

Governing cities for sustainable energy: The UK case☆☆☆



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ABSTRACT

The dependence of cities on intensive consumption of energy from fossil fuels is a major cause of climate disruption, and there is increasing interest in the potential for city governments to facilitate a transition to sustainable energy. Little is known, however, about the extent or structures of current urban energy initiatives. Our paper addresses this gap by mapping UK local authority energy plans and project investments and exploring governance processes in three leading cities. It uses socio-technical and urban studies' perspectives on neo-liberal governing and energy systems to interpret findings. This reveals both the gap between local ambitions and capacity to implement plans, and the potential for translation of neo-liberal governing into contrasting commercial and community urban energy enterprises, prefiguring different energy futures. Overall, however, the neo-liberal framework is associated with small scale and uneven initiatives, with limited contribution to a systemic shift to sustainable cities.

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1. Introduction

Contemporary cities are fundamentally dependent on intensive use of energy from fossil fuels, with three quarters of global energy demand estimated to stem from urban populations, and the proportion in western Europe over 80% (Grubler & Buettner, 2013; International Energy Agency (IEA), 2008). The resulting scale of greenhouse gas emissions is destabilising the Earth's climate and putting future prosperity at risk (Intergovernmental Panel on Climate Change (IPCC), 2014). Many cities, as well as states, are developing ambitious sustainable energy plans (Bulkeley, Castán Broto, & Edwards, 2015; Dowling, McGuirk, & Bulkeley, 2014; Rutherford & Jaglin, 2015), and supra-national arenas such as the European Union provide a political-economic context for capacity building.¹ European political commitment to investing in energy efficiency and clean energy has, however, been unsettled by global financial crisis (Geels, 2013; Oberthür & Kelly, 2008) and ensuing reductions in public spending. In addition,

liberalised energy market policies, pre-dating climate protection measures, have been associated with decline in municipal and local energy businesses: 'More than two-thirds of the European market is now concentrated in the hands of eight large companies' (Jamash & Pollitt, 2005 p.26; Petz, Edgar, Temple, & Maier, 2012). Although European policies position city authorities as significant contributors to a sustainable energy system (European Commission, 2015; UK Government DECC, 2011), their capacity and capability to act is therefore uncertain. Knowledge about the current extent or forms of urban energy initiatives, their rationales and the scope for diversity in practices of governing is also limited. Previous work has focused largely on city case studies, or on subsets of community energy projects, and has only partially addressed local government action (see Rutherford & Coutard, 2014, for review).

Our paper addresses this gap empirically and conceptually. Specifically, it provides the first comprehensive empirical overview, and analysis, of UK local government sustainable energy plans and investments, and differentiates emerging levels and forms of engagement. It complements this broad mapping of activity with brief case studies of three cities in order to gain insight into diversity in practices of governing which are less visible in the overview. A conceptual framework from urban and socio-technical studies guides this analysis (Callon, 1986; Rose & Miller, 2008; Rutherford & Coutard, 2014) by situating the findings in the wider context of UK energy systems' liberalisation and privatisation. The implications for sustainable urban energy are drawn out in the conclusion. The paper thus contributes new knowledge about UK local governance of energy and about the feasibility of city leadership for sustainable energy in societies subject to on-going extension of markets.

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¹ (EU Covenant of Mayors Office, 2015; Energy Cities, 2015; Eurocities, 2015; European Commission, 2015; Smart Cities, 2015; Smart Cities Information System, 2015)

2. Governing change for sustainable urban energy: a socio-technical and urban studies perspective

Socio-technical and urban studies treat change in energy systems not as a matter of techno-economic optimisation in a linear model of development from R&D to implementation but as a process in which the 'social' and the 'technical' are inextricably intertwined, and technologies co-evolve with programmes of governing (Sørensen & Williams, 2002). This perspective leads to the conceptualisation of cities and urban processes as both shaping, and shaped by, high carbon systems' interdependencies and incumbent interests, which create inertia through institutionalised governance, finance and business structures and technologies (Hommels, 2005). Historically, however, such apparent socio-technical closure has proved temporary, with different interests contesting the rationality of dominant systems (Geels, 2011). Understanding prospects for sustainable urban systems therefore requires analysis of the interactions of programmes of governing with technological change. We conceptualise programmes of governing as a set of beliefs and associated institutions and instruments which shape valid problem definitions and solutions, define relevant actors, structure their capacities and capabilities, and mould available finance and business structures (Rose & Miller, 2008). In liberal democracies, governing is orchestrated through a multi-level political-economic arena, where the urban scale is constituted through intersecting local, national and transnational actors, with potentially competing definitions of societal problems and their solutions, as in the case of climate change and energy (Bulkeley et al., 2015).

