Planning and the challenge of decentralised energy: a co-evolution perspective

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Abstract

The UK energy system is currently characterised by lock-in to centralisation. This lock-in can be understood from a co-evolution perspective as arising from a mix of technological, economic, social and governance elements. The governance of energy infrastructure through the planning system is part of this mix. Recently the planning of major energy infrastructure projects has been streamlined through a new infrastructure planning regime in a way likely to support continued centralisation. Yet at the same time there has been encouragement of decentralisation of energy systems through a number of policies as part of the attempt to cut carbon emissions while enhancing energy security. As a result, a great variety of decentralised energy initiatives have become apparent, particularly in urban areas. Using a co-evolution methodology, this paper presents an analysis of this variety in urban contexts and discusses the implications for local planning.

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Introduction

This is a time of change for energy systems and the governance of those systems. The goal of deep carbon emissions, together with concern over energy security is driving the search for new approaches to the delivery of energy and energy services. In the UK the goal of achieving 80% cuts in carbon emissions by 2050 (DECC, 2009; CCC, 2009) is being twinned with a desire to enhance national energy security in the face of a shift from being a net exporter to a net importer of energy in 2004, the experience of high fossil fuel prices, electricity blackouts in the summer of 2003 and ongoing geo-political events (Watson and Devine-Wright, forthcoming - Oct 2011). This is leading to a reconsideration of the UK's currently highly centralised energy system.

The UK energy system is currently 'locked-in' to centralisation but is facing a significant policy shift in favour of decentralised initiatives. This has implications for the planning system, a key aspect of the governance of energy infrastructure. This paper used a co-evolution perspective to understand the nature of (de)centralisation in energy systems. It presents an analysis of contemporary patterns of decentralisation, focussing on urban areas and discusses the implications for the planning system. This is highly topical as a new planning regime for streamlining the consenting of major energy infrastructure schemes has just been implemented, at the same time as a reform of local planning in the spirit of 'localism' is being proposed.

This paper thus addresses two research questions:

- What is the nature of the shift towards decentralized energy systems in urban areas?

- What are the implications for the planning of energy infrastructure?

The paper has five main sections. The first section outlines the nature of the lock-in to centralisation in the UK energy system and the role that infrastructure planning plays. The next section then discusses the way that energy decentralisation has been promoted before, in a third section, showing how the co-evolution perspective can help understand this. This section also sets out our co-evolution methodology for undertaking a scoping survey of urban energy initiatives. The fourth section presents our analysis, which maps the multiple pathways of decentralised urban energy initiatives before, in the fifth section, discussing the implications for local planning.

Lock-in to a centralised energy system and the role of the planning system

It is widely accepted that the current energy system in the UK is characterised by lock-in into centralisation (Bergman and Eyre, 2011). The concept of lock-in arises from critiques of neo-classical economic assumptions (Arthur, 1989) and it is used increasingly in the context of high carbon energy systems (Unruh, 2000). The dynamics of technological change have been repeatedly shown to shape the direction taken by innovation in areas such as electricity systems (Hughes, 1983), nuclear infrastructures (Walker, 1999, Walker, 2000) and fossil fuel infrastructures (Unruh, 2000). Unruh argues that processes of technological 'lock-in' and associated 'path dependence' are prevalent in modern energy systems, making change difficult to achieve (Unruh, 2006).

Lock-in into energy centralisation represents the 'dominant narrative' or 'pathway' in the UK, promoting the idea that the challenges of dealing with climate change and energy security can only be dealt with through a centralised energy system driven forward by traditional actors such as energy utilities and regulators, the government, intensive users and associate professional communities (Leach et al., 2010). But, to anticipate our espousal of the co-evolution perspective, such lock-in is not only a technological phenomenon. Centralised energy technologies such as large power stations and national grids are reinforced by market rules, institutional arrangements, business models and social norms. Governance processes are also implicated in maintaining a centralised energy system. The planning system plays a key role within such governance processes, by regulating the development of major energy infrastructure.

Recently the UK planning system has been restructured to ease the consenting of such development. Under the Planning Act 2000, a new Infrastructure Planning Commission (IPC) was created to examine all applications for 'nationally significant infrastructure projects' (NSIPs) including those from the energy sector in England and Wales. The threshold above which energy projects are considered to be NSIPs was set by central government at 50 megawatts for onshore electricity generating stations and 100 megawatts offshore; similar thresholds are set out for ancillary energy infrastructure such as power lines (DECC, 2011).

The explicit rationale for establishing the IPC was that the former system was "cumbersome and overly-complex", involving up to eight parallel applications for a single project and often lengthy public inquiries (www.infrastructure.independent.gov.uk; accessed 25th ~~august~~ August 2011). Instead the new system unifies the consent regimes and has a clear timetable for decision-making. Project proponents have to consult with local communities prior to making an application but local authorities are not involved in the decision-making.

Originally IPC Commissioners either granted/refused consent directly or made recommendations to central government. All decisions are taken with reference to National Policy Statements (NPSs) prepared by central government.

Following the change of government in May 2010, three significant changes were made to the new regime. First, the NPSs have to be debated and approved by Parliament; the six National Policy Statements for Energy were approved and formally designated in 18-19th July 2011. Second, all decisions are passed to central government; IPC Commissioners can only make recommendations. Third, the IPC was moved into the Planning Inspectorate (the body that considers appeals against the refusal of planning permissions) where it forms the Major Infrastructure Planning Unit (MIPU).

This regime for streamlining the consent process for major infrastructure projects is intended to enable the development of energy infrastructure for a centralised energy system. It covers nuclear power, renewable energy and power lines for the national grid, and is part of the way that the current governance system frames the energy system (Leach et al, 2010). However, this dominance of a centralised pathway is currently under challenge.

