



**Sustainable energy projects and the community: mapping
single building use of
microgeneration technologies in London**

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Sustainable Energy Projects and the Community: Mapping Single Building Use of Microgeneration Technologies in London

Abstract

Microgeneration technologies offer the potential for distributed energy supply and consumption resulting in reduced reliance on centralised generation. Adoption of microgeneration for use in community settings is usually understood as having a beneficial contribution to sustainable development. This is particularly relevant in urban environments which present specific challenges relating to the heterogeneity of building and land use. Small-scale installations in buildings also appear to offer technological flexibility at the ‘human’ level, necessary for local participation in shaping the direction of sustainable development. This paper reports on a project concerned with identifying on-site energy generation projects in Greater London. A database was compiled comprising renewable and energy efficient microgeneration installations in multi-occupancy buildings. The relationships between each project and its associated organisations are mapped as a social network, which illustrates the heterogeneity of technologies and actors involved, as well as the flows of funding and expertise. The structure of the resulting networks indicates a lack of participation by social or not-for-profit groups who are traditionally identified as community level actors. The findings indicate that large institutional actors on the supply side may become regarded as renewable energy experts.

Hence, there is a need to consider how the concept of community level actors in urban microgeneration projects is applicable to local government and commercial organisations.

Introduction

A number of commentators have taken a positive view of the potential for urban sustainability, regeneration and transformation. For example, Girardet (1992) points out that profound change to urban environments has taken place in the recent past, which has shaped the current situation, particularly in post-war slum clearance programmes. This he takes as evidence that strong urban leadership and clear policy initiatives can effect far-reaching change, but also stresses the role of social inclusion, and co-operation to facilitate changing living and consumption practices (Girardet 1992; 1999). Blassingame (1998) is also optimistic regarding the potential for cities to embrace radical socio-technical change, pointing out the past innovations in public health and environmental utilities such as the installation of sanitation systems, clean water supply and, more recently, recycling initiatives. In terms of the prospects for environmentally sustainable change, Brunet-Jailly (2008) reports on the success of Vancouver as a city committed to sustainable development through local participation and policies that are socially progressive but fiscally conservative, which he claims have given rise to an entrepreneurial civic culture. Hodson and Marvin (2009) assert the need to reconfigure resource use, infrastructure and services in a strategic manner to achieve urban sustainability. This, for example, would mean a reduction in dependence on large scale energy generation from outside the city to smaller scale internally generated power sources, echoing Girardet's point that urban energy use is one system of production and consumption that needs reform, as 'a combination of energy efficiency and clean energy technology is critical for the sustainability of our cities' (Girardet, 1992:23).

This paper questions whether such optimism is justified, especially in the larger cities and bearing in mind that energy used in existing buildings comprises almost half of the CO₂ emissions of the C40 group of cities (Arup, 2011). The C40 group includes megacities in