Neo-liberal governing, guided by beliefs about the efficacy of markets for solving societal problems, has been dominant in the multi-level state institutions of contemporary Europe since the 1980s (Crouch, 2011). Its core is the belief that government taxation and deficit spending 'crowd out' more efficient private enterprise. Hence public investment in infrastructure assets, such as energy, should be reduced to a minimum, while 'governing at a distance' (Rose & Miller, 2008), to mobilise private capital and to maximise efficient allocation of available resources, proceeds through extension of market principles across society. The UK offers particular insight into the interactions of neo-liberal governing practices with sustainable energy and cities. It is an early exemplar of experimentation in market instruments as tools for urban governance of public services, as well as in energy systems' liberalisation and privatisation, both of which have been emulated across Europe (Helm, 2010; Hood & Peters, 2004; Le Galès & Scott, 2010). It also embodies European tensions over implementation of sustainable energy policy, with ambitious climate legislation (UK Government DECC, 2011) but uneven progress to date (UK Committee on Climate Change, 2015).

City authorities are identified in central government low carbon policies as critical intermediaries in an envisaged market competition between technologies. Proposed spheres of mediation range across the entire energy system from efficiency retrofit, to decentralised combined heat and power (CHP) generation, district heating (DH) and cooling networks, micro renewables and low carbon transport (UK Government DECC, 2011; UK Government DECC, 2012; UK Government DECC, 2013). Neo-liberal governing does not, however, prescribe intermediary activity on energy systems, but constitutes it as one potential means to secure competitive advantage in relation to a disciplining central government framework of budgetary constraint, carbon taxes and performance audits (Hodson, Marvin, & Bulkeley, 2013). City governments are identified primarily as economic, rather than welfare, entities 'competing for resources in a market-like environment' (Lapsley, Miller, & Panozzo, 2010 p.307). We suggest that urban energy governing in these circumstances proceeds through diverse means, marked by multiple dimensions of uncertainty, and requirements of entrepreneurial assembly of social, technical, and economic capacities. We structure our analysis of resulting practices in relation to three interconnecting processes. The first of these concerns articulation of a

local rationale for acting on energy. The lack of direct local or regional government powers over the UK's centrally regulated, privatised energy system means that local authorities struggle to constitute a legitimate space and rationale for intervening in energy systems (Hodson et al., 2013). Plans for energy efficiency retrofit and low carbon provision are instead likely to be situated in relation to mandated responsibilities for urban planning, economic development, housing, welfare and environmental protection. Given pressures to compete for resources to secure critical infrastructure, energy is likely to be framed as a source of 'green economic growth', as well as social welfare through cost and carbon saving, without direct acknowledgement of tensions between these goals (Anderberg & Clark, 2013; Hodson & Marvin, 2009).

Second, austerity in public finances, reliance on market instruments and the limited technical capacities of many local authorities mean that urban energy governing entails 'a dispersed form of rule' (Dowling et al., 2014 p.19), dependent on assembly of capacity through an actor network (Callon, 1986) of multi-scalar and cross-sector state, market and civil society expertise and agencies. This may involve diverse combinations of consultants, financial investors, utilities and community groups as well as local and central governments (Moss, 2009). The process is likely to be marked by multiple axes of conflict. One such axis is internal to local authorities, which are not homogeneous organisations; different specialisms in economic development, community welfare, environment and planning may contest the substantive meanings and value of 'sustainable energy', as well as seeking to build coalitions to advance perceived interests around energy. A second important axis runs between the local, national and transnational actors who intersect at urban scale and have differential power and potentially competing priorities for redirection of energy systems, with different climate consequences and distributions of costs and benefits (Rutherford & Jaglin, 2015). The result is uncertainty over the scope for locally articulated rationales to be securely embedded in material initiatives.

Third, the use of market instruments to govern local energy developments requires the emergent actor network to work entrepreneurially to secure finance. This is enacted through competition for declining, and constantly evolving, public funding for 'green' initiatives, technology demonstrator projects, renewable energy feed-in-tariffs and energy efficiency subsidies (Rydin, Turcu, Guy, & Austin, 2013), which local governments may seek to use as a means to attract private finance. In the following sections, we explore the pattern of local energy initiatives emerging out of this process of assembling local rationales, actor networks and financial instruments, first by mapping activity across all UK local authorities (Sections 3 and 4) and then by exploring practices in three leading cities (Section 5). As analysis will demonstrate, the model provides insight into the paradoxical qualities of neo-liberal governing of socio-technical change, which does not preclude local diversity in energy strategies, but neither does it enable a systematic transition to governing cities for sustainable energy.

3. UK local governance of energy: Methods and data

Our data are derived from a population survey of local authority energy plans and initiatives, combined with three brief city case studies. Our quantitative database, developed 2013–2014, maps activity across all 434 UK local authorities, based on two indicators: first, an accessible energy and carbon plan, and second, evidence of financial investment in any aspect of energy systems. The former was treated as evidence of a locally articulated rationale for energy governing. The latter was treated as evidence of assembly of capacity for governing material change. In order to make this indicator as robust as possible, fifteen datasets, published by UK Government and European Commission and related agencies, were assembled and cross-checked for consistency. The resulting database records low carbon, renewable and energy efficiency projects (details in Appendices 1a and 1b and Hawkey, Tingey & Webb, 2014). The two indicators were combined in a preliminary classification scheme, with each local authority allocated to one of four groups (see

