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HEAT AND THE CITY RESPONSE TO ENERGY AND CLIMATE CHANGE COMMITTEE CALL FOR EVIDENCE ON LOCAL ENERGY

EXECUTIVE SUMMARY

District heating infrastructure has potential to enable heat generation across a much greater range of scales than would otherwise be possible. By making use of low carbon and low cost heat sources, and building in future flexibility for large numbers of users, district heating can contribute directly to achieving the core energy policy goals of climate change mitigation, energy security and affordability. In addition, through a variety of complex interactions district heating has potential to lower the costs and carbon emissions of the electricity system.

Current patterns of heat network development focus on niche opportunities and are based around gas fired CHP. Key issues raised by this pattern of development are ensuring that the increasing returns to scale of heat networks are exploited, and that lower carbon sources replace unabated gas CHP in future. The latter issue is less challenging than the former as the design of DH systems (insulated pipes carrying hot water) can accommodate multiple sources of low carbon and residual heat. However, ensuring different systems within a city are developed in a strategically coherent manner is more challenging.

A range of different organisational forms are currently used in the UK to deliver DH systems, balancing risk and control across public and private sector actors in different ways. However, in common with DH development in other Western European countries, local authorities play crucial strategic and coordinating roles in developing local energy systems. Capacity and financial constraints on local government are therefore key issues affecting the prospects for DH development in the UK. DECC has recently established a modest Heat Networks Delivery Unit to support local government through development phases (and potentially thereby embedding capacity within local authorities).

The Heat Networks Delivery Unity reflects growing commitments to DH within DECC, and these are mirrored in other administrations, particularly the Scottish Government and the Greater London Authority, although policy in relation to DH has had a somewhat stop-start character over the last decade. While the myriad of minor challenges facing DH may be tackled relatively straightforwardly, significant interrelated challenges remain in relation to mobilising finance, interaction with electricity markets, ensuring small networks become parts of larger systems, weakening of English planning guidance in relation to distributed energy, and ongoing uncertainties in English Zero-Carbon Homes policy.

HEAT AND THE CITY PROJECT

1 This response is derived from evidence collected as part of the UK Research Councils' Energy Programme: Heat and the City project, www.heatandthecity.org.uk, a collaboration between the Universities of Edinburgh and Strathclyde. The aim of this multi-disciplinary project is to examine the prospects for development of sustainable, low carbon heating in urban areas in the UK. We would be happy to provide the committee with further information as requested. Please contact dave.hawkey@ed.ac.uk

Heat generation and infrastructure

2 The Energy and Climate Change Committee's call for evidence relates to energy generating projects in the 5-50MW bracket. Much of the call's text focuses on electricity generation, but it is important to also consider heat generation at scales larger than individual building demand, particularly for space and water heating. This is both because heating is a crucial and relatively neglected aspect of climate, security and affordability goals in energy policy, and because heat generation interacts in various ways with electricity systems (discussed below).

3 In contrast with electricity, the physical infrastructure required to distribute heat from community-scale generation to users does not exist. Accordingly, this response focuses principally on the development of district heating (DH) networks as a means both of enabling new heat generation of this scale, and of exploiting sources of residual heat that would are currently wasted or used only inefficiently.

Contribution to achieving UK's climate change, energy security and energy affordability objectives.

4 In densely populated urban areas, local energy can provide affordable heat (particularly where it replaces electric resistive heating), as well as carbon and primary energy saving. In the right places, they contribute to local economic regeneration and public welfare., For example Göteborg Energi Group heat network operations have a turnover of 3 billion Swedish Kroner, and 1,100 people are employed by the group in district heating, gas, electricity, renewable energy and energy efficiency measures.

5 Heat networks are "source agnostic," capable of accepting heat from a wide variety of sources, thereby contributing to energy security by enabling diversity and flexibility. Where large heat networks exist, for example in Scandinavian cities, large scale heat generation of various kinds feed in. The existence of heat networks in Sweden and Denmark is a significant factor in the high proportion of energy consumed from renewable resources in those countries.[i]

6 Common praxis in the UK is to develop heat networks on the basis of gas fired CHP to minimise some forms of risk. This creates carbon savings in the short term when compared against grid electricity and gas-based or electric heating. In Aberdeen for example where gas CHP serving 24 multi-storey housing blocks, public buildings and leisure facilities has been developed over the last ten years, the local authority estimates that this has resulted in a 31% reduction in emissions from the council's estate (including public housing). Over the longer term, unabated gas CHP could be replaced with other lower carbon heat sources. For example, the UK Committee on Climate Change estimate that delivering heat from large scale low carbon thermal electricity generation (CCS/nuclear) operating in CHP mode would produce economic *savings* of £110 per tonne CO_2 avoided. Source agnosticism of DH means part of its value lies in future proofing large portions of heat demand against uncertainty in the future scarcity of low carbon energy sources/vectors (low carbon electricity, biomass, hydrogen, etc.) and the price and performance of technologies (such as heat pumps).

