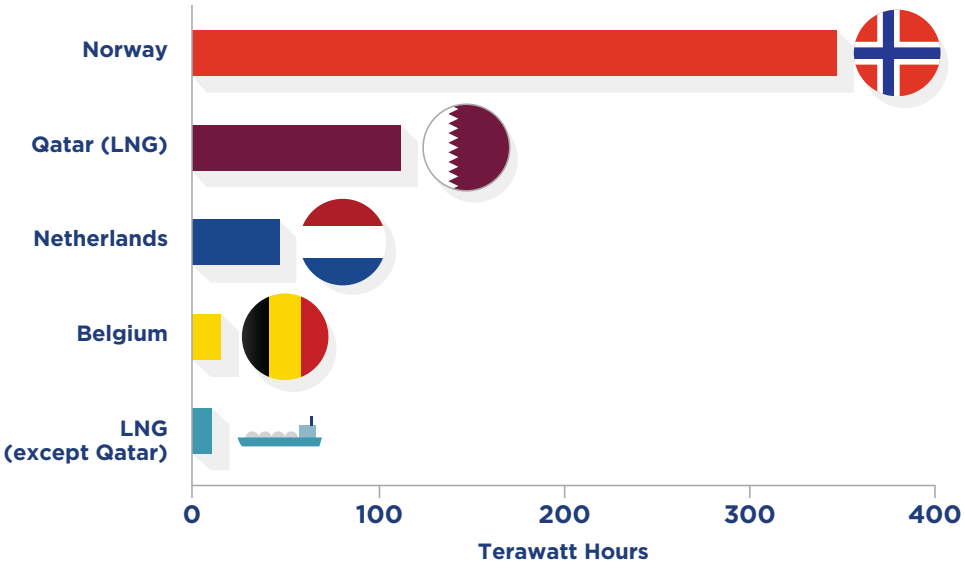
Opportunity areas provide the best potential for joining up energy and planning strategies, and provide infrastructure to sustain growth. In particular, retrofitting is challenging for all types of infrastructures in London (energy, water, and telecommunications) due to the underground ducts being near full capacity, and the long lead time in securing civil and engineering works permission.

Gas imports savings

9. Heat networks can make the most of renewable and recoverable sources of energy that would otherwise be lost. The energy savings from heat networks are significant: the ADE estimates that heat networks save approximately 3,065GWh of gas imports every year. Today, the UK is a net importer of gas (c. 418,000GWh of net gas imports annually). Over a year, the gas savings from existing heat networks are equivalent to:

    - 216,000 households annual gas consumption, or
    - A third of a power station annual electricity supply, or
    - 3.5 LNG tankers.

Origins of the UK gas imports by country (2016)