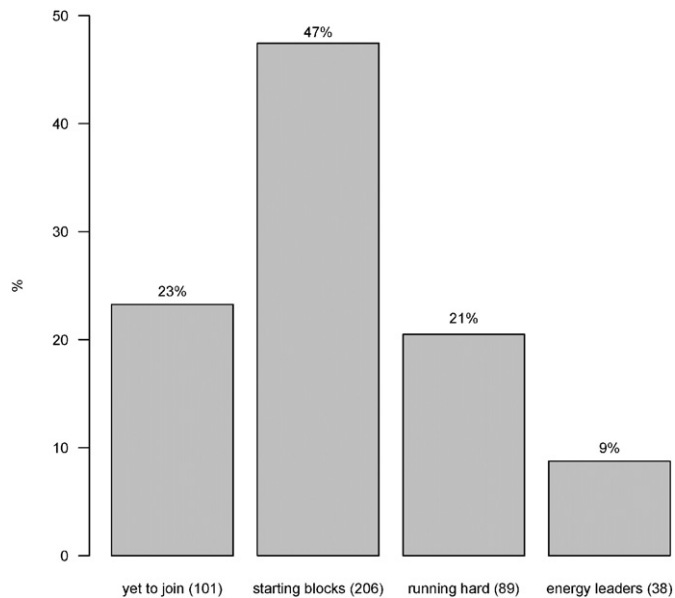


Fig. 1. Proportion of UK local authorities in each category of engagement in energy systems.

Fig. 1): *energy leaders* were defined as those investing in a minimum of three and up to eight projects, with or without an accessible energy plan; local authorities defined as *running hard* were those investing in one or two projects and publishing an energy plan; the largest group, categorised as *at the starting blocks*, had one or two investments, or a published plan; the remainder, categorised as *yet to join*, had no accessible evidence of plans or investments. The typology is tentative, due to incompleteness of published data on localised energy, which remains small scale.

Case studies provide additional insight into urban energy governing, exemplifying the diversity of local rationales, intermediary actor networks and investment instruments. They draw on a small component of qualitative data, collected 2010–2014, comprising in-depth interviews with 159 legal, finance and engineering experts, supply chain businesses, and local and central governments, as well as energy project ethnographies, documentary analysis and knowledge exchange workshops (Hawkey et al., 2016).

4. Characterising UK local authority engagement in energy systems

In this section, findings from our typology are explained using summaries of project types and characterising the distribution of activity across categories of engagement and evolved nations and English regions. In line with research on other states (Bulkeley, Castán Broto, & Maassen, 2014; Dowling et al., 2014; Rice, 2010; Rutherford & Jaglin, 2015), the results of mapping show the high profile of energy and carbon as an object of UK local governing (Fig. 1). Over three quarters of local authorities (77% or 333) are active in sustainable energy planning and/or investment, and over a third (38% or 167) have proceeded to mobilise finance, ranging from around £100,000 to over £20 million, to invest in a total of 322 projects, from capacity building to energy efficiency and supply (Table 1).

Two key points stand out from this review of energy projects. First, and unpredictably given limited municipal powers and resources, the emerging focus of UK local governing is decentralised energy generation and supply (44% or 170 projects), particularly using CHP with district heating (DH) and cooling, but also renewable electricity including marine, off-shore and hydrogen energy. Second, activity also centres on energy efficiency and demand management (31% or 120 projects). This sphere of activity is most amenable to urban governing, and hence a tractable basis for a locally articulated energy and carbon rationale.

The activities of the thirty-eight authorities at the leading edge of strategy and investment can be interpreted as prefiguring a systemic model of governing for decentralised efficient energy through CHP (79% of leaders), DH (74% of leaders) and energy from waste (37% of leaders), as well as electricity from renewables (68% of leaders) and demand management. These authorities were generally larger and therefore have potentially greater capacity, but also considerable economic motivation to govern energy to reduce costs and taxes incurred, and/or to position sustainable energy as a means to secure competitive advantage. This latter ‘green growth’ rationale was most common, prioritised in 21 out of the 38 leading authorities, with affordable warmth, energy and resource efficiency also featured. London, Birmingham and Aberdeen are discussed in the next section as examples of this group. Authorities categorised as *running hard* were more likely to focus on efficiency and demand management. This group included cities such as Edinburgh, which is committed to sustainable energy action as a signatory to the EU Covenant of Mayors, but material investment is limited, focusing on pilot housing retrofit projects and capacity building. Those councils categorised as *at the starting blocks* were also active on energy efficiency, but the presence of 30 energy supply projects reinforce the picture of an increasing local governing focus on decentralised energy. Small cities such as Cambridge exemplify this group; the council has an energy plan, including demonstration of the feasibility of city centre CHP and DH, but has not yet secured cross-sector collaboration and investment. The remaining authorities, without publicly accessible plans or projects, may nevertheless be investing some internal resources in energy efficiency.