The emerging challenge of decentralisation in energy systems

Centralisation has not always characterised the UK energy system. While highly centralised energy systems embodied by large power plants have served the UK since World War II, a century ago the gas and electricity systems were small, localised and fragmented, each developing its own distinctive standards, technologies, degrees of municipal support, regulation and tariffs (GOS, 2008). Thus energy systems were quite decentralised until this ‘first era of decentralisation’ was ended by the advance of technology and mass production in the aftermath of World War II (Alanne and Saari, 2006).

A plethora of terminology has been used to date including ‘distributed generation’, ‘microgeneration’, ‘on-site energy’ or ‘on-site renewables’, ‘dispersed’ and ‘embedded’ (HMSO, 2004). ‘Decentralised energy’ thus is a term that is used to mean the generation and distribution of energy taking place within the boundaries of, or located nearby and directly connected, to a building, a group of buildings or a community. According to DTI’s technical definition, decentralised energy is defined by the technology used:

- distributed electricity generated by PV, micro-wind and micro-hydro technologies;
- combined heat and power (CHP) generation; and
- decentralised initiatives that provide heat such as biomass, solar thermal and heat pumps (DTI, 2006a).

Recently a range of policy measures have been put in place to encourage the take up of such technology (Rydin, 2010). The rationale lies in claims that decentralised energy systems can be more resilient and offer greater levels of energy security (Coaffee, 2008) as well as being more efficient, reliable and environmentally friendly (Alanne and Saari, 2006) and having become more affordable as technology markets mature (Roberts, 2008). The policy measures range from innovative local planning policies requiring on-site renewable energy generation on new developments and targeted subsidies for installation of new technologies, through to the introduction of the Clean Energy Cash-back (a feed-in tariff) and initiatives such as DECC’s Low Carbon Communities Challenge.

In 2006 the Microgeneration Strategy advanced the importance of micro-generation as ‘a realistic alternative or supplementary energy generation source for the householder, the community and small business’ (DTI, 2006b; see also: BERR, 2008; ENDS, 2006). The Strategy was supplemented by the Climate Change and Sustainable Energy Act (2006) which made provision for a greater number of heat and electricity micro-generation installations in the UK (HMSO, 2006). The Low Carbon Building Programme (2006-2010) provided grant support for technologies including PV, solar hot water, micro-wind, micro-hydro, heat pumps and biomass boilers, while the newer Community Energy Saving Programme (CESP) ‘required gas and electricity suppliers and electricity generators to deliver energy-saving measures to domestic customers in specific ~~lo-w~~low income areas of the UK’ from 2009 (Ofgem, 2009). Capital cost support was also available under the 2008 Carbon Emissions Reduction Target (CERT) which obliged energy suppliers to incentivise their customers to install energy-efficient measures, including microgeneration.

More recently the Feed-in-Tariff (FITs) and Renewable Heat Incentives (RHI) have been launched, paying the microgeneration system owner/ generator for the export of energy. Feed-in Tariffs (FITs) became available in the UK on 1st April 2010. Under this scheme the major energy suppliers have to make regular payments to householders and communities who generate their own electricity from renewable or low carbon sources such as solar electricity panels(PV), wind turbines, hydro-electricity, anaerobic digestion and micro combined heat and power (micro CHP). The scheme guarantees a minimum payment for all electricity generated by the system, as well as a separate payment for the electricity exported to grid. These payments are in addition to the bill savings made by using the electricity generated on-site. The scheme has been recently reviewed and cut-back because larger scale development – such as rural PV fields – were profiting from the financial incentives. The Renewable Heat Incentive (RHI) was launched in March 2011 and is designed to provide financial support to encourage switching from using fossil fuel for heating to renewable heat technologies, from household solar thermal panels to industrial wood pellet boilers.

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So it can be argued that the UK is experiencing today a 'second era of decentralisation'. The take-off of decentralised energy, however, can be considered slow in comparison to other countries such as Denmark, Sweden and Germany (Watson and Devine-Wright, forthcoming - Oct 2011, Wolfe, 2008, Woodman and Baker, 2008, Sperling et al., 2010). However, we need to understand much more about this wave of decentralisation and to do so we need a better perspective than is provided by a focus on the technology alone.

Using a co-evolution perspective to understand decentralisation in energy systems

A major barrier to fully understanding the centralisation/decentralisation of the UK energy system is the tendency to approach it largely in terms of the technology involved in generation and distribution (Pepermans et al., 2005; Ackerman et al., 2001). This misses the much broader nature of energy systems as the chain of energy production, conversion, transmission, distribution and consumption (Alanne and Saari, 2006). From this perspective, the issue of the (de)centralisation of energy is more wide-ranging involving different technologies, but also the institutions, policies and behavioural issues involved in energy demand and use (Watson and Devine-Wright, forthcoming - Oct 2011; Bergman and Eyre, 2011).

This tendency to discuss energy systems solely from a technological perspective has been specifically criticised by Guy and Shove, who argue that energy in the built environment has too often been cast in terms of techno-economic model of technology transfer(Guy and Shove, 2000). This is a linear model whereby pioneering research leads to pilot projects, which test economic assumptions and technical specifications; after ‘optimal performance’ is achieved, the ‘transfer’ or dissemination of technology is then encouraged on a wider scale. When the take-up on the broader scale fails, this is viewed as a barrier to technology transfer, rather than the combined effect of interrelated technological, economic, social and institutional factors in society.