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3 countries having high GDP per capita, such as London, New York and Tokyo. It also includes
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5 megacities located in developing countries, such as Beijing, Mexico City, Mumbai and Rio de
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7 Janeiro and smaller cities in both developed and developing countries. The paper contributes to
8
9 one of the concerns of the C40 group, which is to learn about what actions are being taken with
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11 what impact by cities to respond to the challenges of climate change. As well as climate change
12
13 other important concerns for cities, and urban areas more generally, include economic
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15 development and 'green growth', social and economic inequality, health and community
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17 cohesion (UNEP, 2011). Crucially, celebrated successes have occurred in relatively small urban
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19 areas including less populated cities and towns (UNEP, 2011). Among these (and in relation to
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21 actions focused on energy and buildings) are Freiburg, Germany which has a population of less
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23 than 250,000 and Copenhagen which has a population of about 1.2 million.
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30 The adoption of microgeneration systems providing on-site electricity using renewable and
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32 energy efficient technologies could contribute to this positive environmental impact at a local
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34 level in very large as well as the smaller urban locations typically invoked as examples of best
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36 practice. The role of local community actors is often considered to be a key factor in the
37
38 adoption and institutionalisation of microgeneration. However, actors involved in
39
40 microgeneration projects do not necessarily fit the traditional profile of community action
41
42 groups. This paper raises the question of how far organisations involved in sustainable energy
43
44 projects which have an impact at the local level can be considered as *bona fide* community
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46 actors. Furthermore, it questions whether existing conceptualisations of community actions
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48 should be extended to embrace a wider set of actors.
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54 Some commentators argue that microgeneration is a particularly suitable means for reducing
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56 carbon dioxide emissions in urban environments (Blassingame, 1998), considering that energy
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3 use in domestic buildings represents up to half of the overall energy demand of cities (Kellert,
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5 2007). Bergman and Eyre (2011) consider the potential role of microgeneration in the UK
6
7 identifying advantages of small-scale on-site systems for domestic and community use.
8
9 However, in the UK diffusion of microgeneration technologies is at an early stage, and a
10
11 national policy to encourage adoption is a relatively recent development. At present adoption of
12
13 microgeneration technologies is dominated by solar panels, both in urban and rural areas. In
14
15 2013 there were an estimated 520,000 micro-generation installations in the UK, with photo-
16
17 voltaic panels contributing 400,000 of the total units. This capacity provides a miniscule 0.2%
18
19 of energy supplied to households (Balcombe et al, 2014). Referring to the situation in Denmark,
20
21 Marszal et al (2012) suggests that, in dense urban areas, on-site use of renewable energy
22
23 technologies may be limited to PV panels or micro-CHP. Hinnells (2008) also points
24
25 particularly to the growth of micro-CHP units in urban areas, although there are as yet very few
26
27 small installations based on biomass.
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34 The paper undertakes analysis of a focal urban site, Greater London, to probe the nature of city-
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36 scale energy policies and community participation and how these are connected with the
37
38 diffusion of sustainable technologies for energy generation and demand reduction. The study
39
40 identifies and characterises urban energy projects therein and employs social network analysis
41
42 to identify actors and relationships pertaining to the realisation of the projects. The resulting
43
44 analysis gives an indication of the pattern of diffusion of these technologies and reveals the
45
46 heterogeneity of actors involved. These results raise questions relating both to the nature of
47
48 sustainable change in urban areas and to the particular contribution at the local level that can
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50 accrue from adoption and diffusion of microgeneration technologies.
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3 The paper is organised as follows. Section 2 reviews relevant literature, and is split into a
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5 discussion of prior research on community energy projects and then of sustainable cities and
6
7 urban energy policy. Section 3 outlines the methods employed for data collection and analysis.
8
9 This elaborates the approach taken to compiling a database of community energy projects in
10
11 Greater London, as well as to apply social network analysis to the identification of pertinent
12
13 organisational actors and relationships among them. Section 4 discusses findings from the
14
15 study, set in the context of related previous work and UK and Greater London microgeneration
16
17 policies. Section 5 concludes the paper, drawing together its various strands whilst making
18
19 suggestions of relevance to urban and national sustainable energy policy and the promotion,
20
21 design and management of community energy technology projects. It reflects on the
22
23 implications of the paper for future research on urban community microgeneration.
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30 **2 Literature Review**

31 2.1 Community energy projects

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34 A review of community projects undertaken between 2004 and 2006 indicated that
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36 representatives of different projects using the word community interpreted the term in different
37
38 ways (Walker and Devine-Wright, 2008). Based on this data, the authors develop a
39
40 classification of community energy projects according to two dimensions: process and outcome.
41
42 The process dimension refers to project management, what types of actors are involved and
43
44 their influence. The outcome dimension considers both the spatial and social character of the
45
46 results of the projects: To what extent do ‘community’ benefits associated with local energy
47
48 projects actually accrue to ‘the community’?
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54 A classification of community energy projects

