FINDINGS RC-UK *HEAT AND THE CITY* Research (Year one)

More and more UK municipal authorities are recognising the opportunities associated with District Heating (DH) and Combined Heat and Power (CHP): benefits for local people and local economies; potential to reduce public spending on energy infrastructure; effective climate change mitigation and energy security. Historically the UK has done very little of it. This is changing, and local authorities are key actors.

1. Increasing numbers of **Local Authorities are leading the development of district heating and CHP**, despite limited powers and limited access to energy project finance. Many of these, from the length and breadth of Britain, are attending the Edinburgh and Strathclyde Universities' Workshop on Municipal Leadership and Organisation for District Energy on 15 and 16 Sept 2011. (They include Aberdeen, Glasgow, Edinburgh, Dundee, Fife, Renfrewshire, Newcastle, Gateshead, Sheffield, Manchester, Stoke, Croydon, Islington, Hackney, Haringey, Huntingdonshire, Cornwall and Plymouth).
2. Why are local authorities interested in DH and CHP? **Many lead officers are committed to action, within their sphere of control, to mitigate climate change, improve energy security and tackle fuel poverty**. Their investigations identify two areas for action: improving the energy efficiency of the building stock, including retro-fitting micro-renewables; and establishing community scale district energy projects. In densely populated urban areas, district energy provides affordable heat, as well as energy saving and carbon saving. Because heat networks can use heat from multiple sources, including waste heat, they provide greater local control over energy security. In the right places, they contribute to local economic regeneration and public welfare.
3. For most LAs, the **scale and complexities of district energy pose major challenges**. In the absence of well-established routines and resources, and within legal constraints, increasing numbers of projects are nevertheless getting off the ground; officers and politicians are proving resourceful and creative in establishing successful district energy.
4. **LA leadership is key to maximising potential for large heat networks**, with capacity for expansion. This is demonstrated in other western European countries, where LAs have played a crucial strategic and practical role in energy planning. While community enterprises, housing developers and other public bodies are also developing DH, the statutory functions of LAs (as planning authorities and service providers) mean they can give strategic direction. LAs provide long-term contracts for heat and power supply, which stabilise business revenues; as well as having prudential borrowing powers, they can 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.

5. **An effective means of governing and managing district energy is to set up a special purpose Energy Services Company (ESCo).** The ESCo ensures clear accountability, sharp focus, ring-fenced budget and risk-sharing for project planning, development and delivery. The type of ESCo depends on local priorities, and can be a private enterprise (Birmingham District Energy Company), a joint public-private company (Thameswey Energy Ltd) or a not-for-profit company (Aberdeen Heat and Power Ltd).
6. LAs pursuing DH have to deal with the **inertia of existing energy systems**.
    a. Consumers, businesses and public bodies engage routinely with centralised gas and electricity suppliers, but are wary of adopting an unfamiliar supply system, unsupported by regulation.
    b. Interacting with energy markets and network operators via structures designed for large-scale centralised generation and supply is hugely challenging. In the UK the majority of electricity trading between generators and suppliers occurs either within the "Big Six" utility companies or through confidential bilateral contracts, meaning there is little liquidity in wholesale markets. Small CHP generators face significant barriers in accessing markets and struggle to get a reasonable price for electricity exported to the grid.

    Challenges to the development of DH are a clear example of the complex practical difficulties the UK faces in transition to a low carbon society.

7. Benefits of DH and CHP are recognised by the UK Government as cost effective means of reducing CO2 emissions, required by climate change legislation:
    a. The UK Committee on Climate Change [1] states that DH connected to low carbon electricity generation (fossil fuel with CCS/nuclear) is the most cost effective carbon abatement (-£110/tCO2) measure.
    b. The UK Dept of Energy and Climate Change[2] estimates that if all suitable areas were served by biomass CHP connected to DH, carbon savings would be 19.3 MtCO2 annually, in comparison with a saving of 2-3 MtCO2 if the same buildings were heated with ground source heat pumps.
8. **DH and CHP can have positive impacts on other UK energy infrastructures**. By bringing the generation of electricity closer to end users, local CHP reduces or defers some of the estimated £200bn investment required in UK energy infrastructure. By increasing the diversity and flexibility of electricity generation, CHP helps balance supply and demand on the electricity network. This will become more significant as increasing levels of wind energy are connected[3], and new load from electric vehicles and heat pumps, increase peak demand. Distributed generation from CHP reduces the need for investment in under-used (higher carbon) 'stand-by' plant and

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[1] UK Committee on Climate Change (2010) *Fourth Carbon Budget* www.theccc.org.uk

[2] DECC, 2009. *Heat and Energy Saving Strategy Consultation*. http://hes.decc.gov.uk/consultation/consultation_summary/index.html

[3] Because of intermittent generation, depending on wind speed

network infrastructure, because it can operate flexibly as short-term operating reserve[4]. Think of the power of distributed computing[5].

