HEAT AND THE CITY

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Briefing: March 2019

Meeting strategic challenges of UK district heating

This briefing summarises our recent research findings on district heating (DH), and is aimed at UK local authorities, large public bodies, housing associations and policy makers. It draws on heat map analysis and international experiences in the Netherlands and Norway.

Resources and a check-list for practitioners are included at the end of this briefing

Read our research in more detail at heatandthecity.org.uk

Research highlights

- **Equipping local government with the powers and resources** to develop and enforce local heat and energy efficiency strategies will be important for progressing from 'cherry-picking' of DH connections, towards maximising the energy efficiency, scale economies and decarbonisation potential of networks.
- **A 'cluster-density' model of DH development** could deliver a significantly higher connection rate, and corresponding higher scale of low carbon heating provision for buildings.
- **A requirement to connect** for certain building types or heat loads would likely be necessary to ensure financial viability of networks and to de-risk investment in networks for both clustering and zone-based models. This would require coordination between public authorities in network development and strategic planning of heat decarbonisation.
- **Use of concession zones with licenses** (such as in Norway) would incentivise district heating developers to invest in future proofing systems and to plan for future expansion in line with cluster-density planning.
- **Customer protection measures** include transparency of financial data to allow assessment of company profits, and establishment of standards for heat network business accounting (c.f. case study of the Netherlands). Linking consumer protection to concession zones with licensing would provide a means for enforcing standards and collective accountability of network operators.

Research from the Heat and the City team examines the social, political and financial factors shaping our energy technologies and energy use, and investigates how European societies are seeking to transform their energy systems to help mitigate climate change.

A 'low-regrets' contribution to heat decarbonisation in the UK

DH has a critical role to play in the future portfolio of UK low carbon heat technologies. It provides an energy efficient solution for decarbonisation of buildings in and close to areas of high heat-density. It is a cost-effective means of enabling use of waste heat from water sources, air and industrial processes, including energy from waste, data centres and crematoriums. DH infrastructure can use any available heat sources. This makes it a low-regrets solution for decarbonisation, and development should proceed without waiting for long-term choices on associated low carbon options such as hydrogen and electrification [1]. The UK Government's Clean Growth Strategy and Scottish Government's Energy Strategy both recognise this important role for DH and call for new networks to be built and extended. However, at present it is challenging to develop viable business cases for new networks. Extensive gas network coverage and cheap gas prices with tax subsidies and ineffective carbon pricing limit the types and scale of the resulting DH developments.

Challenges facing district heating in the UK

- **Uncertainty around future demand and cherry-picking of sites:** network developers perceive it as financially risky to design and pay for future-proofed systems, given uncertainty over future demand and local energy policy developments. This usually leads to DH developers cherry-picking sites and designing to minimum size specifications, in order to maximise financial returns and minimise payback times. Development of networks in this way is likely to limit future development of more economic city-wide systems.
- **Limited local powers for strategic heat and energy efficiency planning, particularly for retrofitting into existing buildings**: There are few local or regional government powers to support strategic heat planning and energy efficiency; main planning powers are for new developments, rather than retrofit. Lack of a systematic government-supported policy and regulatory framework results in inconsistent, uncertain and piecemeal action, missing the opportunity to steer network expansions and inter-connecting developments to maximise economies of scale and carbon saving.
- **Lack of enforcement of design standards and customer protection:** Current use of planning powers compelling new developments to consider DH provision has not ensured technically optimum scheme design or appropriate customer protections and has perpetuated fragmented development.

Heat planning under uncertainty

In the context of uncertain heat decarbonisation pathways, how can heat and energy efficiency strategies be used to support low-regrets DH development? Heat planning provides an opportunity to facilitate new DH developments today, as well as coordinating the form of development to take advantage of future changes in the wider energy system. In order to plan heat networks, decision makers need to take into account the wider context, including the local potential for scale economies; links to other energy system decisions including demand reduction through improved energy efficiency of buildings; the potential role of other low carbon heat technologies (e.g. hydrogen or electrification), and the decarbonisation pathways of other sectors including transport.

Read about this analysis in more detail: 'What might district heating zones look like?' (Hawkey, 2017) [2]

A cluster-density model for DH development could enable connection of a greater number of small heat users and reach 50% more heat demand.