7 Where electricity is difficult to store, large quantities of heat can be stored for long periods, including inter-seasonally, with scale bringing efficiency benefits. This will become more significant under high penetration of renewables and

nuclear, combined with new load from electric vehicles and heat pumps causing increased peak demand. Heat networks with CHP, heat stores and electric boilers can respond to imbalances in supply and demand in the electricity system. This reduces the need for investment in under-used and less efficient 'stand-by' plant, avoids wastage of "free" electricity and reduces the balancing costs faced by generators. Embedding CHP generation in the distribution network can defer the need to upgrade electricity networks, and heat demand served by a heat network rather than electricity reduces the additional capacity required of the electricity system.[ii]

8 Attempts to quantify the scale of contribution heat networks could make to UK energy policy goals inherit many of the uncertainties across other parts of the energy system including the availability, cost and competing uses of different energy resources; the cost and performance of building-scale heating technologies; and the extent of energy demand reduction. DECC's recent (March 2013) policy document on the future of heating[iii] highlights the variability in different estimates of "the potential" scale of heat network deployment, reflecting both these uncertainties and the challenges of incorporating spatial information and the value of flexibility into scenario modelling. Estimates reviewed by DECC range from 14% to 50% of space and hot water demand, considerably greater than the current figure of under 2%.

ENSURING HEAT NETWORKS MAXIMISE THE OPPORTUNITY FOR COMMUNITY-SCALE HEAT GENERATION

9 In common with other energy networks, heat networks often exhibit increasing returns to scale (the economic characteristic which renders a network a natural monopoly).[iv] The early phases of network development, therefore, usually have poorer overall financial performance than later stages. These "first phase" disadvantages are compounded by the concentration of perceived risk in the establishment of a new local energy supply proposition.

10 While the scale efficiencies of heat networks suggest that rapid construction of large networks is financially more attractive than slow, incremental development from a small system, the challenges of coordinating heat users exerts a countervailing pressure towards smaller systems. In the UK where mechanisms to facilitate coordination at a local level are *ad hoc*, and where heat is not specifically regulated, this leads to a focus on certain heat users: public sector heat users often have duties and commitments to decarbonisation which are stronger than other organisations, and the perceived risks of a public sector organisation relocating or ceasing operation over the lifetime of a district heating business model are low; social housing providers are able to coordinate the heat supply for a large number of heat users, and district heating is often the lowest whole-life-cost form of heating in multi-storey buildings where gas supply is precluded for safety reasons; and the carbon performance of new buildings required by building standards (particularly the trajectory towards zero carbon homes in England in 2016) have led to some new developments built with heat networks.

11 The exploitation of such niche opportunities for DH presents challenges in terms of future proofing systems for future expansion and interconnection. Some aspects of future proofing can be addressed by ensuring physical compatibility by local adoption of technical standards (such as the GLA's District Heating Manual for London). Other engineering aspects (particularly sizing systems to accommodate additional future connection) require additional investment in networks. Justification of this additional investment is often challenging within commercial business models as uncertainty in future connections is difficult where influence over coordinated third party decisions is limited.

12 In addition to future proofing the engineering design of heat networks, commercial and organisational challenges also have the potential to impede the development of larger systems from smaller ones. Limited penetration means there is little experience negotiating such arrangements for heat networks in the UK. However, the history of development of electricity networks in the UK (and particularly in London) suggests a patchwork of incompatible ownership and business models can be just as difficult to bring together in more efficient systems as incompatible engineering standards.[v] The organisational challenges and transaction costs associated with a "link up later" approach to isolated developments has received much less attention in the UK than the engineering challenges.