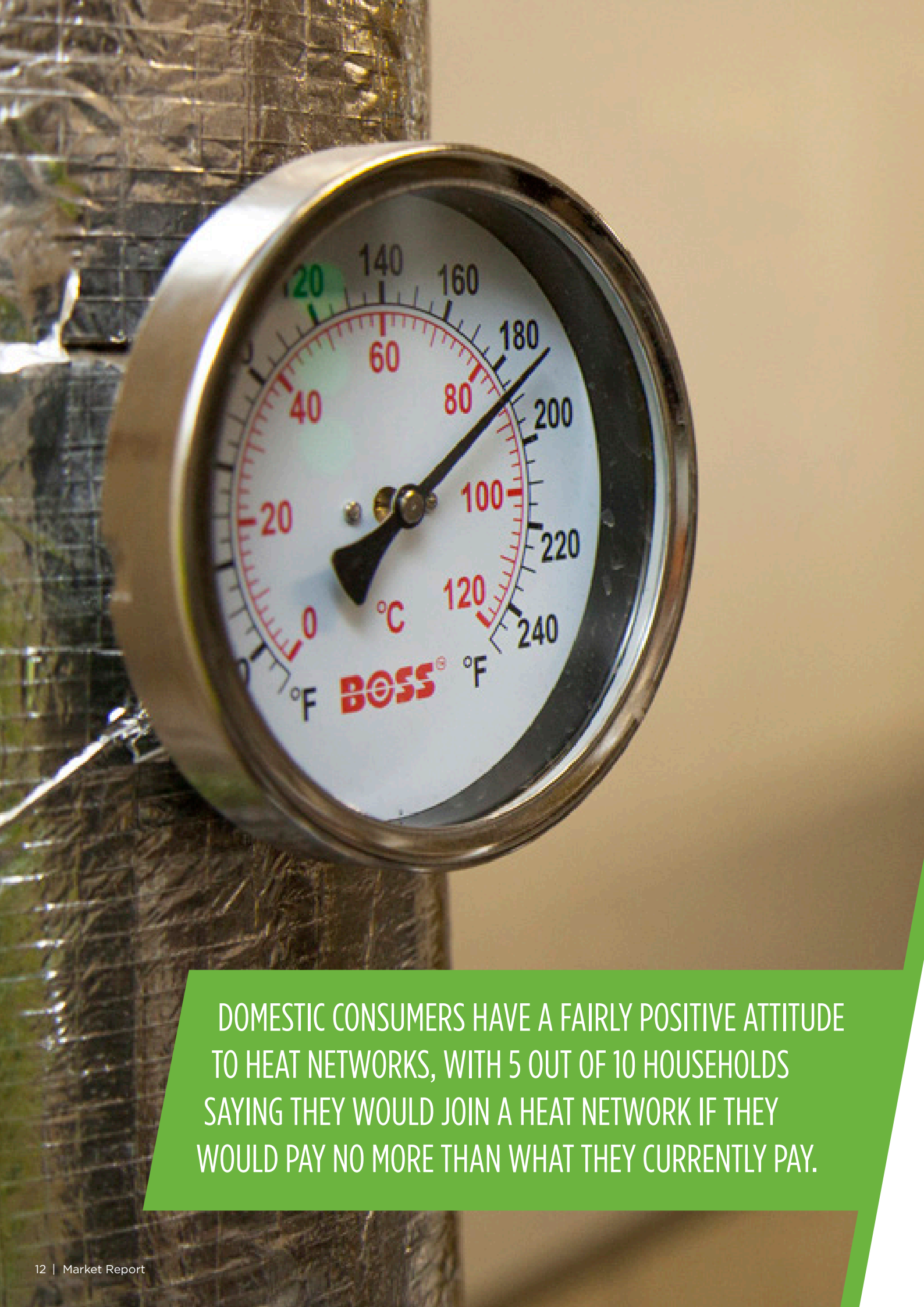


Carbon emissions savings

10. To achieve Government's ambition for inclusive and sustainable growth set out in the 2017 Clean Growth Strategy, the UK needs to decarbonise its building stock. Today heat networks reduce carbon emissions in buildings by approximately 0.7-1 million tonnes of CO_2 each year. However, the potential is much higher. The CCC central scenario analysis suggests that heat networks' (both in on-gas and off-gas grid areas) contribution to heat decarbonisation by 2030 will be about 2.2 million tonnes of carbon emissions ($mtCO_2$) reduction in residential buildings and 3.5 $MtCO_2$ in non-residential buildings, totalling 5.7$MtCO_2$. ADE analysis suggests this requires a six-fold increase in the deployment of heat networks, combined with connections to more renewable heat sources.

Importance of heat networks in jobs creation

11. Heat networks create jobs in the municipalities where they are located. Research from the Energy Technology Institute suggests that 37% of the capital costs of heat networks are associated with the installation of the network (civil engineering work to excavate and reinstate trenches), and 23% with the supply and installation of the Heat Interface Units (HIUs) which enable the connection of the district heating network to the building's heating system. Enabling cost effective levels of deployment, 14-20% of heat demand met by heat networks by 2030, under a range of scenarios set out in Government strategies will require a six-fold growth in heat networks. This growth in heat networks will contribute to the creation of an estimated 46,400 to 63,400 new jobs annually, during the peak employment period, which typically lasts for five years from design to commission of a network project.



DOMESTIC CONSUMERS HAVE A FAIRLY POSITIVE ATTITUDE TO HEAT NETWORKS, WITH 5 OUT OF 10 HOUSEHOLDS SAYING THEY WOULD JOIN A HEAT NETWORK IF THEY WOULD PAY NO MORE THAN WHAT THEY CURRENTLY PAY.

Recent Government surveys of consumers' attitude to heat networks

Public attitude to heat networks

In the Public Attitude Tracking Survey published in April 2016, Government tried to ascertain the level of awareness about heat networks amongst energy consumers on all types of technologies, and their appreciation of heat network services. This survey covered around 2,000 domestic energy consumers.

The findings of this survey suggest that heat networks remain relatively unknown in the UK, with only 2 in 10 households having ever heard of heat networks. The survey also highlighted that domestic consumers have a fairly positive attitude to heat networks, with 5 out of 10 households saying they would join a heat network if they would pay no more than what they currently pay.