Our research sought to understand how heat and energy efficiency strategies could identify DH zones to facilitate low-regrets development, and maximise the benefits from networks in the long-term. We also asked what the characteristics of such development sites might look like.

We conducted an analysis to see what development approach would result in maximising the amount of heat demand connected to a DH network, given a particular network cost threshold. We tested two different models for identifying areas for development – a zone density model and a cluster-density model - using zone-level heat density data from the Scottish Heat Map as a case study.

- The **zone-density model** targeted data zones with the highest heat density, and ignored potential connections in neighbouring areas. This mirrors the relatively fragmented pattern of UK DH development, although in current practice the boundaries of 'prime sites' for DH are usually determined by organisational structures, such as buildings on a single campus, rather than the data zone boundaries used in our theoretical analysis [3].
- **The cluster-density model** of development anchors DH first by supplying large heat loads, and then builds out to serve smaller heat users nearby. This approach would likely involve a form of 'requirement to connect' across an area (E.g. by under-writing investments / demand guarantees) to maximise connections within an acceptable margin of financial return for a network developer.

The case study on the left demonstrates the cluster-density model, which enables economic network connection of lower density Zone A, where the required cost threshold would not otherwise be met. Zone A alone is unlikely to meet cost thresholds for future isolated developments. Combining Zone A and Zone C results in connection of a larger area, creating economies of scale and cost savings, including use of one heat generation source to supply the two areas.

The case study analysis, using Scottish data zones, suggests that the cluster-density model reaches

50% more heat demand

than the zone-density model.

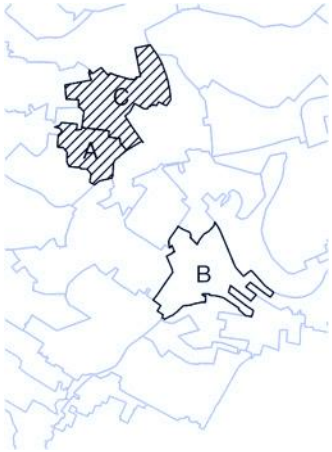
Inclusion of a greater number of households and commercial buildings on a low carbon DH network offers a low-regrets heat decarbonisation solution using an established and safe technology. It also provides a decarbonisation solution for buildings that are difficult to retrofit to high energy performance standards and are unlikely to be suitable for electric heating. This is particularly significant in areas where there are a large number of older flats, making DH and/or hydrogen solutions (or using hydrogen as fuel source for DH) more satisfactory.

Both DH development models are likely to require some form of 'requirement to connect' in order to de-risk investment. This might primarily apply to buildings in the public sector, to provide a base-level of demand certainty for a network investor.

Characteristics of households and dwellings in DH areas in this analysis:

- At present, reduction of fuel poverty is an important driver for development of some DH networks [4]. However, when considering longer-term, low-regrets DH development sites, the cluster analysis suggested that the most suitable zones for DH are often some distance from areas with high levels of fuel poverty.
- Similarly, areas with electrically heated social housing flats often fall outside areas of high heat density. Most social housing flats included in

Case study: the cluster-density approach:



In this theoretical example, the network development costs (Area/Demand) need to be lower than 2 for a development to go ahead:

Zone	Area	Demand	**Area/ Demand**
A	*5.6*	*6.2*	***0.9***
B	*12.1*	*6*	***2***
C	*11.4*	*4.1*	***2.8***
A+C	*17.0*	*10.3*	***1.7***

Individually, only Zone B and C are cost-effective. Combining the heat demand in areas A and C allows the inclusion of area A in a cost effective network.

our cluster-density analysis were selected based on proximity to heat dense clusters, rather than the heat density of their own areas. This highlights the potential social benefit of the clustering model.

Practices in other European countries

How have other countries with similar contexts to the UK supported strategic DH development? Our research considered Norway and the Netherlands, two countries that have relatively small penetrations of DH and were early in liberalising their energy markets, just like the UK. However, both countries have had greater success at increasing DH development. In particular, they have successful examples of enabling clustering of development **(See case studies in Hawkey and Webb (2014) for more details** [5]**).**

Characteristics of DH in Norway and The Netherlands:

*Norway had **3.4%** of heat provided by DH in 2013, and **electric heating** was the predominant energy source underpinning heat services.*

*The Netherlands had **4%** of heat provided by DH in 2013, and **natural gas** was the predominant energy source underpinning heat services.*

Characteristics of Policy and Regulatory Frameworks in Norway and the Netherlands that support strategic DH development:

Our research showed both local and central governments in Norway and the Netherlands successfully bringing business, public and housing sectors together to cooperate on large-scale district heating projects. They did this through forms of **licensing, planning and regulatory measures** which supported development of an effective heat market and enabled large heat sources such as waste industrial heat to be utilised.

