"We're not talking about lab experiments": Emerging Governance Practices for Sustainable Energy in the UK

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Paper for Presentation to

IGov Workshop: Theorising Governance Change for a Sustainable Economy

30 April 2013: Eliot Room, British Library, London

Abstract

This paper uses evidence about practices of local energy development as the basis for theorising about governance change for sustainable economy. It considers the policy ambition for transition to clean, affordable energy as a major collective action problem which has to be addressed in the context of the liberalised, and in the UK centralised, energy markets developed alongside finance capitalism over the last 20-30 years. The paper focuses on decentralised combined heat and power (CHP) projects in cities as a means to explore the contemporary roles of states and markets in governing energy systems change. The experiences of UK practitioners are situated in European context through brief comparison with the Netherlands and Norway.

Heat networks are an established urban energy saving technology, but provide only around 2% of the UK's space and hot water heating. Many of the factors germane to their 20th century developments (resource efficiency, affordable heat, regeneration, local revenue generation) also inform contemporary plans, but climate protection policies have added impetus. Decentralised energy developments do not however fit easily into the dominant templates for UK energy infrastructure investment. Even though there is good evidence that heat networks are in principle carbon, cost and energy efficient, they are marked out by financial calculi as riskier: they have relatively high upfront investment costs and long-term payback, multiple sources of price risk, and lenders adopt high thresholds for the 'bankability' of heat supply contracts. The resulting increase in cost of capital limits the viability of projects. It seems therefore that viable steps towards a more sustainable energy economy are marginalised by current political economic priorities. What are the implications for governing change?

We seek some provisional answers using qualitative case study data to examine the local governance models which have developed out of interaction with policy uncertainties and a centralised energy market. Municipal authorities are working in a context very different from that which supported earlier innovation in Europe. Notably there has been a significant shift towards liberalised markets, and financial deregulation. Nevertheless distinctions between European states persist, with Norway and the Netherlands, as exemplars of a 'stakeholder' model of capitalism, demonstrating more coordinated interaction between localities, states and energy utilities to accelerate urban CHP/DH developments. In the UK, limited local authority powers, resources, and capacities, limited supportive institutions, and tensions between socially- and materially-embedded CHP/DH initiatives have resulted in patchy development. Bridging the gap between rationalised finance and local political and economic interests requires considerable governance capacity at the local project level. This has high transaction costs and is prone to recurring crises over management complexities, organizational risks, power struggles, and cultural tensions. Some local authorities have nevertheless established distinctive approaches to enable the development of heat networks. Resulting governance structures are responsive to local circumstances and policy priorities, and in turn work to reconfigure the local opportunity space, with implications for the distribution of costs and benefits. The cases are used as a basis for reflecting on governance frameworks for reshaping energy provision.

"We're not talking about lab experiments":

Emerging Governance Practices for Sustainable Energy in the UK

1. Introduction

Accelerating energy consumption, concern over security and cost, and evidence of damaging climate impacts are major public issues for advanced societies, and are equally major sources of contention about potential action. Policy for energy system transformation has largely focused on a technology-driven, supply side model of innovation (Steward, 2012). It is however increasingly recognised that any transformation of energy systems will be equally reliant on societal innovation in institutions and practices (Geels 2010; Markard and Truffer, 2008; Mitchell, 2008). These are fundamentally questions about governance for a sustainable economy. This paper comes to questions about theorising governance through empirical analysis of emergent practices in urban heat and power developments in the UK. Decentralised combined heat and power (CHP) projects are used as a means to explore the contemporary roles of state and market actors in liberal democracies in governing change in energy systems. The collective action problems confronting UK urban energy governance are situated in European context through brief comparison with the Netherlands and Norway, where interactions between localities, states and utilities have resulted in changes in energy policy to accelerate CHP developments.

Although the term 'governance' has often been used loosely (Jordan, 2008), it opens up to deliberation the potential solutions to major collective action problems in different political-economic contexts, and at multiple scales and levels. Governance solutions to distributing resources have historically been shown to be contingent on circumstances, rather than being fixed either by laws of economics or normative prescriptions of 'best practice' (Ostrom, 2007). From a social science perspective, governance processes are critical to decisions about the allocation of resources and accountability, legitimacy and equity, and their particular elements are simultaneously products of their historical period and integral to its formation. Applied to contemporary energy systems, a focus on governance draws explicit attention to questions of control, risk and responsibility. It invites analysis of the public and private interests, with different values, goals and resources, implicated in addressing problems of collective action.

Political moves to liberalise gas and electricity provision across European societies have decisively shaped the political-economic circumstances for clean energy investment. In the past, the broadly-based social-democratic consensus in significant parts of post-war western Europe supported equitable access to integrated welfare services including energy. In the last 20-30 years, liberalisation combined with rising public debt has resulted in declining local control over energy services and increasing concentration of ownership by transnational utilities. Even in countries such as Sweden, this has been associated with higher required rates of return on capital, and

consequent rising heating costs (Rutherford, 2008; Sundberg and Sjodin, 2003). Goals in a liberalised energy system are defined in commercial terms and social obligations are limited. Political coordination of policies for energy efficiency, security and affordability is correspondingly structured by the search for profitable returns to private shareholders, either as partners in joint ventures with public bodies, or as lenders to public or private developers. Corresponding theoretical questions focus on whether the marketisation and privatisation of public services, including energy, have set in train the deepening and furthering of the accumulation logics of finance capitalism in forms which are unresponsive to over-exploitation of natural resources, environmental destruction and climate change. Such questions have been framed in Marxist terms, where the modern state is conceived as operating in the interests of capital to create and maintain the conditions for exploitation and private profit, on which the state is in turn structurally dependent (Jessop, 1990; 2002). State withdrawal from service provision, an emphasis on instruments for the extension and expansion of markets, and conditions for private investment and speculation, are interpreted as serving the interests of the most powerful, rather than serving the diverse interests of different strata of society.