Levels of energy governing activity were also differentially distributed across the UK (Fig. 2). Of the four countries, Scotland has the highest proportion of *energy leaders* (19% or 6); within England,² activity was higher in the Yorkshire/Humber region, and in Greater London where over half of local councils (70% or 24) were classified as *energy leaders* and *running hard*.

Further research is needed to explain this pattern, but it is unlikely to be associated simply with differential local budgets. UK local authority budgets are tightly controlled by central government formulae and have been sharply reduced since the 2008 financial crisis, resulting in radically reduced local spending on all activities except statutory duties (Travers, 2012). There may, however, be distinctive cultural and political interests in, and economic opportunities for, national (in Scotland) or regional (in England) collaboration to generate additional investment and capacity for energy governing. National and regional economic agencies, in the form of development, enterprise and resource efficiency bodies, bring resources for energy efficiency and low carbon investment; such intermediaries are significant in Scotland, and in Greater London, and the legacy of Yorkshire’s Regional Development Agency may be instrumental in the locality’s higher rates of energy initiatives.

Overall, the mapping exercise reveals the extensiveness of local energy governing ambition and the gap between ambition and implementation, as well as the uneven pattern of change in local energy provisions. It points first to the increasingly established foundation for a locality-based, decentralised ‘efficient energy’ systems model for urban energy governing, and second to the potential for purposive coordination of multi-level governance to build capacity for such a sustainable energy pathway.

5. Sustainable energy governing in three leading cities: London, Birmingham and Aberdeen

Using case studies of London and Birmingham in England and Aberdeen in Scotland, this section explores the potential for diversity of practices behind the overall patterns of local energy governing. We

² England has the largest population, with 354 local authorities; Scotland has 32; Wales has 22; Northern Ireland has 26.

Table 1
Types and scope of UK local authority energy initiatives.

Energy system activity ¹	EL	EL%	RH	RH%	SB	SB%	Total	Total %
Demand management	55	26%	52	41%	13	29%	120	31%
Energy infrastructure	56	26%	12	9%	0	0%	68	18%
of which are DH	48		11		0		59	
Energy supply	89	42%	51	40%	30	67%	170	44%
of which are heat only	22		12		3		37	
of which are electricity only	9		11		5		25	
of which are heat and electricity	58		28		22		108	
Other	8	4%	5	4%	0	0%	13	3%
Transport	6	3%	7	6%	2	4%	15	4%
Total	214	100%	127	100%	45	100%	386	100%
Scope of activities	EL	EL%	RH	RH%	SB	SB%	Total	Total %
Knowledge exchange/capacity building	11	21%	4	14%	0	0%	15	17%
Strategic energy planning	14	26%	8	29%	3	50%	25	29%
Investment support funds	6	11%	1	4%	0	0%	7	8%
Supply chain development	0	0%	2	7%	0	0%	2	2%
Community projects/support	5	9%	2	7%	0	0%	7	8%
Demonstrator projects	17	32%	11	39%	3	50%	31	36%
Total	53	100%	28	100%	6	100%	87	100%
Electricity supply technology/fuel source where known	EL	EL%	RH	RH%	SB	SB%	Total	Total %
CHP	51	85%	27	71%	22	85%	100	81%
Hydro	1	2%	1	3%	0	0%	2	2%
On-shore wind	0	0%	4	11%	0	0%	4	3%
Solar PV	5	8%	5	13%	1	4%	11	9%
AD	1	2%	0	0%	0	0%	1	1%
Landfill gas	2	3%	0	0%	1	4%	3	2%
Fuelled	0	0%	1	3%	1	4%	2	2%
Waste incineration	0	0%	0	0%	1	4%	1	1%
Total	60	100%	38	100%	26	100%	124	100%
Heat supply technology/fuel source where known	EL	EL%	RH	RH%	SB	SB%	Total	Total %
Biogas	1	2%	0	0%	0	0%	1	1%
Biomass	9	14%	6	16%	3	12%	18	14%
CHP	52	79%	27	73%	22	88%	101	79%
Gas boiler	0	0%	3	8%	0	0%	3	2%
Solar Thermal	3	5%	1	3%	0	0%	4	3%
Waste incineration	1	2%	0	0%	0	0%	1	1%
Total	66	100%	37	100%	25	100%	128	100%

¹ Where projects address more than one aspect of energy systems, they are listed for each aspect, e.g. a project addressing demand management and energy supply is listed in both rows. Totals therefore exceed the total number of projects (322).

focus on the three processes of governing outlined in Section 2; although these are separated here for clarity, in practice, they are neither sequential nor discrete. They are marked by interactions and flux of local and national political cycles, and associated market opportunity structures, resulting in contested strategies, reiterations of rationales and uneven material change. Findings are summarised in Table 2.

5.1. Articulating local energy rationales

Each of these cities has situated urban energy governing in an uneasy mix of carbon, competitive advantage and welfare narratives, without public acknowledgement of potential contradictions. In Greater London, decentralised energy governing has been constituted primarily as a means to secure resources, in a competitive 'green growth' scenario, which is in turn regarded as key to protecting the city's global status and population welfare (Greater London Authority, 2015a). In contrast, in Aberdeen, the same decentralised energy systems have been construed first as a means to local poverty alleviation, with a 'green growth' strategy taking shape subsequently around concepts of a regional hydrogen economy. In Birmingham, local energy rationales have fluctuated in line with changing political control, variously foregrounding competitive advantage, welfare and social justice.