55 **Insert Figure 1 Here**

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3 Walker and Devine-Wright (2008)
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10 There are a number of observations to be made in relation to community energy projects and
11 the Walker and Devine-Wright classification of them. First, as Walker and Devine-Wright
12 (2008) say, the concept of ‘community’ should not be taken for granted. Rather, ‘community’
13 refers to ‘a network of people with common interests and the expectation of mutual recognition,
14 support and friendship’ (Barton, 2000: 5). These interest communities often have little to do
15 with locality (Barton, 2000). Further, energy projects may be distinguished as community
16 ‘based’, ‘led’, ‘set up’ or ‘operated’. In NESTA’s ‘Big Green Challenge, 320 ‘community-led’
17 applications included a number which were led by professionals, some that were geographically
18 bounded, and projects with a variety of target audiences, young people for example, some of
19 which were only indirectly connected with the applicant groups (NESTA, 2009).
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35 Secondly, the participatory dimension of urban energy projects may be undermined by state and
36 local government actions, as well as by the ‘local struggles’ that citizens have. Indeed, while the
37 state may offer ‘structural’ (e.g. financial) incentives conducive to mobilisation of community
38 energy, the effect of doing so may be ‘offset’ by entrenched political interests and ‘closed’
39 policy-making practices and processes (Bomberg and McEwen (2012). Rather, greater attention
40 to ‘symbolic resources’, such as the need for shared identity and community self-reliance, may
41 provide a more effective basis for promoting community energy initiatives. Evans (2007)
42 suggests the need for qualitative analysis of values and culture, which may be central to
43 community identity, cohesion and action relevant to urban energy initiatives. Previous work
44 indicates the need to identify social networks, social capital and capacity dimensions of
45 community organisation (Peters and Jackson, 2008) and to specify what community energy and
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3 sustainability projects need to flourish and the relationship of this to agency (NESTA, 2009;
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5 Smith et al, 2005).
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10 Thirdly, it is assumed that ‘the public’ are necessarily interested in taking an active role in
11
12 urban community energy projects. Rogers et al (2008) found that members of the public
13
14 perceived the benefits of community-based renewable energy in positive terms, connected with
15
16 the conservation of natural resources and building of community spirit. However they also
17
18 observed that, overall, citizens saw themselves as ‘consultees’ rather than ‘project leaders’ of
19
20 community energy projects. In addition, the role of business actors in community energy should
21
22 be considered: evidence from a research project in Scotland (Island of Lewis) suggests that the
23
24 distinction between small scale community owned projects and those driven by private,
25
26 corporate concerns is not clear (Murphy and Smith, 2013).
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32 Finally, it should be noted that the dimensions included in Walker and Devine-Wright’s (2008)
33
34 framework do not address the technical characteristics of community energy projects but the
35
36 social arrangements regarding their ownership and management. However, the co-construction
37
38 of the social and technical characteristics of community energy may need to be reconsidered,
39
40 which is a core task of the paper.
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43 44 2.2 Sustainable cities and urban energy policy 45