Heat networks consumers' attitude to heat networks

The 2017 Heat Networks Consumer Survey is the first significant survey of consumers on heat networks in the UK, covering around 5,000 consumers, of which around 3,000 consumers are on a heat network and 2,000 consumers are on another heating system. The survey asked customers about their satisfaction with their heating system, price and transparency of billing, and customer service.

The main insights can be summarised in the following three areas:

1. **The level of consumer satisfaction** is similar for consumers on heat networks and non-heat networks consumers: 75% of consumers were either 'satisfied' or 'very satisfied' with their system.

   The key drivers of customer satisfaction, from the most important first, are: system reliability, perception of price fairness, satisfaction with information received, not having experienced under-heating or overheating, and satisfaction with complaint handling. Satisfaction is slightly higher on heat networks operated by housing associations, with 8 in 10 consumers expressing satisfaction, than on heat networks operated by a private organisation or a local authority (7 in 10).

2. **The technical reliability** of heat networks is on par with that of non-heat network systems, but the survey reports a lower degree of control over their heating system for heat networks customers.

   Heat network consumers were more likely than non-heat network consumers to report over-heating (heat networks: 39%, non-heat networks: 22%). Consumers in homes built before 1960 said this was because they could not control their heating, while consumers in properties built from 2000 onwards were more likely to cite poor ventilation as a reason for over-heating.

3. **The price and billing information** findings suggest that heat network consumers paid on average around £100 less annually for their heat than consumers with individual gas boilers, even before the cost of a gas boiler had been taken into account. Consumers on Heat Trust registered networks received more comprehensive billing information, reflecting Heat Trust's service standards.

   Overall, consumers on heat networks are more positive about the price they pay than non-heat network consumers. The average price paid by heat network consumers is £580 per year, with more consumers paying less than this amount, and a few very high cost schemes pushing up the average.

Heat network opportunities

A unique lever to tap into renewable and recoverable heat

Heat networks can enable the roll out of renewable and recoverable energy sources at scale. Heat networks represent a unique opportunity to recover waste heat and deploy large scale renewable and low carbon generation:

- Large biomass
- Municipal waste
- Waste heat from industrial activities
- Geothermal energy
- Heat latent in the environment, such as in rivers and lakes, combined with large scale heat pumps
- Waste heat recovered from a combined heat and power plant, fuelled by natural gas or renewables
- Large scale solar thermal heat
- Extraction from the sewage networks

Markets where heat networks are expected to expand in the future

Between 3 and 8 million dwellings, as well as a major share of commercial and public buildings, can be connected to heat networks at reasonable cost according to Government research. The two main markets for heat networks are new-build and retrofit, and each present a set of advantages and limitations.

In the retrofit sector, heat networks can achieve the most cost and carbon emission savings by replacing higher carbon systems. The system installation can sometimes be significant but also provide the opportunity for wider building fabric efficiency improvements, which in turn leads to better consumer experience.

In the new build sector, if opportunities are identified early enough the capital costs of laying the pipes in the ground can be reduced by sharing the civil engineering costs with other infrastructure. Where new homes are highly efficient, they can connect to fourth generation heat networks that operate at lower temperatures and can use low grade waste heat sources. These systems are more efficient and enable a wider source of low carbon heating technologies to be used.

Policy framework surrounding heat networks

Heat networks in the UK are largely unregulated, but there is support for heat networks via various policy instruments:

The UK Government Heat Network Delivery Unit: works to bring seed projects to commercial readiness.

The UK Government Heat Network Investment Project: HNIP provides £320m of capital support to increase the volume of heat network delivery and influence the type of networks built. The full scheme is expected to launch in 2018.

Scottish Government's District Heating Loan Fund, established in 2011, and Low Carbon Infrastructure Transition Programme support heat network investment in Scotland.

The Energy Company Obligation (ECO): Government regulation on heat and electricity suppliers to increase energy efficiency in the domestic sector which provides financial support to new district heating or renovation of old schemes.

Renewable Heat Incentive (RHI): In 2011, the UK Government launched the world's first premium payment scheme for generators of renewable heat. The RHI provides a payment on each MW hour of metered renewable heat production, banded by technology (including energy from waste, biomass and biogas) and paid for out of general taxation.

Heat networks' benefits

Heat networks can provide a range of economic/social, technical, environmental, and political/ employment benefits.