Among the three cities, London, as a constitutive actor in the global markets through which local governing proceeds, is uniquely

positioned to develop strategic capacity for low carbon infrastructure. The Greater London Authority (GLA), led by an elected Mayor and Assembly, is a regional intermediary with significant land and infrastructure assets. 'Green growth' rationales have persisted through changes of political control, with targets for 25% of energy from local low carbon sources by 2025 and 50% by 2050 (Greater London Authority, 2015a). The GLA does not, however, have direct power over the 32 borough councils and City, which represent the highly stratified population; energy initiatives at borough scale are structured around diverse political logics, embodying a degree of 'conflict over how and by whom new forms of urban energy should be generated' (Bulkeley et al., 2014).

Birmingham and Aberdeen lack the scale of resources available in London, and local articulation of a rationale for urban energy governing has been internally contentious. In both cases, energy is, however, increasingly positioned as a facet of both economic advantage and local welfare. Birmingham council debate over energy has fluctuated between a 1980s local politics foregrounding welfare and a local conservative-liberal democrat coalition prioritising 'green growth' through private finance in the early 2000s. Re-establishment of labour control in 2012 reframed energy again as a means to local prosperity, health and fairness (Birmingham City Council, 2015). As in Birmingham, Aberdeen action against fuel poverty has a history dating back to at least the 1980s, but the feasibility of action on technically challenging multi-storey social housing, where the council estimated that 70% of

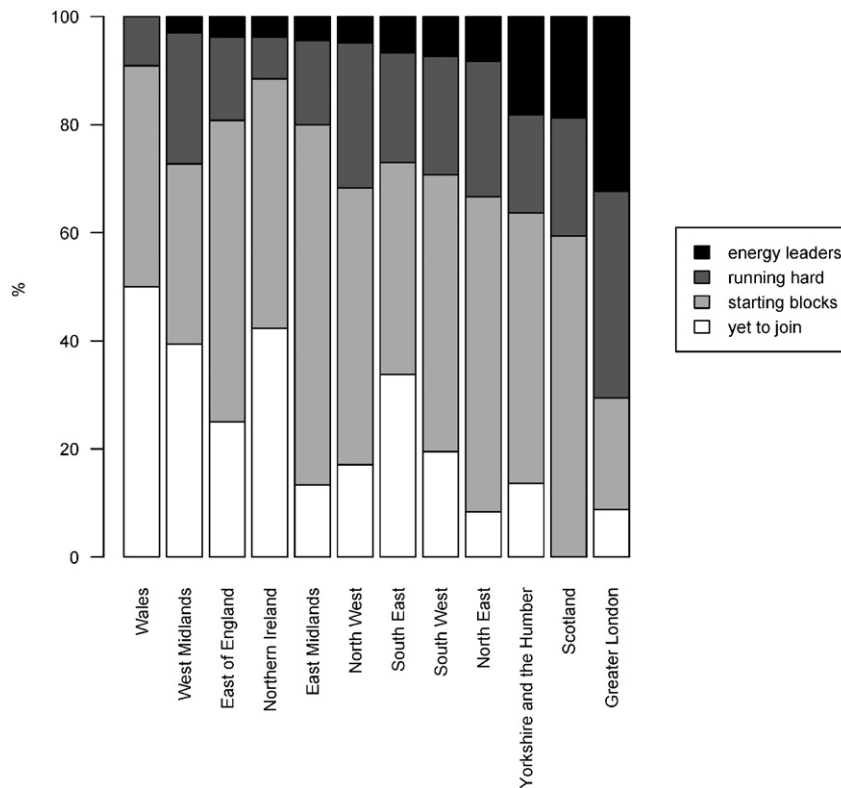


Fig. 2. Proportion of local authorities in the devolved nations and English regions according to each category of engagement.

households were experiencing fuel poverty, was highly contested. The [UK Home Energy Conservation Act \(1995\)](#) provided critical momentum for a local energy rationale grounded in Scottish anti-poverty politics and local welfare ([Aberdeen City Council, 2002](#)). Since then, the rationale for urban energy governing has been increasingly extended to a narrative of 'green growth' in an [Aberdeen City Region Hydrogen Strategy \(Aberdeen City Council, 2015a\)](#).

5.2. Assembling actor networks

In each city, local rationales have formed and reformed interactively with the work of assembling actor networks with capacity to advance emerging ambitions (see [Table 2](#)). The London Sustainable Development Commission ([London Sustainable Development Commission, 2015](#)), Climate Change Agency, District Energy Project Delivery Unit

Table 2
Key differentiating features of urban energy governance in London, Birmingham and Aberdeen.