Such arguments are seductive, but risk a 'soft' economic determinism (Coutard and Guy, 2007), which can however be avoided by empirical enquiry into patterns of variation in economic governance. In relation to the case study countries discussed here, it has for example been argued that a broad distinction can be drawn between two 'ideal types' of liberal and coordinated capitalist market economies (Hall and Soskice, 2001), which are characterised by contrasting institutions of financial and corporate governance. The UK is regarded as an example of a liberal market economy, where economic governance is practiced through market exchange in response to price signals. Countries such as Norway and the Netherlands represent coordinated market economies where economic governance relies more on collaboration through cross-sectoral networks. The latter is characterised as providing longer term 'patient capital' for business investment. Such variants of economic governance persist in contemporary European energy provision, despite a notional single market in gas and electricity. Governance and ownership of energy infrastructures continue to vary from centralised state provision and state-controlled companies, to transnational corporations controlled by private shareholders, to municipal and community enterprise (Helm, 2010: 9). Variety of provision is equalled by variety in financial arrangements, from public to private finance, and from franchises to direct asset ownership. A mixed 'planning and markets' approach is in use: competition in European energy markets is advocated in tandem with policies to enhance territorially-defined security of supply, to reduce overall demand and to drive low carbon transition in the absence of obvious 'market demand' for clean energy; market-mechanisms (liberalisation / 'unbundling', the EU ETS, and variants of carbon incentives and taxes) exist alongside centralised control and planning (energy efficiency and emissions control standards, infrastructure and capacity planning, regulated returns on investment and public subsidies).

The Scope for District Heating (DH) in a Sustainable Energy System

District heating is well established in many European countries as a relatively high-cost infrastructure for the distribution of low cost heat, including heat from low cost primary sources that are difficult to use at an individual building scale, and heat which would otherwise be wasted (or used less efficiently). The global environmental

impacts of DH systems depend primarily on the sources of heat used (indeed, Danish carbon emissions rose during the period when DH was first established as energy systems shifted from oil to coal). In the UK, contemporary praxis is to build DH around gas-fired CHP, achieving short term carbon and cost savings in comparison with grid electricity and individual gas boilers. Recent UK policy positions gas CHP as a transitional technology to support the development of infrastructure for exploitation of lower carbon forms of heat in future. This flexibility and potential to use locally available fuel sources and waste heat would enhance energy security. Co-location of supply and demand in CHP also reduces electricity network losses and can defer capacity upgrades in distribution networks, and heating from a shared source is generally more affordable (Kelly and Pollitt, 2010; UK Department of Energy and Climate Change (DECC), 2009). CHP/DH can also contribute to system balancing by generating heat locally and by thermal storage of excess electricity generation, reducing the need for investment in fossil-fuel 'stand by' plant and reducing costs of transmission network reinforcement (Low Carbon Innovation Coordination Group, 2012; Toke and Fragaki 2008; Lehtonen and Nye 2009).

In the UK energy system, indigenous coal and gas supplies, and a focus on economies of scale through centralised electricity generation, rather than efficiencies in primary energy consumption, have marginalised CHP (Russell, 1993). In the context of current centralised gas and electricity markets there is no institutional or technical infrastructure for heat supply *per se*. Sunk investment in centralised networks means that infrastructure costs of new decentralised DH are defined as high, and market regulatory and incentive structures mean that these are borne directly by a small customer base, rather than spread across the energy system as in electricity network investment. In the absence of an established heat (rather than gas) supply system, and guaranteed long-term heat users, uncertain revenues result in lack of affordable capital for investment, therefore limiting project viability. Hence despite increasing salience of UK energy policy questions about sustainable heat, and the attention now being paid to the value of waste heat recovery and urban heat networks (DECC, 2013), bridging the gap between the interests of private capital and the long-term public interest requires considerable governance capacity to manage the complexities of development.

2. Governance for Sustainable Energy

The multi-level perspective (MLP) on socio-technical innovation conceives of change in terms of a nested hierarchy of niche, regime and landscape (Geels, 2011). This can be combined with an awareness of potential differences between forms of capitalism in European liberal pluralist democracies to inform debate about multi-scalar governance options for sustainable energy systems. It enables some analysis of systemic change driven not simply by interests of capital, but also by multiple end-users, many of whom are complex organisations with different interests and objectives. The concept of a regime characterises the meso-level of institutions and organisations, and represents established knowledge, norms, investments, and infrastructures for provision of societal functions such as energy (Smith et al, 2010). The understanding of the regime as representing incumbent interests has stimulated research about the potential for radical innovation to develop out of protected niches (Kemp et al, 1998). 'Macro-level' societal, environmental and financial landscape pressures, although less the focus of attention, are also treated as potential sources of transformative change (Geels and Schot, 2007). The potential for systemic

transformation through reform of an established regime, by recombining existing technologies and/or incremental innovations, has, Winskel (2011) suggests, also been downplayed.