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47 In terms of energy policy local actions might not integrate well with different levels of policy
48
49 objectives. There is a need to examine whether energy policies differ between national and
50
51 urban levels and how cities can contribute to global policy goals (Keirstead and Schulz, 2010).
52
53 Community renewable energy has been positioned as an integral part of UK energy policy, with
54
55 schemes such as the Community Renewables Initiative providing funding and support towards
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57 this goal (Walker et al, 2007). The increasing prominence of the term suggests a shift from
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3 large-scale centralised energy systems (Devine-Wright, 2007) as microgeneration and
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5 community energy schemes substitute for insufficient, ineffective state efforts. Indeed, in
6
7 relation to renewable energy, cities have been described as “islands of opportunity in seas of
8
9 decay” (Nijkamp and Pepping, 1998:1481), since administrative coherence, interest in resource
10
11 and environmental issues, and the co-location of energy production and consumption make
12
13 cities ideal sites for the evaluation of energy policies.
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18 Guy and Marvin (1999) contrast ‘singular’ and ‘multiple’ visions of the sustainable city, where
19
20 the former relies on overcoming barriers to implementing policies designed in City Hall and
21
22 ‘policing’ to monitor the attainment of targets set ‘top-down’. Multiple visions, however, rely
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24 on partnership and the development of coalitions of interest with a range of participants across
25
26 the city. With particular regard to local authorities,, Bulkeley et al (2011) observe that in the
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28 UK local governments are becoming more self-sufficient in using natural resources, and adept
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30 at utilising local knowledge to inform policy-making. They are also engaging in cross-national
31
32 networks, which enable them to learn from others about how to improve local policies for
33
34 sustainability. Kellert (2007) blames the failure of top down policy instruments and resistant
35
36 markets for a slow move away from fossil fuel use in cities that are characterised by high-
37
38 energy use and low energy production. Jänicke (2008) supports the use of strong environmental
39
40 regulations to act as a driver for innovation by setting out a set of achievable standards. For
41
42 Jänicke (2012) clear policies can promote market development for environmental innovations
43
44 by improving the operational aspects of installed technologies, for example from setting and
45
46 gaining compliance to technical standards. Janicke points to the variation in national success in
47
48 changing practices in energy generation and use as a result of differing emphasis in national
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50 policies. Blassingame (1998) also states that renewable energy generation and increased energy
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52 efficiency measures are equally achievable provided there is a coordinated strategy for change.
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3 These points are supported by Hinnels (2008) who asserts that microgeneration diffusion
4 requires a mix of clear policy objectives, innovation market development and financial support.
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10 Despite these thoughts regarding the ability of the self-governing, participative city to enact
11 environmentally sensitive changes, the role of specific urban energy policies tends to be
12 overlooked despite the fact that cities account for two-thirds of global primary energy
13 consumption (Keirstead and Schulz, 2010). In the UK there is no single national policy which
14 covers on-site microgeneration technologies. The defined capacity of micro-generation
15 technologies is stated in the UK Green Energy Act, 2009. Small power generating systems are
16 those that generate up to 50 kW of electricity and 300 kW of heat. The Department of
17 Environment and Climate Change (DECC) 'Energy Roadmap' states the objective that 15% of
18 energy consumption will be provided by renewable sources by 2020. This objective is to be met
19 through provision of low-carbon electricity from a range of sources, in addition to reduction of
20 demand through energy efficiency measures DECC (2011). There are a number of micro-
21 generation technologies that could contribute to this mix, including photovoltaic panels (PV),
22 solar thermal heating, micro-turbines, biomass boilers, micro-combined heat and power (CHP)
23 and ground and air heat pumps as technologies currently suitable for individual dwellings
24 (Bergman and Eyre, 2011). However, the UK feed-in tariff which compensates for electricity
25 supplied to the National Grid from micro-generation has favoured the installation of
26 photovoltaic panels in the UK. A national strategy to encourage diffusion of microgeneration
27 technologies was published in 2011 (DECC 2011). Amongst the issues identified in the
28 Microgeneration Strategy is the need to strengthen the existing Microgeneration Certification
29 Scheme (MCS). Also necessary are moves to improve consumer protection policies, and the
30 need to support training, knowledge and skills within the industry to meet increasing demand
31 for small unit installation. In addition, the need for continued technological innovation was
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3 noted, along with the need for initiatives to raise awareness of potential customers to the
4
5 available opportunities. A recent government report on UK community energy strategy
6
7 discusses the role of communities as producers of heat and electricity as well as community
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9 involvement in reducing energy use, demand management and energy purchasing (DECC
10
11 2014). At the regional level in London, the Greater London Authority (GLA) and various local
12
13 boroughs have adopted targets for the adoption and use of onsite power generation
14
15 technologies. The Mayor of London (2013) notes the commitment to work towards making
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17 London a thriving low carbon capital, with a target of 25% of energy supply to be achieved
18
19 from distributed sources by 2025. The current London Plan (Mayor of London, 2011), has a
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21 target of 20% of energy in new build to be generated from onsite renewable or through energy
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23 efficiency measures.
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30 **3. Research methods**