	London	Birmingham	Aberdeen
Population	8,000,000	1,000,000	225,000
Local energy rationales and logics of practice	'Green growth' and investment; energy security through decentralised systems to secure future economic status	Prosperity for improved health, fairness and resource efficiency in a 'green city'	Social welfare through energy services and carbon management for public buildings and social housing; Economic development through 'Hydrogen economy'
Key actor network structures/organisational intermediaries	London Sustainable Development Commission; DEPDU; London electricity working group; OPDES (Cofely Ltd)	Birmingham Green Commission; Birmingham Energy Savers (private partner – Carillion); BDEC (Cofely Ltd)	AHP (non-profit company); DEAL (for-profit subsidiary of AHP); Aberdeen City Region Hydrogen Strategy (PPP)
Mediating instruments – finance	London Green Fund (£110 M loan and equity finance); <ul style="list-style-type: none">London Energy Efficiency FundGreener Social HousingForesight Environmental Fund (energy from waste) External sources: ERDF, EIB; Royal Bank of Scotland; ELENA (£6 M); UK TSB Future City Demonstrator Award (£3 M); UK Government Green Deal Pioneer and Fuel Poverty Awards (£5.6 m); UK Government LCIF (£3.5 M) UK Government CEP (£2.2 M)	ELENA (£1.3 M); UK Government Green Deal Pioneer and Fuel Poverty Awards (£2.3 M); UK Government CEP (£700,000); ERDF – 'sustainable urban development'; UK Government LCIF (£2.3 M)	UK Government CEP (£6.5 M); Scottish Government (£1 M); 'Hydrogen Economy' (£19 M combination of partner contributions from city council, Scottish Enterprise, Scottish Government, Scotia Gas Networks, Scottish Hydro, Stagecoach and First Bus. Includes £8.3 m under EU FP7 funding).
Local energy supply	'Licence lite'; CHP with district heating and cooling networks; energy from waste; heat recovery from sewage; domestic 'smart metering'	CHP with district heating and cooling networks; energy from waste	CHP with district heating; biomass boilers for city buildings; hydrogen fuel cell energy storage and buses demonstrator

(DEPDU) and electricity working group; the Birmingham Green Commission and Aberdeen Sustainable Energy Action Planning partners (Aberdeen City Council, 2015b) and regional Hydrogen Economy Partnership (AHEP) are all examples of the types of networks assembled during the early twenty-first century. Each represents attempted alliance-building among cross-sector and multi-scalar interests in political institutions, NGOs, global finance, consulting engineers, construction and utilities, as well as small businesses, in order to secure a degree of agency in energy markets.

Activities indicate the constantly assembling and dissipating quality of actor networks, which variously co-exist, or are superseded or merged into other structures, with the ebb and flow of local political processes and their relative emphasis on market, welfare or environmental objectives. A critical test of their capacity to embed differential energy rationales and priorities is, however, their translation into specific business structures, or Energy Service Companies (ESCOs), and technical infrastructures. This is demonstrated in the three cities through contrasting commercial vs community enterprise formations. The briefly existing London ESCo, set up in 2006 just before the financial crash, was a joint venture 19% owned by the short-lived London Climate Change Agency and 81% by EDF Energy (then owner of the London electricity distribution network). It is a critical example of uncertainty over the capacity of urban governments to embed local accountability and welfare priorities in decentralised energy. The ESCo was expected to balance commercial and community goals through significant decentralised energy investments, but by 2009 was described as lacking business and wound up (Newton, 2009). In 2008, a major 40 year public sector contract for energy networks for the Olympic Park facilities and surrounding area was, however, awarded to commercial utility Cofely Ltd., a subsidiary of transnational GDF Suez. The contract secures long-term revenues at commercial rates of return for private capital invested in the Olympic Park District Energy Scheme (OPDES). Energy tariffs are market-indexed in a local network monopoly, which locates strategic control over future expansion with the commercial operator.

The Birmingham conservative-liberal democrat political commitment to commercial finance for decentralised energy, as a component of city centre regeneration, also resulted in a 25 year contract with Cofely Ltd., and 2006 creation of Birmingham District Energy Company (BDEC). Lack of strategic control by the council has, however, limited progress in welfare targets for connecting social housing to the DH network, where low returns and risks of bad debt mean that private suppliers seek to avoid responsibility for provision. Connection of a few Birmingham multi-storey housing blocks to the network has been funded by UK government grants. A second ESCo, Birmingham Energy Savers (BES), was created in 2012 as a private-public partnership between the city and Carillion plc, for area-based retrofit of houses and public buildings. The aim of BES was to generate around £65 m of direct investment, but response to a 2014 Freedom of Information request suggested that this business structure was struggling to show results, with only twenty-four measures installed in houses in two-and-a-half years (Birmingham City Council, 2014).

The city of Aberdeen council is an exception to this pattern of market-commissioning and commercial finance for urban energy governing. Its welfare-led rationale resulted in 2002 establishment of a non-profit community ESCo, Aberdeen Heat and Power Ltd. (AHP) to own and operate CHP and DH for multi-storey housing clusters and public facilities. This entailed acceptance of business risks, in exchange for securing lowest cost heating and retaining strategic control. The council provided loan guarantees, as well as accepting responsibility for tenant payments for heat with rent. AHP's commercial subsidiary, District Energy Aberdeen Ltd. (DEAL), has since been established for heat supply to the private sector.