Energy system transformation entails conflicting interests and values, which suggests that it is, in principle, at least as reliant on reconfiguring knowledgeable actors and component technologies into new socio-technical configurations as it is on radical technological innovation (Geels, 2006). In this sense any 'dynamically stable' regime is not necessarily internally consistent, but seems likely to be marked by tensions and sources of schism within and among institutions. Different goals and assumptions may be in operation, especially during periods of major political economic uncertainty. Such tensions may work as catalysts to socio-technical innovation at a range of scales, as suggested by analyses of the productivity of intra- and inter-organisational dissonance and discrepancy in assumptions and understandings (Boltanski and Thevenot, 2006; Stark, 2009). Changes in dominant sociotechnical systems may then result from processes internal to the regime, as well as in response to 'landscape pressure' or the successful breakthrough from niches.

Insight into processes for reconfiguring knowledgeable actors seems likely to be accessible at regional and urban scales, where socially and technically embedded systems, such as DH, are customised to a particular place (Hodson and Marvin, 2010). The specificity of locality, deriving from different resources, geography, history and culture, makes visible any potential for variable configurations of governance. It also highlights questions about where the capability and capacity to manage systemic innovation may emanate from, and what political struggles over state policies, sunk investments and public interests are articulated through place-specific projects. Developing DH infrastructure entails the constitution of a new socio-technical nexus, characterised by Summerton (1992) as a grid-based multi-organisation (GBMO). Locally-embedded actors and resources are drawn into complex interdependence with non-embedded financial, legal and technical expertise necessary to secure the new socio-technical infrastructures for heat provision. The physical, technical, grid is paralleled by an invisible grid of interdependencies between different organisations, where social system building may prove more difficult than technical.

In this paper the inter-linkages between 'actors and institutions of markets, technology and societal demand with those of market regulation, innovation policy and environmental governance' (Smith et al, 2010, p.446) are explored through qualitative case studies of emerging governance practices for heat network development. Data is derived from 15 semi-structured interviews with project developers, analysis of documents from web sites, and, in one case, internal evaluation and contractual papers. The UK, Netherlands and Norway all moved early to liberalise energy supply, and all have limited DH provision. The Netherlands and Norway, unlike the UK, however are examples of relatively rapid heat network development, which seems to be attributable to interactions between early stage CHP/DH 'experiments', the growing prominence of climate change politics and corresponding shifts in central government policies, and the increasing involvement of local government, giving further momentum to investments.

Governance Dynamics of District Heating Development in European Context: Netherlands, Norway and UK.

In Europe, institutional arrangements for developing CHP and DH have varied, but historically two factors - the relative autonomy of municipal governments, and significant public sector control over energy supply - have been particularly significant (Grohnheit and Gram Mortensen 2003). Modes of governance have centred on locally-controlled energy businesses, where the municipal authority is at least a significant shareholder (Ericson, 2009; EuroHeat & Power, 2009). Local governments have played a critical role by virtue of:

- Capability and capacity to map heat demand and supply, and to plan energy supply to optimise spatial efficiencies;
- Capability to coordinate heat network development with other utility systems;
- Significant heat loads controlled;
- Capability as a quasi-regulator to reduce risks associated with exploitation by a monopoly heat supplier;
- Responsibility to balance societal well-being against financial profit.

Local government structures in the Netherlands, Norway and the UK have all been influenced by principles of liberalisation and markets, but it is in the UK that such principles have been driven furthest, and it is here that local authorities have least autonomy, effectively operating as 'a bureaucratic quasi-agency of central government' (Le Gales, 2002: 232). Norwegian municipalities exercise considerable direct control over revenues: local taxes account for around 40% of income, with an additional 14% from fees and charges. Financial centralisation is strong in the Netherlands, but local political leaders have considerable discretion over developments and play a prominent role in state, and European, politics through locally-devised economic strategies. Hence Le Gales' (2002) review of the prospects for city governance to shape the future of European societies concludes that most cities retain significant capacity for direct governance of innovation, except in the UK, where experiments in privatisation of public services are most advanced. It might be expected therefore that local authorities in the Netherlands and Norway will have greater capacity to govern clean energy developments than those in the UK, and will have a correspondingly significant role in changing the institutions of governance at state level.

2.1 **District Heating in BERGEN, Norway**: dynamics of multi-level governance and joint ventures

Norwegian energy provision is centred on hydro-electricity; transnational businesses are active in wholesale markets but most distribution companies remain in public ownership at local and regional authority levels (NVE, 2010). Increasing demand for electricity has raised concern about future capacity, and suppliers have supported DH investment as a means of minimising strain on electricity networks, reducing system costs and providing additional revenue; Norsk Fjernvarme, the Norwegian district heating trade association, was initially made up predominantly of electricity companies. Concern about future capacity has coincided with increasing prominence of climate protection policy, to give further impetus to DH development as a source of system flexibility. The state government has created a licensing system, granting an approved operator sole rights to DH supply in a specified area. Applicants must submit detailed plans, including commitments to connect, and evidence of integrated social, economic and environmental benefits of DH relative to other options (NVE, 2009). In addition, technical support and finance, for up to 20% of capital costs, are

provided by the Norwegian Water Resources and Energy Directorate. Licensing legitimates DH for developers and customers by imposing standard data requirements, appraisal methodologies, heat tariff limits and consumer protection. Licensed operators can seek a local planning mandate for DH connection of new and retrofit developments.