Well designed, built and operated networks can offer:

Economic and social benefits

- ✓ Heat network customers pay, on average, £100 less annually than gas customers - even before the cost of purchasing and maintaining a gas boiler is taken into account.
- ✓ Long term price stability. This is even greater for schemes using a varied energy mix (such as city-scale heat networks) - by utilising varied sources of heat, heat network operators can become less dependent on single fuel price variability.
- ✓ Business cases are established on a full costs basis over the life of the project, including both upfront capital expenditure and operational and maintenance costs, leading to a more comprehensive understanding of full project costs from the outset.
- ✓ Heat networks connecting more than one building can remove the need for individual plant rooms and can free up space in buildings which would traditionally be needed to house equipment – this can be utilised for other purposes, such as cycle storage or communal social spaces.

Technical benefits

- ✓ For many new schemes, modern system design and maintenance is provided by a single operator, who continuously monitors the scheme operation and follows heat provision in real time. This increased scrutiny and understanding of heat use patterns enables much greater efficiencies over time, compared to electric heating and older systems.
- ✓ Well-designed networks are adaptable, meaning technical improvements can unlock further energy efficiency potential. Fourth generation heat networks are designed to work at lower temperatures (around 60 degrees Celsius outflow and 40 degrees return) and they enable a more cost effective transition away from burning fossil fuels, and toward heat supplied from local renewable and secondary heat sources.

Environmental benefits

- ✓ Heat networks can present a unique lever to capture massive amounts of waste heat, and turn this into energy for communities.
- ✓ Heat networks are a technology neutral infrastructure that can connect multiple heat sources over time - meaning they have a role in future energy policy even as policy changes shape and technology evolves and can flex to meet future challenges. Policy development must distinguish between heat distribution and generation systems, which represent fundamentally different investment propositions, each having their own investment profiles in terms of risk, return and lifetime. The flexibility offered by heat networks is a key benefit in the move towards a decentralised heat system.
- ✓ Leading local authorities driven by a carbon emissions reduction target will find heat networks to be a fantastic tool to reach their goal.
- ✓ Heat networks can centralise heating and give planning authorities and regulators better control, understanding and verification than they would otherwise have for thousands of individual households.

Employment benefits

- ✓ Local jobs are created during the construction of the network, and long term jobs are created to maintain the system – ranging from highly skilled engineering jobs to soft-skill focussed roles.
- ✓ Innovation is a key driver of growth and productivity. Innovation on heat networks, for example in areas such as heat interface units and smart meters, could create further jobs across the UK and open up opportunities for international trade.

Conclusion

Heat networks are not suited to all buildings, but as many as 50% of buildings in the UK are in areas of suitable density for heat networks. The characteristics of heat networks lend them well to dense areas with a mix of residential and non-residential buildings as it creates a more stable heat load profile all year long.

In addition, the CCC modelling suggests that heat networks can deliver up to 5.7MtCO_2 emissions reduction in residential and non-residential buildings by 2030, which represents around a six-fold increase on today's heat networks carbon emissions savings level.

BEIS's Heat Network Delivery Unit (HNDU) shows that there is political will to implement the strategic opportunity of heat networks. There were 81 heat network projects looking for investment as of Q3 2017.

Innovation in heat networks through smart metering, thermal storage and cooling networks can transform the UK heat network market. HNIP supports nine innovative heat network projects that are being tested across the UK, which include the use of smart systems to diagnose performance issues and heat recovered from data centres and canals. Innovation on heat networks opens up opportunities for UK-international trade.

Following its work over the past five years, including:

- Creating Heat Trust, the UK's first heat customer protection scheme, now covering more than 32,000 customers, and planning to expand to third-party schemes
- Publishing with CIBSE the UK's first heat network's Code of Practice, and committing to a technical compliance scheme to be delivered in 2018
- Launching the Industry Heat Network Task Force, which examined how a new policy framework can reduce investment risk, delivering cost-effective market growth, and ensure excellent customer service,

industry is well placed to address risks and capture opportunities that will arise going forward.

Image courtesy of Veolia

HEAT NETWORKS CAN DELIVER UP TO 5.7MTCO2 EMISSIONS REDUCTION IN RESIDENTIAL AND NON-RESIDENTIAL BUILDINGS BY 2030, WHICH REPRESENTS AROUND A SIX-FOLD INCREASE ON TODAY'S HEAT NETWORKS CARBON EMISSIONS SAVINGS LEVEL.