We follow Guy and Shove in rejecting this model as too simplistic and instead favour a relational model where energy systems in the built environment context are understood from the perspective of complex interdependencies between different actors and their interests, and between technology and societal rules and values, the so-called socio-technological ‘assemblages’. The paper therefore draws from the literature of socio-technical transitions which conceives technology not simply as designed and engineered material objects, but as embedded components of socio-technical systems. According to Geels and colleagues, change in such systems ‘not only entail new technologies, but also changes in markets, user practices, policy and cultural discourses, and governing institutions’ (Geels et al., 2008).

Under such a conceptualisation, energy use and the development of urban energy systems cannot be understood merely as a series of changes in technologies and associated infrastructures, but as the outcome of ongoing interactions between technologies, political and economic frameworks, and human behaviour during which these different dimensions co-evolve. Co-evolution has become an important concept in a range of disciplines such as evolutionary economics, innovation studies, and industrial economics. It emphasises seamless webs, emerging linkages between heterogeneous elements and the co-construction of those elements. It is usually studied with regard to two or three aspects and is often used as 'a reminder to disciplinary scholars that more aspects are important than they actually study' (Geels, 2005b).

Co-evolution has been employed to describe the relationship between technologies or material artefacts and social relations/ practices, but also the relationship between specific technologies or material artefacts and more complex socio-technical systems generally (Shove, 2003). It has been used in a variety of contexts to refer ~~study~~ to the interdependencies between devices, systems and practices. For example, the 'Powering our Lives' Foresight report uses the co-evolution term to describe interdependencies between, political, economic and technological aspects of energy generation and use (GOS, 2008), while Brand (2005) offers a discussion from a co-evolutionary perspective of interdependencies in sustainable built environments (Brand, 2005). In a more specific example, Crosbie and Guy (2008) argue that lighting is intrinsically linked to cultural factors such as 'mood' and 'well-being', factors which need to be addressed when designing and marketing energy-efficient lighting. Furthermore, lighting choices made by householders co-evolve with the household lighting practices, themselves influenced by the media (Crosbie and Guy, 2008). Other authors have looked at the co-evolution of technology and society in the transition in water supply and personal hygiene (Geels, 2005a), the transition from sailing ships to stream ships in British oceanic transport and from piston engine aircraft to jetliners in American aviation (Geels, 2005b).

This paper therefore draws on this co-evolution perspective in order to understand the combination of technological, governance, economic and cultural factors that characterise urban energy systems. Furthermore, it draws on empirical research that was undertaken using this perspective. The rest of this section describes our method of data collection and analysis from a co-evolution perspective.

A co-evolution methodology

Our methodology for this research was based around the construction of a database collecting examples of UK urban energy projects, with the emphasis on finding as many different kinds of such project as possible. Inevitably we had more examples of some types of project than other. However this cannot be taken as an indicator that such projects were more numerous in the total population of urban energy initiatives. We did not attempt to gather a comprehensive catalogue of all such projects in operation. Rather this was a database of types of urban energy initiatives and we focussed on finding examples of new types of initiative not collected up to that point in the database.

The database was collated during October 2010 to January 2011 and the main sources were published documents and online material, supplemented by telephone interviews where necessary to gather more information about specific projects. A wide range of grey and secondary literature was consulted including local authorities websites, a number of databases including the Energy Efficiency Partnership for Homes database, DECC's CHP database and case studies from CABE, SDC, Urban

Design Compendium, Low Carbon Community Challenge programme and Sustainability Awards such as RIBA and Ashden Awards.

The database aimed to collect information solely on ‘urban energy systems’ defined as ‘energy initiatives’ located within an ‘urban setting’ or in ‘towns and cities with no less than 10,000 inhabitants’. ‘Energy systems’ were understood as defined above as the chain of energy production, conversion, transmission, distribution and consumption. The ‘initiatives’ were those with an element of collective action, whether organised by the public, private or third sector. Using this approach, we identified 181 projects in the UK.

The next stage was to understand the information collected about these projects from a, co-evolution perspective. We used the co-evolution approach in a pragmatic way to organise and structure this information into a ‘matrix’ of institutional, economic, social and technological features of urban energy initiatives. Each of the matrix’s main categories was further subdivided as follows:

- **Governance** was divided according to who led the project into local authority, private sector, third sector including community groups, NGOs or housing associations, and partnership counting formal agreements between public, private and third sector bodies;
- **Economic** looked at whether a subsidy was in operation, whether price regulation/feed-in-tariff was relevant, whether both forms of economic instrument pertained or whether there was no such reliance on an economic instrument;
- **Social** tabled information on whether there was an element of public awareness activity involved such as information provision, whether more

extensive and active public engagement was involved, whether both forms of public involvement activity were occurring or whether there was no apparent public involvement activity; and

- **Technological** information was collected on fourteen different types of technology[2] that were involved in these urban energy projects, however within the matrix the emphasis was on whether there was the inclusion of energy generation technology, technology oriented towards demand management or both; a category for recording the absence of any such technology was also included.

This approach allowed us to identify different pathways for urban energy initiatives, each with a distinctive combination of governance, economic, social and technological dimensions.

As we had four sub-categories under each of our four main dimensions, there were 256 (=4^4) possible combinations. However by using a sorting methodology to group initiatives into similar combination of the governance, economic, social and technological dimensions, the actual number of distinct combinations identified was much lower at 49. Mind-mapping software was used to illustrate these distinct pathways. In undertaking the sorting, we began with the governance dimension and then moved on in order to economic, social and technological. This affects how we present the pathways but does not affect the number of type of pathways that we identified. The following section analyses these 49 distinct pathways and this

[2] The 14 different types of technology were the following: air source heat pump (ASHP), biomass, combined heat and power (CHP), geothermal, ground source heat pump (GSHP), hydro, insulation, solar PV, solar thermal, waste, wind, anaerobic digestion (AD), aquifer thermal energy storage (ATES), community heating/ district heating (CH/DH).

provides a basis for the final section which discusses the implications for the planning system.