Development of the DH system in Bergen, Norway's second city, however predates technical support from the state agency ENOVA, but the licensing system was in place. Bergen's mountainous location restricts the use of landfill for waste disposal, with waste incineration dating back to 1996 when a municipal company, BIR, was licensed to operate a waste incinerator 12km from central Bergen. In 2003, new state regulation raised the efficiency standards for recovery of energy from waste to a minimum of 50%, effectively requiring the capture of the heat from incineration. In Bergen industrial use of heat from the plant was considered, but DH proved more economically attractive, even before the introduction of central government support. The network is now the third largest in Norway (75km), with further expansion planned. The project was developed through a partnership between Norway's electricity utility, BKK, and the municipal waste management company BIR. BKK is itself a joint state- and municipally-owned business, though under Norwegian energy market liberalisation, public sector shareholders do not use share ownership to override commercial goals. A new joint venture (BKK Varme) was set up to construct and operate the heat network, with BKK exercising overall control through a 51% shareholding. Bergen's local government is a shareholder in both BKK and BIR, but initially exerted little effort to facilitate development of the network. The growing prominence of climate change in Norwegian politics since around 2007 has however increased municipal interest in expansion of the heat network, and Bergen Kommune has since integrated DH into the city's strategic plan, alongside aims to increase urban population density. It has collaborated with BKK Varme to identify long-term heat demand and sites for new energy centres, and to connect municipal buildings. Rapid development of the heat network is seen locally as a significant achievement, attracting further support from subscribers and the Bergen Chamber of Commerce.

In Norway, central and municipal governments have acted in concert with publicly-owned electricity companies, in an energy system which remains predominantly territorially-located, and where considerable control continues to be exercised through public sector shares in for-profit energy companies, with local accountability. The licensing regime may hence be interpreted as a means to secure the spatial dependencies of network efficiencies, while maintaining a competitive/liberalised logic to energy services.

Energy efficiency, and, latterly, climate policy and institutional frameworks, have intersected to regularise DH development, contributing to public climate protection goals, reducing the costs of reinforcing the electricity network, and creating the supply chains for a DH industry.

2.2 **DH in ROTTERDAM**, **Netherlands**: informal knowledge exchange to joint venture

In the Netherlands, attempts to develop DH in the 1970s and 1980s had limited success. These programmes are however regarded as providing the basis for organisational and policy learning which fed into 1990s DH development in new

housing, in turn creating skills and experience for subsequent investment (Raven and Verbong, 2007). Energy market liberalisation proceeded in the 1990s, followed by consolidation of the regional electricity companies which had developed most existing heat networks. The introduction of primary heat legislation in 2009 responded to concerns that market liberalisation may have failed to protect DH customers with a monopoly heat supplier. The legislation is designed to mitigate consumer risks by regulating heat tariffs in relation to other heating options, while also setting a maximum reasonable return on infrastructure investment. In 2012 there was however continuing uncertainty about the final parameters of the law, although primary powers had been established.

Discussions about the potential for use of waste heat from Rotterdam harbour-based industries date back to 1990s industrial ecology programmes. These were established initially as industry/academia collaborations, with the objective of reframing environmental issues as joint problems, rather than as sites of antagonism between industry and regulators (Baas, 2008). The consensual governance model drew in regulators, local and regional government, and NGOs, and aimed to build trust between participants. Plant managers were encouraged to share data for DH feasibility studies, and initial plans centred on a publicly-owned development and operating company. Uncertainties over heat sources, costs and expertise, prompted by withdrawal of an industrial partner and overcapacity in Dutch waste incineration, however, precipitated crises and reconfiguration. On discovering that the costs of refinery equipment to allow continuous operation, during any heat network downtime, had been significantly underestimated, the industrial refinery withdrew. A planned waste incinerator was also relocated to a more distant site, imposing higher heat network infrastructure costs. Investigations coalesced around urban heat demand, with the municipal authority taking a more central role, including the requirement of competitive procurement for supply of waste heat to any network, causing frustration among other project stakeholders (Visser, 2008). Political divisions over whether to proceed or not, given the risks of future costs versus loss of sunk investment, resulted in the authority pausing the initiative in 2007 while a new business model was investigated. The eventual Warmtebedrijf public-private partnership structure is complex, entailing a separate transmission system operator, heat producers, a wholesaler (transnational company E.ON) and two commercial retail and distribution companies (Nuon and Eneco). The latter supply companies are largely owned by provincial and municipal governments (OECD, 2012), although Vattenfal took a 49% stake in Nuon in 2009, and is expected to increase its stake up to 100% in 2014. Nuon and Eneco were recruited for their retail expertise, with responsibilities for developing the market. As large supply companies, their involvement was an important factor in mobilising finance from commercial lenders (PVW, 2005). E.ON contributed expertise in energy dispatching, but wished to avoid risks of network development and operation. This resulted in Warmtebedrijf heat supply to networks previously supplied by E.ON's fossil fuel CHP generators. Complex calculations govern the process, which is intended to make the arrangement profit-neutral for E.ON, while providing Warmtebedrijf with revenue.

