Urban energy initiatives: the implications of new urban energy pathways for the UK

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The existing lock-in to centralisation of the UK energy system is being challenged. The CLUES project explores the role of urban energy initiatives and the implications for carbon reductions.

The UK energy system is currently characterised by a high degree of centralisation both in terms of energy generation and distribution (GOS, 2008, Watson and Devine-Wright, 2011; Scrase and MacKerron, 2009). For example, there is only 5.9 GWe of combined heat and power capacity installed at present, which accounts for some 7% of the UK’s electricity supply (DUKES, 2012). Moreover, despite the recent expansion in on-site PV and solar thermal energy generation in the UK, such micro-generation remains a tiny proportion of the total energy production when compared to that of other European countries (EPIA, 2012). The limited use of such localised energy generation and distribution, which can make more efficient use of carbon-based fuel sources and/or utilised renewable sources, has implications for the carbon emissions of the current UK energy system.

In 2008 the UK Government Foresight unit published a report into sustainable energy management and the built environment (GOS, 2008) which used a futures approach to look at this issue of lock-in to centralisation within the UK. Based on scenario development and informed by an extensive range of state of science reviews (all available at http://www.bis.gov.uk/foresight), this report argued that the UK should make better use of the full energy spectrum. This paper reports on a follow-up research project (CLUES, i.e. Challenging Lock-in through Urban Energy Systems) funded by the UK Engineering and Physical Science Research Council (EPSRC) under Grant No. EP/1002170/1, and involving the Lead Expert Group from the Foresight project. This explored to what extent and in what way urban energy initiatives are currently challenging the lock-in to centralisation in the UK and changing the energy system.

The CLUES project (www.ucl.ac.uk/clues) has been undertaken between October 2011 and September 2012 by a multi-disciplinary consortium comprising six universities: University College London, Exeter, Loughborough, Manchester, Surrey and Sussex Universities. It posed two overarching questions:

* What is the contribution to carbon reductions at the national scale that can be achieved by the greater deployment of urban energy initiatives?
* What are the implications of this promotion of urban energy systems for change in urban environments to 2050 and for the sustainability of urban areas?

This paper provides a short summary of the key methods and findings of the CLUES project.

Developing new energy futures

A first step in the project was to develop the scenarios within the original Foresight report through a quantification exercise. This was to provide greater detail to the individual scenarios and to identify tensions and contradictions within the supporting narratives. It involved using the Tyndall Centre’s ASK carbon accounting tool (Bows et al., 2006; Anderson et al., 2008). While originally designed for backcasting, this was adapted for the more ‘exploratory’ approach in the CLUES project. The tool is not a model and does not include formulae or algorithms for economic relationships apart from energy intensity of GDP, which links economic output with energy consumption. It uses a decomposition analysis to iteratively explore changes in energy supply and demand and requires repeated inputs of key assumptions until supply and demand balance. Demand is disaggregated into 16 sectors (e.g. households, commercial) and supply into

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different technologies (e.g. coal, nuclear) and vectors (e.g. electricity, heat, hydrogen). The project teams used a wide range of published studies and empirical data to inform the quantification of each of these elements for each of the four Foresight scenarios. In addition, a stakeholder workshop was held to verify the inputs.

This provided a wealth of quantified material for each of the four (Watson and Rynikiewicz, forthcoming). The most significant outcome of the exercise was the identification of only two of the four scenarios with the potential to come close to meeting the 80% carbon reduction target for 2050 that the UK Government have committed to under the Climate Change Act 2008. These two scenarios were labelled 'Green Growth' and 'Sunshine State'. The former approximates to an ecological modernisation pathway and is widely recommended as an appropriate way to move towards a more sustainable future. The latter is the scenario with a substantial amount of decentralisation in energy systems.

The focus of the project was then concentrated on developing these two further into CLUES scenarios, currently labelled as 'centralist' and 'localist'. The assumptions involved in developing these scenarios extended beyond the energy systems by considering the socio-economic worlds within which these systems are situated. To enable comparison, the economic growth assumptions were brought into alignment and other assumptions were further refined. The impacts of the detailed assumptions were tested out with a panel of technological experts, resulting in further amendments. Insights from other elements of the project (the case studies reported below and a Delphi survey which sought to generalise from the case studies) were fed back into the scenario development. The project team is currently writing new narratives for these two scenarios, illustrating the possible urban futures that they involve. Table 1 below briefly outlines the main characteristics of the two scenarios.

The Localist scenario raises questions about how the transition to such a mixed centralised/ decentralised system will occur. The sheer scale of the roll-out of decentralised options needed under this scenario is staggering. For example, by 2050, 20 million roofs would need to be retrofitted with PVs; over ½ million on-site wind turbines installed; 4,000 small scale hydro-plants created; and over 100,000 combined heat and power installations delivered.