Annex 1: Assumptions underpinning analysis

Report item	Evidence used	ADE analysis
Number of schemes and scale	This section uses evidence from BEIS (2017) Regulatory data.	
Heat demand met by heat networks and sectors	This analysis uses evidence from BEIS (2016), ECUK (2017) and the 2017 ADE survey of heat networks. Non-domestic heat networks consumption comes from BEIS public figures.	The domestic heat networks consumption depends on the number of domestic customers connected to heat networks. The outturn* average domestic gas consumption in 2016 is adjusted for individual gas boiler efficiency to work out the average domestic heat consumption. A recent survey by BEIS suggests that heat network consumers tend to use more heat than non-heat network consumers (Heat networks consumer survey 2017), which we take into account by applying an uplift to the outturn average domestic heat consumption. The result is then multiplied by the number of heat networks domestic connections to work out the total domestic loads on heat networks in the UK. *Outturn is temperature-adjusted.
Electricity demand met by Combined Heat and Power (CHP) on heat networks	This section uses evidence from BEIS (2017) DUKES Chapter 7 Combined Heat and Power.	
Current energy mix and future trends	This section uses evidence from the 2017 ADE survey of heat networks.	
Connections by customers and sectors	This section uses evidence from BEIS (2017) Regulatory data.	
Length of insulated pipework	This section uses evidence from the ADE survey of heat networks and Ofgem (2015).	This estimate is based on the ADE survey of heat networks. A sample of 89 heat networks reported their pipework length, totalling c. 430 kilometres. The length of pipework from the sample is extrapolated to the UK market using the overall number of heat network customers in the UK.
Current use of thermal storage and future potential	This section uses evidence from the report "Next steps for UK heat policy" by the Committee on Climate Change (2016), the Government's Clean Growth Strategy (2017), the Heat Network Investment Project (HNIP) Investment Pipeline (2017) and the ADE 2017 survey of heat networks.	The thermal storage potential uses data from a case study of a London based heat network serving a mix of domestic and commercial customers with CHP associated to a large central thermal store. The analysis uses the thermal energy store capacity as a share of the energy provided by the scheme to its customers, and extrapolates it to the UK by using Government assumption that heat networks reach their potential of a 17% penetration in the overall UK heat demand.
Location of schemes by region: England, Scotland, Wales and Northern Ireland	This section uses evidence from the ADE 2017 survey of heat networks and information on the GLA website.	

Report item	Evidence used	ADE analysis
Gas imports savings	The gas imports analysis uses evidence from BEIS DUKES Natural gas and Electricity Chapters (2017).	Gas imports savings depend on the main energy sources used to supply heat through heat networks. Recoverable heat could not be used without a heat network. Energy sources such as geothermal wells or energy from waste are sometimes combined with heat pumps, which use electricity. This analysis uses government figures for heat pump efficiency (COP 3) and a Combined Cycle Gas Turbine (CCGT) gas use to produce electricity. The 3TWh of gas savings from heat networks have been translated into other indicators. Number of households: This analysis uses evidence from BEIS (2016) ECUK outturn domestic gas consumption. Number of power stations: This analysis uses the same method as was used by BEIS to calculate power plant avoidance: a 1GW power plant operated 24 hours a day and 365 days a week. Number of LNG tankers: This analysis converts the annual natural gas imports savings of 3TWh to LNG tankers by converting the volume of natural gas into liquid gas and using the average LNG carrier capacity.
Carbon emissions savings	This carbon analysis uses evidence from DEFRA (2017) Emission conversion factors, BEIS DUKES (2017) Electricity and Combined Heat and Power Chapters, the CCC Next Steps for Heat Policy analysis - Annex 2 Heat in Buildings (2016) and Columbia University Technology board's publication on Energy from Waste.	The carbon emissions reduction depends on the energy sources used to generate heat in heat networks, the losses in the process and on the distribution route, and are relative to a counterfactual. Gas boilers are the main form of heating in buildings in the UK, with an estimated 24 million boilers currently in use. Heat networks are also installed in existing buildings to replace old electric heating systems. Individual gas boilers are the most relevant counterfactual as they are widely used in the domestic sector (90% of UK households). This analysis uses the Government figure for gas boiler efficiency (81%).
Importance of heat networks in jobs creation		The ADE used the employment multiplier produced by the Office for National Statistics to work out the jobs created with heat networks. The investment in heat networks that could enable the sector to meet the potential for 14% of the UK heat demand to be met by heat networks in 2030 is worked out from evidence from research for Government by AECOM.

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