The consequences of municipal involvement are contested, with some claims that the trust built among industrial ecology programme participants was undermined, and that bureaucratic procedures slowed development. With Rotterdam joining the C40 cities initiative, however, the growing prominence of cities as actors in climate politics lent

support to proceeding, and the role of the authority in mobilising finance, and supporting DH through required connection of buildings in target zones, has been central. The project is financed by a 70/30 debt/equity split, and the authority's equity investment has increased from €9m to €38m. The creditworthiness of the local authority was crucial, with the city guaranteeing commercial loans, which rose from €58m to €149.5m (Warmtebedrijf, 2010).

As in Bergen, the Warmtebedrijf project illustrates the dynamics of interaction between municipal and central government in providing supportive policy frameworks to mobilise urban energy development in a liberalised context. Both cases have their origins outside local government policy, but illustrate the central role which local governments came to play in coordination and stabilisation of large scale, long term local investments. Potential for waste heat capture from the refinery remains unresolved, but further opportunities have been created through the establishment of the heat main. In both countries, significant local stakes in energy system assets seem to have contributed to the capacity for eventual coordination of competing interests.

2.3 **DH in the UK**

2.3.1 Energy Policy and Market Context

Since the late twentieth century, successive governments have acted on neo-liberal governance models, advocating privatisation of public assets, and private finance, as a means to reduce public expenditure, improve cost efficiencies and stimulate growth without degrading public infrastructure, even at a higher cost of capital (Helm, 2010). The legacy of the UK model of energy privatisation is a market dominated by six integrated utility companies, which comprise a powerful lobbying force on government (Meek, 2012; Mitchell, 2010). Top-down energy policy-making has however returned prominently to government agendas, prompted by failure of private utilities to maintain the infrastructure asset base, and by the increasing prominence of climate politics and resulting legislation with ambitious decarbonisation targets. It is recognised that a low carbon, secure and affordable energy system is unlikely to be delivered under current market structures (UK DECC 2010).

The UK lacks a clear regulatory framework for DH, with deployment presenting a significant governance problem (Kelly and Pollitt, 2010). Electricity Market Reform (EMR) (UK Government, 2011) and the new regulatory formulae for electricity and gas networks (OFGEM, 2010) will shape financial feasibility, but these reforms focus on centralised generation and supply. One element of wider policy debate, which indicates the presence of alternative orientations to evaluation of sustainable energy pathways inside government, concerns the contribution of CHP and DH to an energy portfolio intended to reduce over-reliance on any single solution, while improving innovation, cost saving, resilience and security (DECC, 2011; 2012; 2013; HMT National Infrastructure Plan 2011; UK Carbon Plan, 2011). Such policies recognise the strategic significance of local authorities in developing heat networks, but have not yet created a direct mandate for action. It is unclear therefore to what extent, and how, aspirations to a greater contribution to a sustainable energy system from urban scale infrastructure will be brought about, and there remain many questions about whether outline policy supportive of CHP/DH will result in significant practical development.

2.3.2 Local Authorities and Energy Governance: Uncertain Routes to Development

Most UK local authorities have played little or no role in energy provision since the early 20th century. They have relevant powers for CHP and heat network development and operation, including permission to produce and sell heat and to lay networks, and to sell electricity produced in association with heat (and, in Scotland, from waste incineration) or from renewable sources. Local technical and commercial capability is however lacking, as are the kinds of local supply chains established through involvement of municipalities in energy supply. Moreover, the large scale utilities are responsive to shareholder interests in predictable, short-term rates of return on investment. Urban CHP and DH appear financially risky, and the UK regulatory structures, which separates retail and generation from distribution and transmission in a centralised market, arguably work against active participation of local governments in local energy planning and project development.

Public duties under climate change legislation, and the introduction of penalties for carbon emissions, notably the UK CRC Energy Efficiency Scheme, have created some impetus for public bodies to reduce energy use, and, more ambitiously, to consider the potential for low-carbon district energy, but most authorities are facing significant reductions in budgets and, in a governance structure where responsibilities and powers are set centrally, they have little incentive to take on new responsibilities for local energy services. The absence of a cohesive DH policy framework also makes experimentation highly challenging. Perceived risks and uncertainties, and transaction costs arising from coordinating multiple stakeholders around an unfamiliar energy system, slow the pace of deployment. Project developers face uncertainty over future regulatory frameworks and technical standards, as well as energy prices, the costs of long-term finance and the customer base. Limited expertise also leads to uncertainty about the relative merits of DH vis a vis alternative low carbon options, and the extent to which it can be deployed to serve potentially competing local objectives for affordable warmth provision, regeneration and economic development, reduced estate costs, or new revenue streams.

2.3.3 Local Governance of CHP/DH: Aberdeen, Birmingham and Woking

ABERDEEN: a non-profit company for the benefit of citizens.