5.3. Market mediating finance instruments

Translation between a rationale for urban energy governing, the assembling of a competent actor and making initiatives material has in all cases entailed competition for multi-level European, UK and devolved government finance. Public funding has in practice proved critical to every development, even where a commercial ESCo is created. This includes London, where the city's powerful global position and high land values enable systematic use of regulatory powers to require private developers to invest in sustainable infrastructure. The Olympic Games site, for example, received around £6.2 billion central and local government investment (Rogers, 2012); private investment of around £100 million for low carbon energy infrastructure was hence a very low risk, with highly secure revenues over the 40 year contract. The GLA has also accessed European Investment Bank (EIB) European Local Energy Assistance (ELENA) funds to enable decentralised energy business planning under DEPDU, which operates as a joint venture with transnational ARUP. The largest source of energy and energy efficiency finance among the three cities, London's loan and equity 'Green Fund', is also significantly dependent on public finance from Europe (ERDF and EIB) and London Development Agency, alongside investment from the Royal Bank of Scotland, which could also be considered a form of public finance, since its 2008 financial collapse was averted by public purchase of 80% of shares.

With less powerful roles in global capital accumulation, Birmingham and Aberdeen are in more responsive positions. The first BDEC development for example required a public finance contribution of £700,000 from a short-lived (2002–2007) UK government Community Energy Programme (CEP), towards a total budget of £1.86 million. Subsequent city centre extension of the heat network has also been funded by combined grants and private finance. Finance for BES was secured from UK Government grants, ELENA and £14 million of council borrowing. In Aberdeen, reliance has been placed on central government grant funding and council borrowing against capital budgets. The CEP contributed 40% of capital for the first three energy centres and networks built by AHP, which has itself recently borrowed a further £1 million from the Scottish Government. The Aberdeen City Region Hydrogen Strategy, with its focus on economic growth, has mobilised £19 million from EU, UK and Scottish governments, as well as Aberdeen council, with smaller contributions from utilities (who are discharging government-imposed carbon reduction obligations) and other businesses.

5.4. Governing cities for sustainable energy: Lessons from London, Birmingham and Aberdeen

Comparison of the three cities reveals scope for diversity in sustainable energy strategies, in the context of neo-liberal governing. Notably, the interplay between logics of welfare and 'green growth' prefigures different forms of governing, with potential for alternative urban energy futures. In London and Birmingham, the dominant liberalised energy market logic is re-enacted through a commercial ESCo structure, exemplified by BDEC and OPDES. Technical and economic capabilities and control are located with a corporation ultimately governed by global shareholder interests in maximising returns on mobile capital. Contractually, the municipality is released from these risks, but energy market and technical expertise, and future strategic control remain with the commercial utility. Urban governing is formatted around the skills of managing long-term supply contracts in a localised monopoly market in order to balance revenue guarantees for private investors with energy pricing and performance standards for users. Such long-term private finance contracts may also introduce new risks of inflexibility for large users and public services, given future uncertainties over energy and climate change.

An alternative urban energy capacity building model is exemplified in Aberdeen, which has embedded a local welfare logic and local economic value in a community non-profit ESCo structure. Governing

Table 3
London, Birmingham and aberdeen carbon targets and progress reporting.

CITY	London	Birmingham	Aberdeen
Carbon target area	City	City	Own estate
Baseline year	1990	1990	2008/09
Reduction target	60% by 2025	60% by 2026/27	42% by 2020
UK Government data on city emissions' reductions 2005–2012¹			
Per capita	16%	17%	18%
Absolute	7%	10%	10%
Own reporting of emissions' reductions			
	1990–2012 City ²	1990–2012 City ³	2008/09–2012/13 Own estate ⁴
Per capita	28%	18%	–
Absolute	10%	–	20%

¹ Source: <https://www.gov.uk/government/statistics/local-authority-emissions-estimates>

² Source: Mayor's Climate Change Mitigation and Energy Annual Report, 2013–14, GLA https://www.london.gov.uk/sites/default/files/CCME_annual_report_2014.pdf

³ Source: Report on Birmingham's Carbon Dioxide Emissions Reduction, Technical Paper 2 2013 Available at <http://www.birmingham.gov.uk/sustainability>

⁴ Source: Aberdeen City Council Carbon Management Programme Progress Review 2012/2013 Available at http://www.aberdeency.gov.uk/planning_environment/environmental/your_environment/cma_carbonmanagement.asp

in this model requires local assembly of capacity and capability in relation to energy markets, business and decentralised energy technologies. The business risks are borne locally, but strategic control and future flexibility are retained as well as cost-based pricing, and accountability is to local populations rather than mobile shareholders. The model depends on sufficient critical mass of local political commitment to long-term underwriting of financial risks, enabling a local actor network to contest the values and centralised structures of the UK liberalised system.