In both cases, it was clear that the outcomes were very sensitive to assumptions about international transportatio, both shipping and aviation. Very substantial carbon emissions were associated with even small percentage shifts in activity in these sectors. And, while the scenarios did not develop aspects relating to domestic transport in any detail, clearly these are closely related to the way that the built environment will change in the future.

**Mapping urban energy pathways**

Against this backdrop, the project sought to map what is currently happening in terms of urban level energy initiatives. It established a database of 182 such initiatives, seeking not to create a representative sample of projects but to collect information about as many different kinds of projects as possible. These were analysed by being clustered according to different mixes of technology, economic incentives, governance structures and public involvement. This produced 51 different pathways of technological and associated change into the future.

Such an analysis captures the sheer diversity of current change in urban energy systems. However, it also led to finding some common patterns: 74% of the distinct pathways involved subsidies or grants; 57% entailed no public...
involvement of any discernible kind; and 73% involved some energy generation technology. While pathways promoted by local governments, third-sector organisations or partnerships took many different forms, and among those initiated by the private sector there was much less variation (Turcu and Rydin, 2012; Rydin et al., forthcoming).

Diversity creates difficulties for local strategic planning of change in urban energy systems as there are multiple initiators of projects to deal with (Rydin et al., forthcoming). At the same time, individual projects are often very complex. Many involve assumptions of behavioural change in relation to technology use and energy demand; but such change depends on effective public engagement. The lack of such engagement or its limited effectiveness may constrain progress towards behavioural change, leading to lower carbon reductions than hoped for. This also suggests the need for mechanisms to promote knowledge exchange between projects to increase the benefits from the wave of experimentation that such diversity of projects represents.

Exploring UK case studies of urban energy initiatives

From the aforementioned database, nine case studies of current UK urban energy initiatives were selected for further study (Table 2). This research identified very diverse drivers with a lack of emphasis on reducing carbon emissions compared to, say, reducing fuel poverty, saving money or acting in conformity with biosphere values. There was little environmental monitoring.

The barriers to successful implementation were typically seen as social, followed by problems of governance and economic factors; technological problems were less commonly identified. Most projects relied on grant funding. Perhaps surprisingly for local initiatives, often promoted by community groups or with the involvement of community groups, increased public engagement was not always an outcome. Behaviour change was therefore less prominent than expected. However, it was clear that a supportive political and economic context was essential for success of such initiatives. But many ‘local’ projects were not strongly locally embedded. Many were pilots, with implications for their ambitions and notions of ‘success’. Scaling up often was not part of the project’s goals; if so, it was typically within the key organisation’s remit.

Exploring overseas case studies of urban energy initiatives

To compare current UK practice with examples of innovative practice overseas, four case studies were undertaken (Table 2). These case studies exhibited a variety of aims for investing in new systems. Financial viability was not essential in all cases, but having a reputation for ‘being sustainable’ was important; these were value-driven initiatives. Successful implementation was found to be related to previous involvement with stakeholders and support from local government. The latter was in contrast with many of the UK case studies. An interest in research and replication was also integral to all four cases.

While none of the cases above had a high dependency on or were instigated because of regulations, governance problems were perceived as a key barrier for replication. Social attitudes and the behavioural dimension were regarded as potentially problematic (as in the UK). Moreover, the policy emphasis in each of the four cases was on addressing potential financial and technological issues and policy makers were not really addressing issues of project governance and social engagement which, however, interviewees in each case had identified as important for their success.

Conclusions

Bringing the results of the scenarios and case study research together reveals that the UK is currently in a situation of exploring multiple possible pathways, particularly at the local level. This will inevitably change over time as some pathways fade away through national and local decision

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Table 1 | CLUES UK urban energy case studies
making. Strategic planning, especially local, is currently being challenged by these multiple pathways, as are the uncertainties, in terms of carbon outcomes, involved in relying on demand management as key elements within individual projects.

Yet rolling out greater decentralisation through urban energy initiatives in order to achieve anything close to 80% carbon cuts has been shown to involve a very radical shift for the current UK energy system. Such urban initiatives need to be locally embedded in terms of values, policy and institutional change, but this is currently not happening in the UK. This suggests that there needs to be more emphasis on fostering learning across local initiatives, especially where behavioural change is concerned. It also needs to be recognised that urban energy initiatives currently meet important non-carbon agendas, such as addressing fuel poverty or energy security.

While assessment of urban energy initiatives may seem to throw the emphasis back onto centralisation, where carbon reduction is concerned, the scenario analysis also made it clear that centralisation has its own uncertainties and risks. Ultimately the choice of future energy pathway(s) is one of policy and politics. 

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