9. Despite the benefits of DH, the **UK has historically had very little of it**. DH supplies 1-2% of heat used in buildings, whereas in countries such as Denmark and Sweden it supplies around 50%, and a higher proportion in densely populated areas[6].
10. Around 50% of the energy consumed in the UK is used for heating, and we **currently waste as much heat** (from thermal generation of electricity and other industrial processes) **as we use to heat our buildings and water**. Some of this waste heat could be used for DH.
11. Despite recent policy measures to support investment, **DH and CHP remain on the margins of UK and Scottish energy policy**, which focuses on electricity markets, and is designed around the structures of large centralised generators. The absence of clear incentives and directive planning measures means that targets for investment are being missed. However, both Scottish and UK Governments are developing a more pro-active approach.
12. **Sample policy measures** which could successfully drive UK investment in DH are:
    a. Directive government measures for planning low carbon heat supply,[7] establishing local authority powers and resources to map heat demand, analyse technical options, and plan areas suitable for DH, including location of heat supply and pipework. International models include Danish Heat Supply Law, which makes local authorities responsible for designating DH zones and mandating connection of buildings.[8]
    b. Government-led integrated energy planning, fully incorporating plans for low carbon heat and CHP with smart grid and power station location and infrastructure. This would set regional context and framework for local authority project development.
    c. A central energy efficiency fund to enable investment in district energy as a public good. The Fund, administered for example by the Green Investment Bank (GIB), would offer loans at low interest rates,

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[4] Streckiene, G and Andersen, A (2010) *Analysing the Optimal Size of a CHP Unit and Thermal Store When a German CHP Plant is Selling at the Spot Market*, MASSIG EIE/07/164/S12.467618

[5] Distributed computing connects many small computers together in a network which performs at a higher level than the sum of individual machines, by virtue of network flexibility

[6] In Copenhagen DH serves approx 98% of demand for heat and serves 500,000 inhabitants; residents pay around 50% less than householders using gas central heating with a stand-alone boiler. In Gothenburg, Sweden, DH supplies approx 90% of the city's 500,000 population.

[7] Under current English and Scottish planning guidelines, LAs have the option to impose targets for use of decentralised energy in new developments, but there is no requirement to do so. There is no requirement for: connection of existing buildings, DH retrofit in suitable regeneration areas, or co-location of new generating capacity with heat load.

[8] IEA (2009) *The International CHP/DHC Collaborative: Scorecard Denmark* http://www.iea.org/G8/CHP/profiles.asp Denmark is ranked 2nd most energy efficient country in the world. Before the use of Heat Supply Law, in the 1980s a handful of large power stations generated Denmark's electricity. Currently electricity is supplied from a large number of mainly CHP suppliers, co-located with heat loads; wind turbines also supply electricity. There are now around 450 DH suppliers. Danish Law also requires DH to operate on a non-profit basis, using cost-reflective heat and electricity prices.

reducing investment risk by supporting a portfolio of projects. Specific funding for project development (as well as capital expenditure) would address the problem of developing appropriate plans to the point where investment can take place. The GIB would need effective capitalisation and/or appropriate borrowing powers.

d. Training for local authority officers to plan, develop and deliver district energy services, including the significant legal, commercial and technical challenges.
e. Simplification of mechanisms for access to electricity markets for small generators, to enable them to optimise revenues from electricity sales.
f. The development of consumer protection standards to incentivise connections and to overcome perceived risks of service reliability[9]. Licensing of DH companies, as in Norway[10] for example, would support expansion.

Heat and the City is a four-year research project. Principal Investigator is Prof Janette Webb; Research Fellow is Dr David Hawkey. Details at http://www.heatandthecity.org.uk/

Project Funding: Research Councils UK (RC UK) Energy and Communities Programme http://www.rcukenergy.org.uk/home/research-councils-energy-program.html

[9] The UK Green Building Council has a Task-Group working on legal frameworks for Sustainable Community Infrastructure, reporting in January 2012.

[10] The Norwegian Government Water Resources and Energy Directorate (NVE) evaluates applications for district heating licenses against joint social, environmental and economic criteria. The assessed impacts of projects are signed off by central government as locally beneficial and tariff price is required to be below equivalent cost of electrical heating.