The deep background to development of new district heating through a local non-profit company in Aberdeen is situated in social movement campaigns to reduce fuel poverty, which culminated in the 1995 Home Energy Conservation Act (HECA). Influenced both by HECA and Scottish government anti-poverty strategy, Aberdeen city council (ACC) created a new home energy conservation post, and the officer appointed set in motion an appraisal of fuel poverty solutions for tenants in electrically-heated multi-storey housing. Gas CHP with DH was identified as achieving the lowest ‘cost in use’, and this assessment criterion overrode the standard ‘lowest cost’ regeneration indicator, because of the Council’s political anti-poverty objectives. Local politicians decided to proceed, despite dissent and legal advice against. By the early 21st century, the increasing prominence of climate politics in the UK led to the then Labour government providing short-term funding for community

energy, as a carbon saving measure, and it was this finance which allowed the council's outline commitment to be enacted through formation of a non-profit ESCo, Aberdeen Heat and Power (AHP), with responsibility to act for the good of the citizens of Aberdeen. Three energy centres and heat networks have since been developed, supplying heating and hot water to 24 of the city's 59 multi-storey housing blocks. Two of the networks also serve other municipally-controlled buildings, and the third project has enabled on-going connections to additional public sector enterprises. Developments have been financed by housing regeneration capital, prudential borrowing, UK and Scottish government grant funding, energy efficiency obligations on utilities, and a commercial bank loan and overdraft. The council has acted as loan guarantor, reducing the costs of borrowing.

The focus on housing and local authority anchor loads enabled AHP to develop governance, technical and financial expertise without the difficulties introduced by commercial supply contracts. Connection of a sports facility, set up as a joint venture between ACC and other public bodies, provided an opportunity to develop capacities for supply in a quasi-commercial setting, and AHP could now supply commercial organisations. Management of bad debt risk is challenging, however, and would require a modified organisational structure, in order to protect the LA from liability. Commercial contracting would also mean that AHP was no longer primarily working for the LA, hence requiring the use of EU competitive procurement when considering further investment in heat network development.

BIRMINGHAM: risk aversion and ambitions for local economic regeneration via a private partner.

Although fuel poverty movements prompted initial interest in CHP/DH in Birmingham, eventual developments were configured around economic development rather than affordable warmth provision. The city council faced court cases brought by tenant campaigners in the 1980s, which resulted in orders for improvements in energy performance of housing stock. City engineers advocated the benefits of CHP with DH as a long term cost effective solution, but renovations focused on lowest short term cost (rather than cost in use), resulting in renewal of electric heating alongside improved building insulation. A pilot CHP/DH project was however approved, resulting in direct investment in a CHP system serving a local leisure centre and a number of multi-storey residences. It was early 21st century plans for economic regeneration of Birmingham's city centre arena, retail, commercial and conference facilities which were subsequently harnessed as an opportunity by council engineers committed to the energy saving facets of the technology. UK Labour government requirements for adoption of whole-life-cost accounting in public-private partnership contracts helped to establish an alternative cost-benefit calculus, and the same government funding for community energy used in Aberdeen proved instrumental in eventual council support. Seeking to avoid direct investment through public borrowing, however, and partly inspired by a visit to the private sector Southampton Geothermal Heating Company, the Birmingham Conservative-Liberal Democrat coalition tendered for a commercial contractor, Utilicom (subsequently Cofely), to own and operate gas CHP/DH networks for the city and to provide some of the necessary finance. Negotiations over the final contract proved challenging, with the city's legal, finance and procurement teams hesitant over the use of a component of grant funding in relation to state aid rules, and uncertain about the risks of a long-term contract for heat and electricity supply.

The local Liberal Democrat manifesto had however included a commitment to sustainable economic development, which was used by officers to gain political support for the project. The Liberal Democrat deputy council leader played a part in ensuring final agreement and the Birmingham District Energy Company (BDEC) was established by Utilicom on the basis of a 25 year concession contract guaranteeing heat and power purchase by the council and other public and private sector customers. Conservatism by the council meant that the local authority relied on Utilicom's access to loan and equity finance, its experience of network development and operation, and its knowledge of retail supply contracts, externalising the risk, but also ceding control over future development. The established network now supplies public and commercial heat users including council offices, a university, a hotel, a sports arena, a convention centre, retail centre and a hospital. BDEC's commercial model results in limited motivation to address fuel poverty, because of the high costs of connection to housing and low, insecure returns. A small number of council-owned multi-storey flats have since been connected to the network, but this relied on UK government grant-funding under the Department of Communities and Local Government's (England) Low Carbon Investment Fund. The venture is nevertheless regarded as successful, and the council has used the experience to develop further ambitious plans for district energy, using local biomass from its estate as well as investing in energy from waste.

WOKING: environmental politics, executive leadership and local enterprise.

Local environmental politics and the commitment of the Chief Executive made Woking Borough Council (WBC) an early innovator in energy saving and small scale CHP/ DH. The energy efficiency programme began in 1992, with a £250,000 revolving fund for reducing energy use in council buildings. The success of the programme on both environmental and financial criteria strengthened political support and the council sought to develop larger scale CHP/DH systems. To reduce its exposure to financial risk, and in compliance with earlier regulations limiting direct local authority trading, two arms length companies were created to manage project development: the first wholly owned company, Thameswey, established a joint commercial venture, Thameswey Energy Limited (TEL), with a Danish company. Initial energy efficiency funding was extended through both prudential borrowing and commercial loans. Unlike Aberdeen however, WBC lends to TEL at prevailing commercial rates, using the resulting interest payment differential to reinvest in further in-house sustainability projects. TEL is required to behave entrepreneurially, seeking energy investment opportunities outside the Borough, and has developed and operates CHP/DH schemes in Milton Keynes (about 100km away) as well as Woking. Over time, TEL has developed a systematic performance database and recruited specialist staff, hence building capacity in electricity trading through both private wire supply, and a 'virtual' private wire agreement with the regional Distribution Network Operator. Its increasing energy market knowledge and expertise have enabled it to improve the price obtained from selling electricity to the grid, by participating in wholesale market trading and grid balancing payments. This has helped to secure the cash flow position of the business, but the financial market crash has made investment in systems outside the borough politically contentious.