Multiple pathways in contemporary urban energy systems

An initial analysis of the complexity of the 49 different types of UK urban energy projects looked at the governance, economic, social and technological dimensions separately. This is illustrated in Figures 1-4. Figure 1 shows that there were relatively few (6%) of the identified project types were private sector-led. The majority were either led by a partnership (34%) or by a third sector organisation (34%), although over a quarter (26%) of the projects identified were local authority led.

[INSERT FIGURES 1-4]

Considering the role that different packages of economic instruments played, it is clear that subsidies dominated. There were 52% project types where subsidies were the main economic instrument used and another 18% where they were combined with price regulation or reliance on the feed-in tariff. There were though a fifth of project types where there was no discernable economic policy instrument involved.

Turning to the social dimension, public involvement was a major feature of urban energy projects. Just under a third of project types involved both public awareness-raising and more active public engagement and another 28% involved one or the other. However, some 40% of the project types did not involved any discernable level of public involvement.

Finally, looking at the involvement of technology in defining project types, energy generation technology was the focus on its own in 42% of projects types and in another 32% was involved in combination with demand management technology. Demand management technology was the focus on its own in 16% of project types and there were only 10% of project types that did not involve technology at all.

This emphasises the complexity and non-linearity of current urban energy pathways, well reflected by the co-evolution perspective and confirming the argument put forward by Geels et al. (2008). Co-evolution approaches advance a relational model where energy systems are understood from the perspective of complex interdependencies between different institutions, economic actors and their interests, and between technology and the public. Thus, the co-evolution frame of mind encourages us to look at the inter-relationships between the governance, economic, social and technological dimensions of urban energy projects and consider the different pathways that projects take in combining these dimensions in distinctive ways. The following section looks at these different pathways.

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We use the governance dimensions as the starting point. Which pathways come to prominence and which remain hidden, depends heavily on institutional or governance options (Leach, 2010). 'Alternative pathways' have challenged traditional 'centrally speared' governance mechanisms and 'opened-up' the arena for multi level and participatory governance, or coined novel models such as adaptive, deliberative and reflexive governance (Olsson et al, 2006; Dietz at al, 2003; Folke et al, 2005). Thus the remainder of this section is organised under the categories of our governance dimension. However, as the pathway diagrams in Figures 5-8 illustrate, there is much more complexity than is implied by this four-way presentation.

Local authority-led pathways

Looking at projects typified by the local authority-led pathways, three main patterns can be identified among the 13 pathways or categories of distinctive project combinations (Figure 5). First, there are a number of schemes where the local authority does not rely on any economic tools or any form of public involvement but simply invests directly in a range of technological options in pursuit of energy and financial savings. For example, Barnsley Council has installed a 500kW biomass boiler at its Westgate Plaza headquarters as part of its 'Econergy Initiative' with reported savings of over £500k p.a. for an initial additional capital cost of £132k (IctActive, 2010; NewEnergyFocus, 2008). Similarly the London Borough of Brixton has invested in a full energy-efficiency retrofit at its council estate in Angell Town, with the effect of halving energy consumption (Sustainable Homes, 2004).

[INSERT FIGURE 5]

Similarly – and this is the second pattern – there are local authority schemes that rely on the feed-in tariff as a form of regulation to support installation of energy generation technology but do not go beyond this to engage in any form of public involvement. A good example here is ~~This can be illustrated by~~ an Aberdeen Council initiative which installed a 1MWe Combined Heat and Power (CHP) unit in Seaton, Aberdeen to service four tower blocks of flats and a variety of leisure facilities. This was run by a council-owned not-for-profit company Aberdeen Heat and Power, which sold excess electricity back to Green Energy UK to finance the scheme (Green Energy UK, 2006; Kelly, 2008).

Third, we found local authority-led schemes that rely on subsidies and use this to support a range of different kinds of public involvement and a range of different kinds of technological applications, sometimes with use of the feed-in-tariff and sometimes not. Subsidies seem to support ~~innovative~~ innovation and flexibility in local authority action on urban energy and local authorities have used this to extend their involvement with local communities. The initiatives under the Greater London Authority's Low Carbon Zones fall into this category. For example, the Wandle Valley Project has installed PVs on local schools and free energy saving devices in 500 homes but also undertaken a range of low carbon education activities, including the recruitment of two Green Doctors, energy advice surgeries and a Climate Change Volunteers scheme (Merton Council, 2010; Groundwork, 2010).

Private~~-~~ sector-led pathways

Private sector-led projects cover private companies and businesses investing in decentralised energy in urban areas. It is notable that we identified only three pathways (Figure 6). Sometimes economic instruments were relied on and sometimes they were not but, in all cases, there was no public involvement activity and a tendency to focus on energy generation. For example, in Lyme Regis, Dorset, a private trust installed a micro hydro-electric system at Town Mill, partially funded by a Clearskies Renewable Energy Grant and the EDF Energy Green Fund (The Town Mill, 2010). Green Park Wind Farm in Reading is another example where a private developer, the Prudential, and the energy supplier, Ecotricity, invested in the installation of a 2MW wind turbine, selling energy to a business park and 1000 adjacent homes.

[INSERT FIGURE 6]

Third-sector-led pathways

Third-sector-led projects include initiatives headed by community groups, non-governmental organisations (NGOs) and housing associations (non profit associations which provide ‘social housing’). There were 17 types of such projects which fell broadly into two groups (Figure 7).