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32 This section outlines the research methods employed in the present study. The study aims to
33
34 identify patterns in the diffusion of community energy and microgeneration technology in urban
35
36 locations. The site of Greater London is selected because its decentralised governance structure
37
38 helps to examine how policy initiatives at different levels contribute to urban micro-generation
39
40 viz national level policies, and policies developed at the metropolitan level and by individual
41
42 boroughs. Furthermore, the plurality in fuel sources and energy conversion technologies found
43
44 in London micro-generation projects makes it an interesting site to examine variation in urban
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46 community energy initiatives. Micro-focused engagement or project-specific case study
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48 approaches would not be suitable for meeting the project aim. Surveys of community energy
49
50 actors may allow for comparisons between projects and point to factors affecting the success of
51
52 renewable technologies. Unlike case studies, surveys may provide an overview of community
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54 energy in a particular geographical setting or focus on a particular renewable technology.
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3 However, unlike surveys (c.f. Seyfang et al, 2012; Walker et al, 2005), this study adopts a
4 relational perspective, employing social network analysis (SNA) to examine Greater London
5 community energy projects and associated actors. Emphasis is placed on the links between
6 technologies, projects and different types of organisational actors and how these enable
7 knowledge sharing. The use of a relational, network approach bypasses the dichotomy between
8 qualitative case studies and quantitative, survey-based methods (Cambrosio et al, 2004). The
9 relational approach advocated is an alternative to both qualitative, ethnographic studies of
10 community energy projects and to survey-based approaches.
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23 Microgeneration projects may be supplemented by energy demand reduction initiatives at the
24 community level (DECC, 2014). However, this study refers to energy demand reduction only in
25 cases where such activities are combined with a microgeneration project. Data regarding the
26 current status of community energy microgeneration projects in London were collected from
27 publicly available sources, such as planning applications to local councils, company documents
28 and the DECC website. Social network analysis methods were then applied to the visualisation
29 and analysis of the data; large amounts of qualitative information about the actors and their
30 relations were summarised in the graphical format of network maps.
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43 Fundamentally, SNA is employed to address the following research questions:

- 44 1. What community and microgeneration renewable energy technology projects are being
45 undertaken in Greater London?
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- 48 2. What actors are involved in such activities, why and with what effect? To what extent and
49 how are actors and projects connected and with what implications for promotion and diffusion
50 of community and microgeneration renewable energy technology projects?
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- 54 3. What is (or what should be) the role of residents and community actors in such activities?
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3 The methodology includes the following stages:
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- 5 • Identification of community energy projects and related organisational actors in the
6 metropolitan area of Greater London
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- 9 • Classification of both the projects and the associated organisations
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- 11 • Construction of network databases noting the links between organisations and projects
12 and visualisation of the resulting networks
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- 15 • Analysis of the networks in order to identify the degree of cohesion and heterogeneity,
16 and indicate organisations/projects holding prominent network positions.
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23 According to the socio-spatial concept of an area (Murphy and Smith, 2013) the selected
24 projects were Greater London-based: although some installations are not located physically
25 within the Greater London geographical boundaries, their energy source may be a by-product of
26 Greater London-based activities (as in the case of some waste management projects). Following
27 Callon (1992) actors may be defined empirically. A database of projects was constructed using
28 non-obtrusive methods of data collection relying mostly on publicly available data (e.g. from
29 the Department of Energy and Climate Change, the Renewable Energy Association and local
30 authorities). Information from planning applications was used to describe the current state of
31 various projects. Organisational actors associated with the projects were subsequently identified
32 on a basis similar to that of a snowball method (Heckathorn, 2002): organisations were included
33 in the network only where there was a defined link with an already identified project. Hence,
34 community energy projects are the primary units of analysis or the actors that one follows to
35 map the Greater London community energy landscape.
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54 Arguably, a different representation of the network may have emerged if organisations had been
55 selected as the primary points of analysis instead of projects. Network boundaries are
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3 problematic to identify and there is inevitably a degree of subjectivity in their selection. Unlike
4
5 systems, networks are in principle unbounded, yet it is necessary to specify limits for analytical
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7 purposes (Conway and Steward, 1998). First one has to decide the rules of inclusion in the
8
9 network or as termed by Laumann et al (1983) “the definitional focus”. In this case, projects
10
11 were selected according to geographical location (Greater London), evidence of renewable
12
13 energy use and their generating capacity (small to medium). Since the term community energy
14
15 is subject to interpretation, projects were not included solely because they demonstrated
16
17 evidence of community engagement. Indeed DECC (2014) suggests that the definition of
18
19 community energy may be expanded to include projects instigated by local authorities, housing
20
21 associations or local businesses. We would not claim that the aforementioned rules of inclusion
22
23 provide a definitive account of community energy in Greater London. Adopting different
24
25 criteria regarding the selection of projects would lead to the enactment of alternative realities:
26
27 realities and their representations are not independent of the research process that generates
28
29 these representations (Law, 2004). In that sense, interpretations of the term “community
30
31 energy” affect the definition of the questions, while the term itself is subject to redefinition in
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33 the light of analysis and findings produced.
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40 Both the organisations and the projects were classified according to certain criteria. The
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42 organisations were categorised according to their organisational type (businesses, local or
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44 central government actors and civil society organisations such as community groups). In
45
46 addition, organisations are classified in terms of their relation to the projects: they can be linked
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48 to a project as funders, as clients/users of the generated energy or as technology developers.
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50 Information on the power generation capacity of the projects was added where available.
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52 However, information on the energy generating capacity was in some cases either missing or
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54 unclear since different sources provided different estimations. Information is also available on
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3 the intended energy use (domestic or office use; heat, power or both). The projects are
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5 classified according to a combination of energy source and energy conversion technology. The
6
7 classification leads to the following categories of projects:
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- 9 • Solar energy (power or hot water generation)
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- 11 • Wind turbine
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- 13 • Geothermal energy
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- 15 • Landfill gas or biomass anaerobic digestion (biological rather than thermo chemical
16
17 energy conversion)
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- 19 • CHP (using biomass or waste)
- 20
- 21 • Biomass or waste incineration
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- 23 • Hydro energy
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- 25 • Hybrid projects (e.g. combining PV panels and a wind turbine)
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32 SNA was employed to examine characteristics regarding technology diffusion. The concepts of
33
34 homophily and heterophily were applied to demonstrate how the characteristics of network
35
36 actors affect the potential for innovation. Homophilous networks where actors share the same
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38 attributes are more likely to lead to standardisation **in technology choices**, while participation in
39
40 heterophilous networks is more likely to expose actors to new ideas. Ideally, a balance between
41
42 homophily and heterophily should exist in order for a network to be effective in nurturing
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44 innovation (Callon, 1992; Granovetter, 1985), though increased homogeneity and
45
46 standardisation are likely to exist in a denser, more cohesive network (Granovetter, 2005). Here
47
48 the role of homophily versus heterophily in the network of organisations is evaluated by
49
50 counting the number of external ties (between organisations of the same type) minus internal
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52 ties (between organisations of different types) as a proportion of all ties in the network (**the E-I**
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54 **index measure** by Krackhardt and Stern, 1988). **Hence, the value of the E-I index is -1 in a**
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3 **network dominated by internal ties.** In terms of the network of projects and actors involved in
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5 community energy in Greater London, the co-existence of multiple technologies and actors of
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7 different organisational characteristics is used to evaluate the level of heterogeneity; however,
8
9 heterogeneity is not seen as an obstacle to the diffusion of sustainable energy technologies.
10
11 SNA techniques were applied to identify potential sociotechnical trajectories by observing the
12
13 structural pattern of network relations. Subsets of the aggregate network that are characterised
14
15 by increased levels of cohesion suggest that actors within the same subset are more likely to
16
17 share expertise and share similar views on the implementation of community microgeneration
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19 (Burt, 1992; 2004). The approach taken here identifies network ‘components’, in other words
20
21 subsets of a network where there is at least one path of links that connects any two given nodes
22
23 (de Nooy et al, 2005). Finally, network centrality measures are used to identify actors that hold
24
25 more influential positions. These actors are positioned as gatekeepers in the flows of expertise
26
27 and funding in the aggregate network, which can act as bridges between actors and effect
28
29 collective action (Moss, 2009). Hargreaves et al (2013) suggest that community energy
30
31 intermediaries deploy diverse ways in diffusing generic lessons from projects developed in
32
33 specific contexts. Betweenness centrality analysis was used to identify central actors as this
34
35 centrality measure is more suitable to identify actors with the potential to act as mediators
36
37 (Knoke and Yang, 2008).
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48 **4. Microgeneration and community energy projects in Greater London**