2.3.4 CHP/DH Development in the Three UK Cities: improvised local governance

Under UK neo-liberal political-economy, these urban energy projects have been established in the interstices of centralised markets, where local officers and/or politicians frame CHP/DH as a solution to varying local objectives, which may or may not forefront sustainable economy, and which are themselves indicative of ambiguity and context over the meanings of sustainable economy. Nevertheless, a number of local government officers and politicians have identified urban energy projects as an innovative way to integrate local social, economic and environmental objectives. Modes of local energy governance practices are in this sense emergent: ad hoc routes are found through a complex maze of issues. Intermittent funding has been a significant catalyst, but developers face multiple sources, and dimensions, of uncertainty: in relation to finance and business viability, fragmented governance instruments which send contradictory market signals, lack of a clear mandate and weakly-established technical expertise and supply chains. They worked to mobilise political consent and financial resources, and to negotiate viable governance solutions. Locally-relevant interests, knowledge and investment were configured to fit the matrix of global energy market, local social economy and shifting state regulatory frames. In each case, local actors were instrumental in constructing intersecting networks of community energy knowledge with non-local finance, engineering and legal resources. In Woking, networks stemmed from environmental activism; in Aberdeen from anti-poverty commitments and in Birmingham from a market model of local economic competitiveness and regeneration. Different governance modes have followed, focusing on community benefit in Aberdeen, private enterprise in Birmingham and local environmental enterprise in Woking.

In the language of the MLP, such governance experiments can be interpreted as occupying a ‘spatial’ or locality-based niche, situated in an unsupportive energy regime, with a shifting landscape, constituted by political struggle over what constitutes a sustainable energy system, the relevance of equity in access to energy services, and the underlying economic model. These DH projects were ‘protected innovation spaces’ in the sense that local commitment intersected productively with intermittent grant funding to enable project development. The development teams would however perceive little that was ‘protected’, given the demands of the work entailed in developing energy systems and market knowledge and expertise, building legitimacy for decentralised energy, handling opposition, and gaining agreement to proceed. These processes were filtered and funnelled through the central concern of making the finances ‘stack up’ by iterative translation between the dominant market logic of short-term cost and risk mitigation, and local goals concerned with securing long-term social, economic and environmental benefits. The definition of such projects as niche developments is also challenged by the necessary interactions between the local project team, with large scale utilities, engineering services, financial markets, and devolved UK state governments, which had to be brought into a partially-stable formation in order to establish the material infrastructure for local energy provisions. Within the MLP, this might be reframed as an account of the failure of the UK energy regime to enable niche innovations, suggesting that a productive innovation/transition policy would establish more protected conditions. Such a formulation however bypasses the analysis of the power relations structuring the status quo which might reveal why such prescriptions for policy development are unlikely to be heard.

3. Discussion

The establishment of urban CHP and district heating, as a recognised carbon and energy saving technology which is physically, socially and economically embedded, is used here as an indicator of the quality of governance frameworks for sustainable energy. The comparison of liberalised energy governance models in Netherlands, Norway and the UK shows that the same discourse is deployed in different variants of practice with the Netherlands and Norway demonstrating a more coordinated approach to sustainable energy governance than the UK. This has shaped the pace and scale of investment, and local engagement, as the prominence of climate politics has increased in city and state governance. Weaker local powers, a centralised energy market and a focus on short-term return on investment in the UK mean that the prospects for coordinated governance of the type practiced in the Netherlands and Norway, are more limited. The incumbent utilities, a product of the 'share-holder capitalism' dominant in the UK, are powerful actors in the framing of costs and benefits of different energy technology pathways. Nevertheless, this framing is shown here to be, to some degree, permeable to alternative modes of local energy governance, with different criteria of value. Neither were superficially 'local' energy developments simply bounded by locality; indeed local project teams interacted to uncover partially complementary interests, to 'cement' links with non-local finance, state politics, legal and technical expertise, creating a new project network at their intersection (Law and Callon, 1992; Summerton, 1992). Project development and implementation brought local and 'cosmopolitan' interests into structured, and to some degree spontaneous, interaction in development and implementation of the material infrastructures of urban energy. Local governance frameworks entailed resolution of political questions about contested understandings of value, cost and legitimacy. The lack of direct UK policy to legitimise CHP/DH development makes local engagement in energy governance halting and fragmentary.

Our research suggests that governance for systemic change to sustainable energy in liberal market economies such as the UK is likely to require change in dominant frameworks of value, to give greater scope for value creation through local economic action, rather than prioritising short-term investment returns and value extraction, as in the current model (Mazzucato, 2011). Significant heat network development, as one component, would for example require institutional innovation to legitimise provision, govern investment, set technical standards, pricing and customer protection. This is where much of the current struggle over UK policy direction in energy networks and low carbon heat is focused, and much of it is played out through practical interaction at the scale of specific projects, conveyed in the interlocking and shifting relationships between complex actors, working with multiple identities, at different scales in localities, state and market: local and central governments, businesses and financial investors. Concepts of niche, regime and landscape analytically distinguished in the MLP, are in this sense mutually constitutive (Grin, Rotmans and Schot 2010).