Ownership and governance

13 Various ownership and governance models for the construction, extension and operation of DH systems coexist in the UK, involving local authorities (often via an arms length energy services company), campus-based systems such as Universities and NHS estate, private sector Energy Services Providers and subscribers in various permutations. In most instances, heat networks are small and ownership is integrated with ownership of the heat generating equipment. The balance between public and private sector in these arrangements typically reflects the appetite for risk and control within the local authority, or other public body, and (increasingly) the availability of finance within the local authority (e.g. via prudential borrowing) to cover capital costs.

14 The degree to which control over a local heat network is held by the local authority impacts the extent to which that authority is able to direct the development (extension) of the network. Differences between public sector goals and the priorities of commercial owner/operators of networks have, in some instances, led to frustration within local government over how or whether networks have been expanded (both to new heat users and new heat sources).

Financing district heating

15 Because the output of DH systems can be consistent over many years, financial models are often highly sensitive to how future benefits are valued – i.e. the rate of return required of investment. In comparison with gas and electricity networks where returns on sunk investment are protected by regulation, DH investments are perceived to be exposed to greater risks, raising the costs of capital hence reducing viability. In common with other investments, a public-sector led approach can accommodate lower rates of return (and lower borrowing costs), but implies risk is taken on by the public sector.

16 In the UK centralised energy market context, Heat networks face a number of challenges in mobilising finance. The declining willingness of banks to offer long term commercial finance in the wake of the financial crisis is one source of difficulty. The Green Investment Bank targets district heating under its Non-Domestic Energy Efficiency theme. Some practitioners have questioned whether the approach of the GIB (which is to lend on the same terms as commercial lenders to “crowd in” investment) will adequately address the challenges faced by first-stage projects in mobilising finance that is sufficiently long term and low cost.

17 Institutional investors (such as pension funds and sovereign wealth funds) are more suited to district heating investment in terms of time scale and returns. However, the minimum investment these investors will consider is generally much larger than the costs of the niche opportunities which are currently the focus of activity in the UK.

18 Ensuring network subscribers remain connected and require heat over the lifetime of the business model is a crucial dimension of risk perceptions in district heating investments. Often this is mitigated through selection of subscribers perceived to offer low risk (such as public sector organisations). There are differences in opinion as to how significant heat offtake risk actually is to DH business models with some considering it as a “red herring” as subscribers can be replaced.[vi] However, given low levels of experience with DH, lenders are unable to quantify such mitigation options and instead will assess projects on the basis of “bankable” heat supply contracts.

APPETITE AMONG UK LOCAL AUTHORITIES TO DEVELOP DISTRICT HEATING SYSTEMS

19 Local authority leadership is key to maximising potential for local heat networks, with capacity for expansion. This is demonstrated in other western European countries, where local authorities have played a crucial strategic and coordinating role in local energy services. Heat networks have either been developed as a municipal enterprise (integrated with other infrastructure and development), a joint public/private venture, or local authorities have governed private sector delivery under city-wide municipal franchise.

20 While community enterprises, housing developers and other public bodies are also developing small scale heat networks, the statutory functions of LAs (as planning authorities and service providers) mean they can give strategic direction. In addition, the heat demands of local authority estates and their capacity to broker relationships among stakeholders place local government in a crucial position. They can provide long-term contracts for heat and power supply, which stabilise business revenues. Their prudential borrowing powers provide access to affordable finance; they can also act as guarantor to reduce costs of long term loan finance; they can ensure that heat tariffs are fair and transparent; and they can assist in developing consumer protections and service standards. DH is inherently local, and needs actors with long-term commitment to the area; this requires local knowledge about opportunities, their timing, and potential for integration with other developments.

21 Important differences exist however between UK local authorities and their Scandinavian counterparts. Under current centralised control by government, and centralised energy markets, local authorities have restricted capacity, expertise, financial resources and motivation to develop medium scale energy projects. Energy services are not core statutory activities and the *ultra vires* restrictions contrast with the more general freedom of local government in countries where DH is established. Development of DH competes with other local authority priorities, and pressures on budgets make a strategic approach uncommon.

22 Increasing numbers of projects are nevertheless being established, with officers and politicians acting resourcefully to find the means to develop successful local energy infrastructure and services. DH projects have for example been developed, by members of the District Energy Vanguards network (http://www.heatandthecity.org.uk/dh_projects). These projects have usually relied on determined, very able, local champions willing to work far beyond their formal remit, and contracted working hours, in order to tackle combined problems of regeneration, poor housing and climate change, through local energy services.