Norway

- **Local directive planning policies:** Local government supported DH market development by adopting directive planning policies and helping companies to plan strategically in relation to anticipated new developments, facilitating investment. Norwegian regulation of energy efficiency standards in waste incineration also meant there was a "commercial" (though publicly owned) actor which had an interest in ensuring DH development at scale in order to meet required efficiency standards.
- **Licensing of concession areas:** Norway has a license system to grant area concessions to energy companies to develop a new network. License holders have exclusive rights to develop a network in the concession area, and the right to apply to local government for mandated connections of new development within the zone. Licensing offers protection from competition whilst also legitimising the network among potential subscribers through certified economic, social and environmental standards.
- **Consumer protections:** Concession agreements are linked to consumer protection standards, avoiding the risk of exploitation of a monopoly position. Local government has the ability to intervene where necessary, and network customers have a standard of accountability, and an option for collective switching to a new operator at certain points in the contract if the service is unsatisfactory. A provider of last resort supports customers through collective switching, rather than emphasising individual switching. This preserves the level of heat demand across the network (and hence its financial viability).

The Netherlands

- **Cooperation between local government and industry:** In the Netherlands, governance of DH is framed as a joint responsibility of public authorities and industries, underpinned by consumer protection legislation. The Rotterdam government successfully facilitated DH development through these cooperative relationships by granting a series of exclusive DH

concessions to utilities, and applying supportive building control policies. The concession areas encompassed both existing buildings and new developments.

- **Consumer protection through transparent financial data:** Regulation of DH initially focused on consumer protection due to customer concerns that they were being exploited by companies making excessive returns. However, investigation of DH businesses found the returns extracted were quite low. This demonstrated the importance of access to financial data for customers or their representatives to assess the balance between heat prices and company profits. A standardised method for heat network business accounting was established, ensuring requirements did not place a heavy burden on DH operators.
- **Budget control at local government level:** Although the Netherlands national government retains control of the majority of local finance, local governments own stakes in regional energy enterprises [6], and local political leaders exercise considerable discretion over budget allocation. They also have prominent roles in state and European politics, which provides space and impetus for local governments to steer local energy system development.
    - In contrast, UK local government is principally dependent on central government grant funding rather than local taxation [7]. This makes it harder for local governments to take initiatives to support district heating, independently of national government support or regulation.
    - UK local governments have no direct mandate for localised energy provision and are obliged to prioritise statutory duties prescribed by central government; austerity budgets have further reduced the scope for discretionary activity.

Read this research in full at: 'District energy development in liberalised markets: situating UK heat network development in comparison with Dutch and Norwegian case studies' (Hawkey and Webb, 2014) [5]

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Check-list and resources for practitioners

Read our research in more detail at heatandthecity.org.uk

What do our research findings mean in practice for heat planners or district heating project sponsors in the UK? In the following check-list we pose questions, offer suggestions and sign-post relevant resources.

Strategic planning for heat network development

As a heat planner, how are you approaching strategic planning for long-term heat network development, despite uncertainties about future energy system pathways? What details can be included in your plan, and over what timescales? What data and methodologies have you used to define your priorities?

- Scotland is in the process of developing guidance for local heat and energy efficiency strategies and is considering a new statutory duty on local authorities to develop and implement plans and monitor progress. Find out about experiences and lessons from pilot projects on the Scottish Government Energy Efficient Scotland website [8] and in the Heat and the City evaluation report [9].
- See an example of a strategic energy whole area plan: Burntisland energy masterplan (Fife, Scotland) [10]

Encouraging other organisations to support strategic development in your area

How can the organisational arrangements for networks in your area enable future development and interconnection to meet strategic aims?