[INSERT FIGURE 7]

The first group involved the use of price regulation instruments, either on their own or with subsidies; these were associated with various forms of public involvement and energy generation technology, sometimes with additional demand management measures. For example, the Transition Streets Project in Totnes, Devon ~~have~~ has tapped into feed in tariff agreements by installing PVs on the local town hall. This builds on Transition Towns Totnes, a community-led initiative funded under the Government’s Low Carbon Community Challenge Programme. ~~This~~ It involves extensive public engagement through ‘Transition Together’, a behaviour change programme which is a pre-requisite for subsidised retrofits and low interest loans for PVs (Transition Town Totnes, 2009).

The second group involved either subsidies or no economic instruments but were again notable for the variety of different forms of public engagement and of different uses of technology; i.e. for the multiplicity of possible pathways. The Bristol Green Doors Project is led by a voluntary organisation and seeks to facilitate energy awareness and promote home retrofitting. It offers advice and publicises demonstration homes. Funding is received from some local businesses but not from the government (Bristol Green Doors, 2010).

These ‘third pathways’ showed considerable commitment to some form of public involvement, with 13 of the 17 pathways including public awareness and/or engagement activities. Energy generation technology also was a key motif with 12 of the third sector-led project involving such technology.

Partnership-led pathways

Partnerships are ‘joined-up’ or ‘multi-agency’ bodies providing leadership to a group of organizations. They usually include local public authorities such as local government and housing associations, local service providers, residents and community-based organizations and sometimes local businesses as well. The partnership project types fell into 16 different pathways which followed two main patterns (Figure 8). The first pattern involved subsidies, sometimes with the feed-in-tariff. As with the third sector-led projects, these were found to involve a variety of forms of public involvement and of technological possibilities. The second pattern involved a reliance on price regulation, sometimes with subsidies. These were also associated with different kinds of public involvement but always with investment in energy generation technology, either alongside demand management technology or on its own.

[INSERT FIGURE 8]

An example is provided by the Cirencester Energy Neighbourhood Project, which received European funding through the Intelligent Energy Europe Grant Fund to encourage energy saving through changes in behaviour. Households formed Energy Neighbourhood Teams and, under the guidance of an Energy Master, used a toolkit to monitor and reduce their consumption. The partnership here involved Cirencester Council, Severn Wye Energy Agency and two housing associations. Another example is the Sustainable Moseley Project in Birmingham, where partnership between community organisations, housing associations, schools and churches was leading a programme of PV installation and resident-led campaigning for behavioural change. Funding here came from the British Gas Green Streets Programme.

The 16 partnership pathways or project types included 11 pathways with some form of public involvement and 10 pathways integrating energy generation technology. Again the presence of subsidies seemed to galvanise partnerships to engage in a range of possible combinations.

The implications for the planning system

It is clear that there is considerable complexity in the current shift towards a more decentralized energy system. Following Geels et al. (2008), the way that un-locking is currently being pursued is resulting in a proliferation of pathways. This is particularly apparent if attention is drawn not just to the technology but also to the economic, social and governance dimensions of urban decentralization. Our co-evolution framework has shown that each decentralization pathway involves finding a specific combination of economic instrument, governance structure and public involvement strategy for a given technology. There is clearly considerably agency and discretion involved in challenging the lock-in to centralization. This is not just a matter of identifying and applying a given technology. Rather choices have to be made as to how to devise and support a combination of economic, social and governance features to enable the specific decentralization pathway.

This poses a considerable challenge to the planning system, one which falls to local authority planning rather than the centralised infrastructure planning regime outlined above. Centralised energy infrastructure implies a strong hand for national-level actors in infrastructure planning, as with the IPC/MIPU reviewing applications for major infrastructure against national policy statements and with decisions taken by central government ministers. Decentralised energy systems cannot be handled in such a streamlined way. As we have seen from a co-evolution perspective, the path to decentralisation involves many different twists and turns – technological options are not the only player in delivering decentralised urban energy, but also economic mechanisms, cultural factors and institutional arrangements. There are multiple possibilities and these involve demand management much more integrally with energy generation options. Central government cannot direct such decentralisation although it can seek to incentivise. The onus for promoting, delivering and coordinating urban energy decentralisation is therefore likely to fall on local government. We have again seen that local authorities are often involved in leading decentralisation initiatives or are involved in partnerships that are taking such a leadership role. But overall planning on an urban scale goes beyond individual initiatives of these kinds. How can the local authority plan for urban energy decentralisation?

Currently in the UK, much more emphasis is being placed on infrastructure delivery within local planning. This has been an element of local planning since the Local Government Act 2000 and the 2007 Local Government Act has reinforced this together with the 2008 revision of Planning Policy Statement 12. Spatial planning at the local scale is meant to proactively plan for infrastructure investment alongside new urban development and changing local demographic and economic needs. Such infrastructure is understood broadly to encompass transport, education and health services, as well as drainage, water supply and energy supply. The local planning documents within the Local Development Framework are supposed to consider the need for and cost of new infrastructure investment, link this to the phasing of new urban development and identify both funding sources and responsible delivery agents. It will prove challenging to link such an analysis to the bottom-up proliferation of different kinds of decentralised energy initiative that this paper has identified.

Furthermore, the current regime is intended to identify the financial gap between all committed infrastructure investment from public and private sources and to compare this with identified needs. The gap can then form the basis for setting a tariff on all new development known as the Community Infrastructure Levy (CIL). This CIL will be expected to form part of local planning documents and also support the local Infrastructure Delivery Plan. Again the number and variety of urban energy initiatives may make it much more difficult to cost infrastructure requirements or to reallocate the income from CIL to specific local schemes where needed.