4. Conclusions

Different governance modes and urban energy trajectories can be understood in relation to the interdependent problem framings, and partially mutually constituted

interests, of state and energy market actors. What forms of governance would accelerate UK deployment of decentralised energy and urban heat networks, with what consequences for local control? Different models have different implications for the identities and configurations of lead actors, heat sources and users, and for likely shares of costs and benefits: constructing networks in areas of fuel poverty for example meets social as well as climate protection objectives, but is treated by commercial interests as bearing high costs and risks, with unattractive returns relative investment in the regulated sector. Change to a sustainable energy system therefore requires the state to change the balance of power by changing the rules of the game. There are of course major questions of political leadership which lie behind such a statement.

One way of conceptualising potential governance models is to think of them as distributed along a continuum. If the current status quo is characterised as 'liberalised market governance', then the opposite end of the continuum might be described as 'command and control' governance, which sets top-down 'planned' measures for sustainable energy. The power of incumbent interests, corresponding uncertainty over finance and costs of capital under current liberal market governance seems unlikely to increase the momentum, or result in the level of provision of CHP/DH envisaged in even relatively modest government policy for heat networks. Development is likely to remain small scale and patchy, sub-optimal in technical, economic and social terms, and to carry high transaction costs for local actors. Each development team have to find discrete pathways through interlocking sources of uncertainty and risk. This is an insufficient basis for meeting radical decarbonisation targets with tight timetables.

A 'command and control' model of governance seems to offer advantages of relative certainty for investors, assuming that forms of public guarantee for sunk costs of investment in infrastructure could be politically delivered, and that questions of regulation, ownership and control could be resolved. This would encourage major utilities or 'regime incumbents' to invest, and incorporate CHP/DH into their portfolios. Established businesses outside the current UK energy supply regime may enter the competition, with adaptation of the dominant regime, although mergers and acquisitions in European energy markets suggest that further concentration of ownership may also follow. There are risks associated with 'command and control' solutions, however, which stem from limited responsiveness to local circumstances, potential for perverse incentives and 'rent seeking' by major businesses, and potentially less than optimal solutions to the combined social, environmental and economic goals of sustainable energy.

As illustrated by the multi-level governance solutions devised in the context of Norwegian and Netherlands variants of liberalised energy markets, there are intermediary locations along such a spectrum. These can be characterised as forms of reflexive, coordinated governance which give scope for polycentric and locally-optimised solutions. Local interests gain capacity to shape innovative solutions, while improving inter-municipal learning and reducing uncertainties, in an attempt to streamline development and mobilise investment. Reflexive governance, able to recognise public interest goals in sustainable energy, equity and retention of revenues in the local economy, is however under-developed. Changing the regulatory parameters through coordinated action between local governments and the devolved administrations of the UK state could reshape the risk calculus, by integrating social and environmental goods into dominant financial evaluation practices, as practiced for

example under the Norwegian DH licensing model. Reflexive governance, which seeks to devolve control and resources in a cohesive policy framework, without determining outcomes, may be the most effective UK route to a more resilient low carbon energy system, which minimises 'stranded assets' and sub-optimal solutions, and encompasses social and environmental benefits. It should enable accelerated transferable learning between projects and shared templates for technical standards and customer protections. It retains the value of local government intermediaries, with long-term commitment to locality, local democratic participation, and local knowledge. As partners, or quasi-regulators, if not lead system developers, local authorities can act to reduce transaction costs, optimise system design for energy saving, and give clarity to the implications of different control, risk sharing and ownership models.

Reflexive governance requires explicit coordination between state, market and civil society interests to devise responsive regulatory measures, which neither exclude potential for the public good in secure and affordable heating, nor lose the value embedded in resources and capacities controlled by the major utilities. Reflexive governance may enable constitution of a sustainable energy system, to the extent that 'regime' configurations are subject to legitimate democratic scrutiny, beyond the 'engineered' configuration of technical infrastructures. Such prescriptions are demanding, because they require acknowledgement of the limitations of all forms of governance, whether through markets, hierarchy or community. They are particularly relevant in situations of asymmetry, uncertainty and divergence in interests, perspectives and objectives, such as those which centre on the transformation of complex energy systems.

The current struggle over a governance model for a sustainable energy system is being played out between the incumbent interests of utilities, based on sunk investments in infrastructure, legal, technical and financial expertise, and municipal and state governments, with their mixed competing and collaborative interests in public goods and private profit. There is no technical silver bullet solution to clean energy transformation, but a need for partial solutions as steps towards the systemic transformation envisaged by ambitious energy policies. The recomposition of the state to enable more constructive and coordinated change places civil society back in the centre of the picture. Proactive local authorities with prominent sustainable energy plans are one key component of change, but political shift also has to come from public dissatisfaction with the status quo, and a better understanding of the real costs of our current climate change trajectory.

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Acknowledgements

We are grateful to the RC UK Energy Programme for funding for the *Heat and the City* Research project (www.heatandthecity.org.uk) and to members of the team:

Richard Bellingham, University of Strathclyde, & Andy Kerr, Heather Lovell, David McCrone and Mark Winskel, University of Edinburgh.