23 The capacity of local authorities to engage with the market for consultancy and design is currently limited by low levels of experience. Difficulties in local government acting as an "informed client" mean that feasibility studies may be under-specified and outputs of consultancy services may not be adequately challenged, opening the potential for low quality work to undercut rigorous evaluation. DECC's recently announced Heat Networks Delivery Unit (HNDU) aims to address this capacity shortfall by supporting local government in its relationships with consultants. The extent to which HNDU builds capacity within local authorities to take on future development unaided, and the extent to which HNDU-supported projects are future proofed will be crucial to the success of this initiative in supporting heat generation in the 5-50MW scale bracket.

BARRIERS TO DEPLOYMENT OF DH INFRASTRUCTURE

24 A number of barriers to DH development have been discussed above, including challenges identifying and developing projects, first phase disadvantages, local government capacity and difficulties mobilising finance. Although DH is a well established technology elsewhere, its low penetration in the UK means there are a variety of market and institutional factors, as well as routine practices which are not well suited to DH. For example, business rates levied on the value of assets disadvantage heat networks (high value assets delivering low cost energy) against other systems. Many of these barriers may be small (and in some instances specific to local by-laws and regulations) but nonetheless contribute to the difficulties faced by practitioners which cumulatively can lead to abandonment of projects. This underscores the importance of robust commitments at both national and local government levels to overcoming this myriad of minor difficulties as they arise.

25 However, a significant, and consistent, challenge throughout earlier attempts to establish DH in the UK,[vii] is the interactions between DH, CHP and electricity supply. Market arrangements in the UK are set up around a model of large scale generation[viii] making it difficult for smaller generators (including CHP) to create value from electricity exported to the grid. This general issue is manifest in a variety of ways, including a prohibition of using "private wire" arrangements to ensure long term retail opportunities,[ix] through difficulties engaging with Distribution Network Operators (DNOs) over connection to the public system[x], limited liquidity in wholesale markets, to high transaction costs and risks associated with small generator engaging with wholesale markets.[xi]

26 Ofgem is responding to these challenges by developing a "License Lite" arrangement under which small generators could access customers via the public system by partnering with an established supplier. A key area of uncertainty in this approach is the response of established suppliers, and whether they perceive sufficient incentives to facilitate small competitors' access to retail markets.

Effectiveness of government policy

27 It is an oft-repeated staple of UK energy policy that clear, and long term policy commitments are required to mobilise investment in the UK's energy systems. The current phase of policy interest in DH arguably dates back to the 2003 Energy White Paper and the Community Energy Programme (£50m, 2002-2005). Over this period, policy focus and funding programmes have had a somewhat stop-start character[xii], making long-term planning and investment difficult, and creating intermittent spikes in demand for DH consultancy and contractors, raising costs and lengthening lead times.

28 Planning policy and building standards in England are identified by local authorities engaged in district heating as an area for improvement.[xiii] Where earlier guidance to planning authorities required them to develop an evidence base for decentralised energy and to adopt supportive planning policies, reform and simplification of planning policy makes the use of planning policy in support of local energy more difficult, and reduces consistency in such planning policies across authorities. The 2016 zero carbon building standards for homes also interact with district heating both as a means of reducing emissions from new buildings and through the "Allowable Solutions" mechanism which will allow offsetting investments in off-site technologies including district heating.[xiv] However, revisions to the definition of "zero carbon" and delays in setting out the parameters for Allowable Solutions contributes further uncertainty to DH investment.

29 As DH projects cut across municipal and energy-system issues, relevant policy is similarly split across organisations including DECC, DCLG, devolved administrations and local government. While this creates challenges for policy coordination it also allows a degree of flexibility to local/regional needs and creates space for innovation. For example, the establishment of the Decentralised Energy Project Delivery Unit (DEPDU) by the GLA stands as a precursor to DECC's new Heat Networks Delivery Unit (HNDU).

30 HNDU's approach will focus on the development stages of network development. While this is an important contribution both to establishing projects and building capacity within local authorities, DECC has not allocated any budget for capital investment in DH. Risks remain, therefore, that first-phase disadvantages and the costs of future-proofing systems, coupled with the potential for patchworks of technically or commercially incompatible systems to emerge without strategic oversight, leads to stunted development of DH in the UK.

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