The challenges of planning coherently for decentralisation that is being pursued through complex multiple pathways are considerable. First, there is the problem of achieving an overall coordinated plan when local planning is reacting to proposals from the private sector rather than directly initiating development schemes. To the extent that the private sector plays a major role in initiating and investing in decentralised systems, this can create problems of coordinating and managing the aggregate impact of many individual schemes. This is a problem that local planning has had to struggle with in the case of multiple small development schemes, where the aggregate impacts are not readily predictable. Tighter regulation can be a response but where there is a desire to promote development – as with developments incorporating decentralised energy generation – then there may be a tension between achieving a greater quantum of decentralisation and controlling the aggregate impacts. Such private sector schemes are also often limited to the development site and may not connect to other local energy schemes. Again the absence of an area-wide plan that is used to regulate new development proposals tightly is a problem in achieving such connections.

This may become more of an issue in the future given the reforms that are being proposed to the local planning system under the Localism Bill (likely to be enacted by the end of 2011). This makes provision for local communities, but also businesses to make neighbourhood plans which will then be implemented by neighbourhood development orders. Much commentary has focussed on the potential for NIMBYism in such neighbourhood planning but the scope for business-led plans and the inclusion in the Bill of a presumption in favour of sustainable development (understood in strongly pro-growth terms) means that private sector developments, including those with an energy dimension, are more likely to be approved under future planning.

Second, the analysis has shown how decentralisation of energy systems involves investment in demand management as well as energy generation technology. This has considerable implications as the extent to which demand management is successful will affect the desired capacity of heat networks and renewable energy generation schemes. It will also affect the balance between the demand for heat services (which can be reduced through insulation measures) and for electricity (where appliance use is important). The rebound effect – whereby energy efficiencies and therefore financial savings result in greater expenditure elsewhere, including on other energy consuming activities – may be quite significant and again alter the balance between heat and electricity. Given that decentralised energy supply options all have an optimal scale for technical efficiency and economic viability, these questions of neighbourhood demand are important to resolve.

Third, the impact of demand management initiatives is very difficult to predict since it depends on the effectiveness of public engagement activities. This is likely to vary with the nature of the initiative and the extent to which communities are directly involved. The analysis has shown the range of pathways involving public awareness and deeper engagement activities and the role that community groups can play, both leading initiatives and being part of partnership. Understanding the specific pattern of pathways that emerge in a locality will be part of understanding the impact of demand management measures and the implications for overall planning of local energy infrastructure.

It may be that the new infrastructure planning regime will favour local authority-led schemes in order to simplify informational requirements for planning and ensure the steady flow of funds into new decentralised urban energy schemes. However, the above analysis has shown that this is unlikely to be effective. The variety of decentralisation initiatives has considerable momentum behind it and it cannot be considered desirable to choke this off. The issue is how to plan effectively in the face of such variety in urban energy decentralisation and to ensure that the full benefits of such initiatives in terms of energy and carbon reductions are taken advantage of.

This throws the emphasis back on how local planning can effectively engage with a large number of decentralised energy stakeholders across the public, private and third sectors. Governance for decentralised urban energy will need to involve new collaborations between government institutions, private industry, civil society and the public, to generate more effective networks that will reflect the many complexities of achieving a transition to low-carbon energy systems (Scorse et all, 2009). It may be that emerging new models such as adaptive and reflexive governance will become more necessary. Adaptive governance is experimental in nature, seeking to built capabilities based on past experiences and a commitment to social learning (Olsson et al, 2006; Dietz et al, 2005; Folke et al, 2005). Such governance based on experimentation and innovation can be effective ways of allowing diversity to flourish (Rotmans et al, 2001).

Conclusion

While the current UK energy system is characterised by lock-in to centralisation, and major changes to the planning of energy infrastructure is continuing to support such centralisation, there is a challenge being posed by a range of policies and initiatives seeking to promote decentralisation. Using a co-evolution perspective and associated methodology, we have investigated the nature of current decentralisation initiatives in urban contexts. This has unpacked the variety and complexity of the pathways that urban energy decentralisation is currently taking and show how public, private and third sectors are initiating projects. It has shown the importance of key economic incentives such as the feed-in tariff, of the involvement of and engagement with local communities and the use of energy demand management technologies alongside energy generation from renewable sources. This complexity and variety has significant implications for planning, particularly at the local level.

While local planning has developed a regime for incorporating local infrastructure delivery into planning decision-making, it is likely to struggle in the context of multiple pathways promoted by diverse bodies. Coordination and anticipation of the aggregate effects of schemes will be a major challenge. This could be exacerbated by the active role of the private sector as an initiator of urban energy schemes linked to their developments. The role of demand management as an integral element of urban energy initiatives also creates complications as it makes the estimation of heat and electricity demand more uncertain; such estimations are essential to ensuring technically efficient and economically viable schemes. Demand management depends significantly on behavioural change and this, in turn, is supported by community involvement. Some urban energy pathways have significant community involvement while others do not. Here again the complexity of urban energy decentralisation makes it difficult to anticipate and plan for local infrastructure needs.

This implies that a major role for local planning will be to monitor the evolving nature of energy decentralisation in their areas, looking across public, private and third sector schemes and taking a broad view of urban energy systems as encompassing generation, distribution and consumption. Monitoring the scale, variety and complexity of these schemes and their implications in terms of heat, energy and electricity demand patterns will be necessary elements if local planning is to support decentralisation as effectively as it is trying to support continued centralisation.