As a heat planner, developing a strong culture of cross-sector collaboration and coordination around district heating development is essential (particularly in the absence of formal energy planning powers). This will encourage development of strategically optimum sites to enable future network expansion and greater heat decarbonisation. Useful resources to support effective 'stakeholder engagement' are:

- The International Energy Agency guide includes a section addressing 'Community based energy planning for successful projects' Chapter 3 [11], Chapter 3
- The UK Government Heat Networks Delivery Unit make suggestions for good practice: 'Stakeholder engagement in heat networks: a guide for project managers' [12].

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Key factors for successful project development, operation, expansion and renewal:

As a district heating project developer, are you ensuring good practice in technical standards, stakeholder engagement, customer protection, governance and financial management?

- The International Energy Agency guide has a chapter 'District energy lifecycle and strategies for success', which identifies five key factors for a project to successfully navigate the different lifecycle stages, maintain momentum and enable all participants to work toward project objectives: allocating and managing **risk**; gathering and disseminating **information** for decision-making; managing **funds** to align with the system lifecycle stage; including appropriate **people** and experts as needed in decision-making; using available **tools** to improve decision making.[11], Chapter 5.
- The Department for Business, Energy and Industrial Strategy has published a collection of guides which aim to provide heat network developers, and those involved in the heat network supply chain including technical, financial and legal advisers, with a firm grounding in the sector. [13]
    - This includes 'Heat Network detailed project development' [14]
    - As well as 'Optimisation of heat networks: issues for project sponsors to consider' when designing a new heat network [15].
- Scottish-specific resources are available at the Scottish Heat Network Partnership website, including guidance on local authority powers, business models and energy service companies (ESCOs), heat supply agreements and a summary for local authority project sponsors.
- In England and Wales, capital funding is available through the BEIS Heat Networks Investment Project to gap fund DH projects.
- An updated version of the CIBSE Heat Networks Code of Practice is under consultation, and a final version will be published in 2019 [16].

Future proofing projects

As a project sponsor, how do you evaluate the expansion and interconnection potential of your network? Can you future-proof your network to make this growth easier in the future? And how could the network's heat source become low carbon (if it is not already)?

- HM Treasury recognised the value of future proofing heat networks in their supplementary guidance to the Green Book, using the example of a heat network in Islington, London – 'Valuing Infrastructure Spend' [17, p. 21]

Customer experience and protection

What forms of accountability and transparency are available to your heat network customers? E.g. Do they have access to financial data to allow assessment of heat prices? Both UK and Scottish Government have confirmed their intention to introduce a form of customer protection regulation, or licensing for customer protection, and therefore it is prudential to ensure network operators are responsive to these requirements.

- The following reports consider the experience of heat network consumers, the complaints process and perceptions of consumer protection and regulation:
    - '*Consumer expectations of regulation: heat networks*', commissioned by Citizen's Advice, [18].
    - 'Turning up the heat: Getting a fair deal for District Heating users', commissioned by Which? [19]
    - 'Qualitative research with consumers and operators of heat networks' published by BEIS in 2018 [20]

- ‘Heat Networks Consumer Survey: Executive Summary’ published by BEIS in 2017 [21]
- The UK Competition and Markets Authority conducted a market study into domestic heat networks, to review how well the market works and if consumers are getting a good deal [22], making a final recommendation that the sector should be regulated.
- The Heat Trust provides a voluntary customer protection scheme (note: this does not place controls on heat pricing at present, although it recommends that the way that futures prices are set should be transparent) http://www.heattrust.org [23]. Both UK and Scottish Government have recognised the Heat Trust as a useful basis for future customer protection measures.

Networks for peer-support and advice

- The UK District Energy Vanguards Network is a UK-wide knowledge exchange network whose core consists of local authorities and housing associations actively developing or operating district energy systems. As part of the network, you can subscribe to a regular newsletter and attend meetings across the UK https://heatandthecity.org.uk/project/vanguards-network/
- In Scotland, the Scottish Heat Network Partnership can provide access to advice in all stages of project development, including signposting potential specialised funding and loan sources to support planning and development of projects in Scotland http://www.districtheatingscotland.com/network-developers/
- In England and Wales, the Heat Network Delivery Unit provides support and guidance to local authorities in the early stages of developing DH projects. Local authorities can apply for HNDU grant support through bidding rounds: https://www.gov.uk/guidance/heat-networks-delivery-unit

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