Energy from these decentralised systems, however, currently constitutes a very small component of energy use within the respective local authority areas. In addition, any carbon reductions are difficult to assess; despite increasing numbers of UK cities publishing targets, carbon metrics remain under-developed, and reporting conventions differ. Measures are also usually confined to territorial energy use, ignoring emissions embodied in imported goods and services. In these three cities, London and Birmingham report on change in area carbon emissions, while Aberdeen council reports on its own operations, as well as reporting area emissions under the Scottish Climate Change Declaration, a partnership between local authorities and Scottish Government (see Table 3). In council reports, CHP and DH provisions are reported as reducing carbon emissions by approximately 40% in comparison with previous electric heating. Only London publishes an estimate of the contribution of decentralised energy to total demand; the most recent data show contributions of 3.5% of electricity demand and 2% of heat demand (Greater London Authority, 2015b).

UK Government data comparing estimated city emissions between 2005 and 2012 show the similarity of overall reductions in the three cities (see Table 3), indicating the dependence of city governments on UK scales of action and their limited capacity to effect differential change through local political strategies: per capita emissions are estimated to have reduced by 16–18%, with absolute emissions reducing by 7–10%. Rapid population growth in London means that absolute reductions are lowest here. By comparison, in the same period, reported emissions for all of the UK, excluding Aberdeen, Birmingham and Greater London, fell slightly *faster* than in these three cities, averaging 19% per capita and 14% absolute reductions. In addition, in our analysis of all local authorities, we found no relationship between local government energy activity and rate of change of per capita emissions.³ Decentralised energy and retrofit initiatives are therefore having no measureable differential impact on emissions, again

demonstrating the limited capacities of local authorities in governing area-based energy and carbon.

6. Conclusions

Neo-liberal governing in the UK is associated with resourcefulness in local energy activity, with three quarters of local authorities demonstrating ambition, often backed up by material investment in decentralised energy and efficiency retrofit. City case studies also indicate potential for actor networks and local political coalitions to create diversity in energy structures, co-opting elements of neo-liberal governing to serve community welfare priorities. This is demonstrated in the contrast between an adapted 'business as usual' model of liberalised energy markets incorporating decentralised low carbon infrastructures for 'green growth', as in London and Birmingham, and an alternative user-led mutual enterprise model more responsive to local welfare, economy and accountability, as in Aberdeen. In both models, there are, however, significant questions about the future scale of material contributions to urban sustainable energy and carbon reduction, and even harder questions about whether the local capacity building model, exemplified in Aberdeen, is more likely than an adapted liberalised market model, exemplified in London and Birmingham, to provide a pathway for low energy, low carbon sustainable cities.

The struggle to assemble a relatively secure local energy rationale, effective actor networks and financial capacity means these small scale 'island' projects currently make only a limited contribution to a low carbon urban system. Even in London, the gap between ambition and achievement is stark, with targets of 25% of demand from decentralised energy by 2025 against 3% achieved by 2013. Overall, neo-liberal governing hence emerges as limiting, rather than enabling, municipal capacity to act systematically on sustainable energy ambitions. Bounded projects, governed by shifting political rationales, variously query the status quo of centralised, liberalised, high carbon energy systems, and function in uneasy co-existence with it. The pattern suggests that city politicians and officials struggle to engage critically with the materiality and local translation of governing for sustainable energy. The symbolic terrain of debate centres on visions of sustainable cities as a new model for 'green growth' and competitiveness. The disciplining impacts of market instruments and competition to attract finance for infrastructure renewal marginalise the mounting evidence of incompatibility between future growth and climate stability. Urban energy governing is hence rendered susceptible to co-optation for green branding, which risks treating climate change as a new opportunity for capital accumulation and normalising the continuing mass consumption of resources, rather than building long-term foundations for low energy, low carbon municipalities.

³ We calculated the average rate of change in per-capita emissions over 2005–2012 for all local authorities, and found engagement category had no significant effect ($F(3,430) = 0.843, p = 0.471$).

The gap between ambition and advancement nevertheless indicates the latent potential for significant city leadership. A key pathway identified from our findings is a systemic model of efficient energy combining comprehensive urban retrofit with greater decentralised generation and supply. Such a model of multi-level governing of innovation for sustainable cities is user-, rather than producer-led, and requires coordinated local, regional and national action. UK central and devolved governments would need to equip municipalities and regions with capacity through statutory powers for energy efficiency planning and development, combined with access to long-term affordable finance and/or financial guarantees. This would strengthen democratic city leadership in energy provisions and change the balance of power to enable more constructive, concerted local mediation of the different interests of state, market and civil society actors. In the UK, central–local government relations have been marked by a history of distrust and progressive centralisation of power (Le Galès, 2002; Travers, 2012). This has weakened political capacity and democratic institutions at local, regional and national scales. UK politics is, however, in a period of change, with renewed demands for greater devolution of tax-raising and spending powers, and tensions over neo-liberal governing where the focus on short-term cost and capital accumulation is limiting the capacity to identify and respond to long-term societal damage from climate change and risks to long-term sustainable prosperity.

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