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Figure 1 – Distribution of governance pathways in urban energy projects

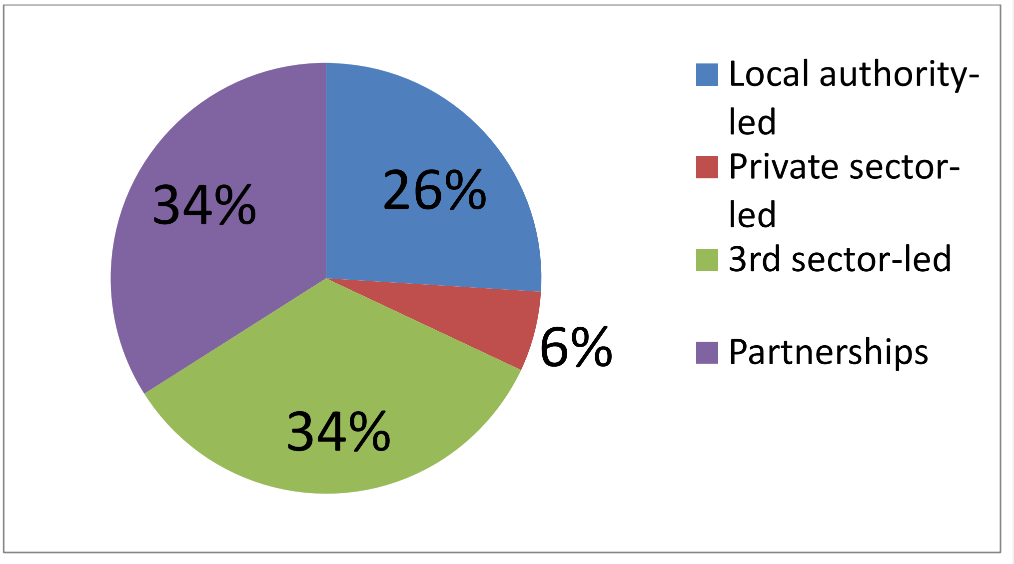

Figure 2 – Distribution of economic tools pathways in urban energy projects

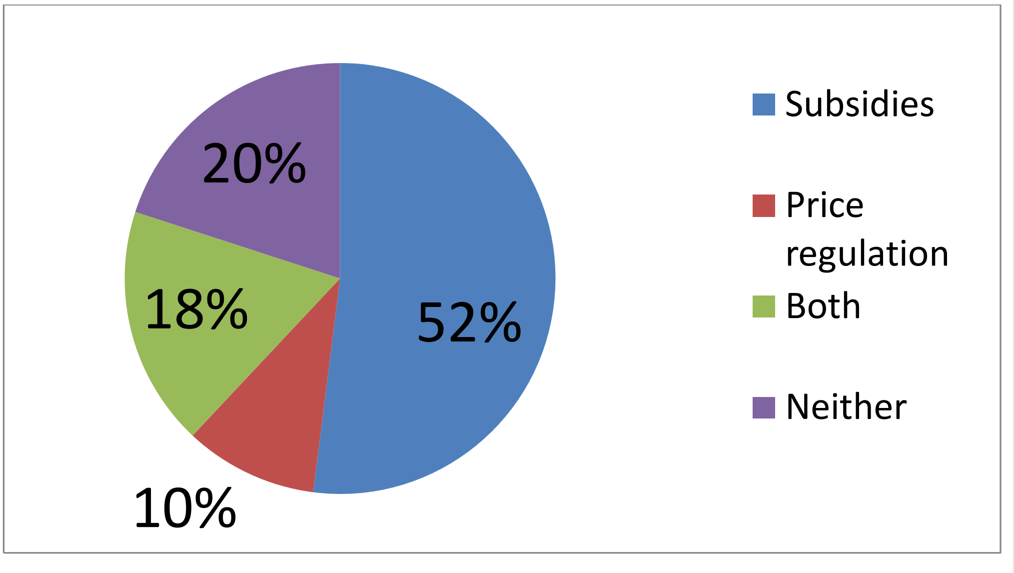

Figure 3 – Distribution of public involvement pathways in urban energy projects

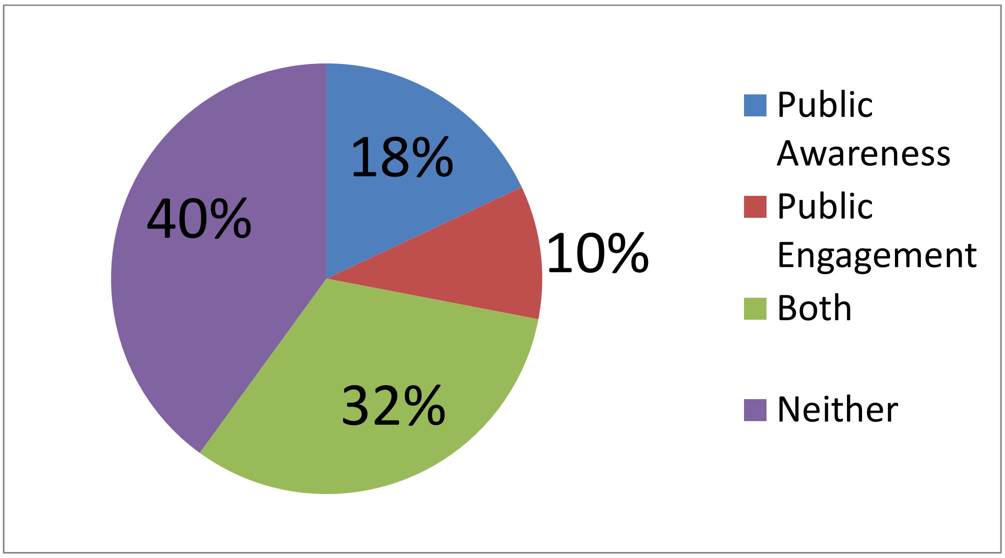

Figure 4 – Distribution of technological pathways in urban energy projects

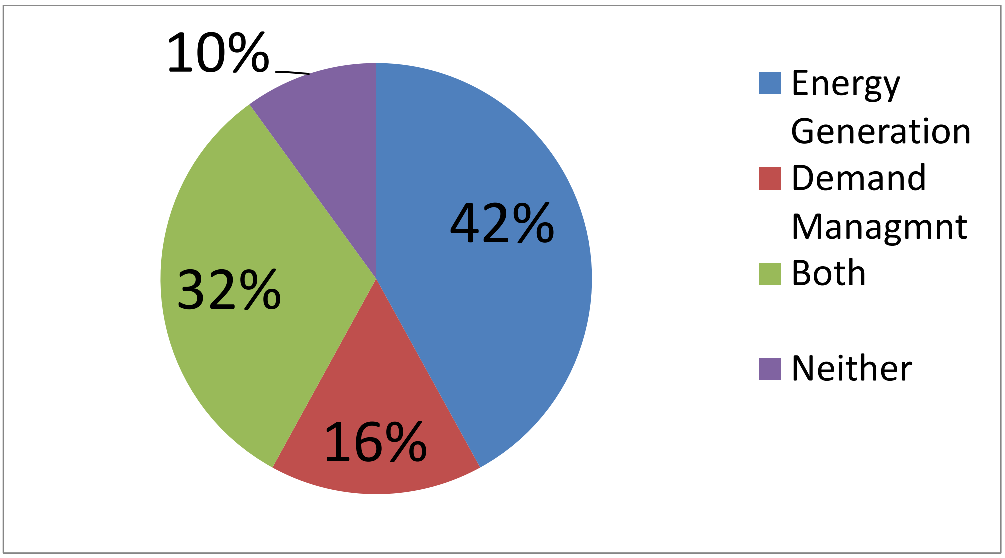

Figure 5 – Pathways of local authority-led projects

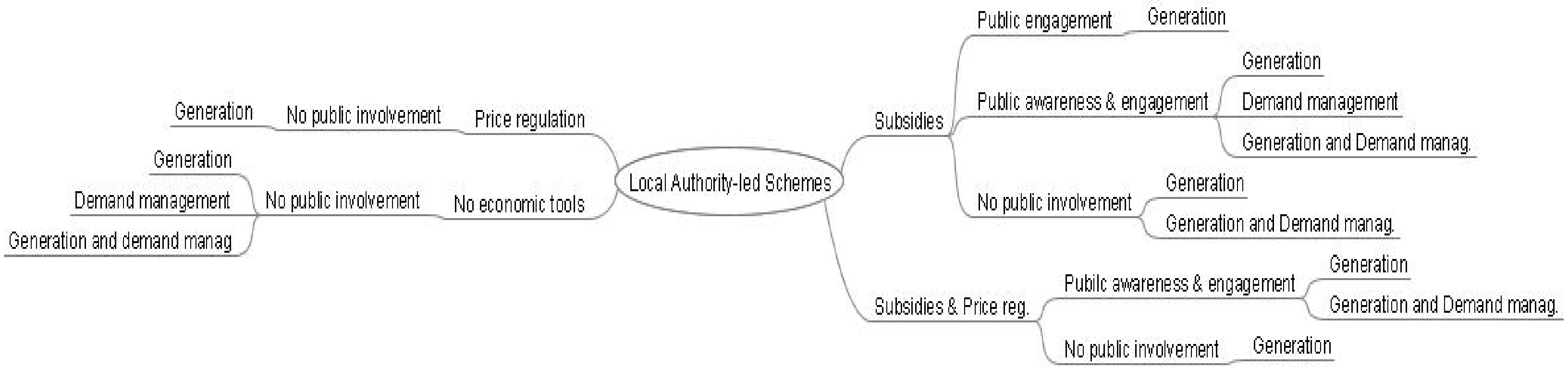

Figure 6 – Pathways of private sector-led projects

Figure 7 – Pathways of third sector-led projects

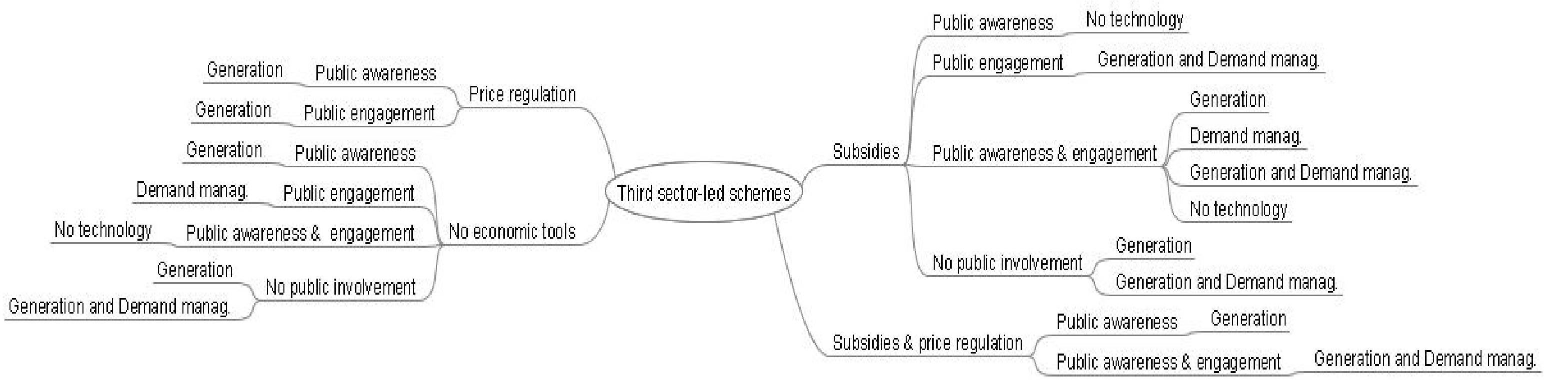

Figure 8 – Pathways of partnership projects