49 *Projects, Networks and Actors*

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51 The secondary research identified 93 microgeneration projects in Greater London
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53 (approximately within the area bounded by the M25 orbital motorway). Each project is linked
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55 to a number of organisational actors. 86 of the projects were included in the analysis; projects
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3 were excluded if proposers did not gain planning permission, withdrew their planning
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5 application or abandoned projects. The resulting database includes only operational projects and
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7 projects awaiting construction. Initially, a bipartite network was constructed that includes both
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9 projects and organisational actors: the bipartite network only includes links between
10
11 organisations and projects. The visualisation does not distinguish between the types or strength
12
13 of the linkages between organisations and projects; only the presence or absence of a linkage is
14
15 indicated. For reasons of visual clarity, only network components with at least four nodes
16
17 (organisations or projects) are included.
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23 Figure 2: London community energy projects and linked organisations
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25 **Insert Figure 2 here**
26

27
28 Key: White circles=projects, black squares=organisations
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33 The network is divided into different components. A number of major actors in some
34
35 components are highlighted in Figure 2. Communication and exchanges between organisations
36
37 in the same component are possible even if the actors are not involved in the same projects. On
38
39 the other hand, interaction between actors in different components is not possible on the basis
40
41 of the linkages that have been mapped in this network. Yet, the network represents concrete
42
43 evidence of involvement in particular renewable energy installations: there is the possibility that
44
45 actors in different components may have forged looser, more informal linkages through
46
47 alternative networks.
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53 The participation of utility companies (Veolia, Thames Water) is observed in two of the
54
55 components. These companies are involved in fairly large-scale projects in terms of capacity.
56
57 The network component including Veolia (top left in Figure 2) demonstrates the company's
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2
3 involvement in a number of projects (including landfill gas, energy from waste and CHP). Their
4
5 involvement in the South East London Heat & Power (CHP) plant provides a bridging link to a
6
7 number of projects involving boroughs in South East London. Thames Water (mid left side) is
8
9 also involved in CHP, but also in solar and wind energy projects.
10

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13
14 Other network components include retailers (IKEA, Sainsbury's) and local councils, which
15
16 have a strong presence. However, participation of Greater London-wide or central government
17
18 organisations is more limited. Regarding the involvement of corporate actors, Ford has invested
19
20 in wind turbines and biomass/waste incineration in its Dagenham plant in partnership with
21
22 organisations that could provide technical expertise (lower right side in Figure 2).
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26
27 The bipartite network provides more detailed information on the current state of community
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29 energy in London; however, the identification of patterns is better achieved through the
30
31 examination of two separate one-mode networks: the network of projects and the network of
32
33 organisations. In the visual representations of these networks the strength of the link between
34
35 two organisations represents the number of projects they are jointly involved in. Similarly,
36
37 projects are linked when they both have links to the same organisations. Figure 3 includes the
38
39 network of organisations.
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43 Figure 3: London community energy actors

44 **Insert figure 3 here**

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46 Key: circles=business actors, square=central government, boxes=local government,
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48 triangles=civil society
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54 There is a dominant presence of business actors in the network of organisations and very
55
56 limited presence of civil society actors (Riverside community, Bioregional, **Brixton Energy**
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3 Coop), that one would expect to have a co-ordinating role in community energy projects.

4
5 Businesses are involved both as technology developers (for instance, engineering and
6
7 architecture firms) but also as users of community energy. There is a strong presence of local
8
9 government actors (22 organisations); it is arguable that the presence of local government
10
11 serves a function in promoting/financing community energy that one would expect community
12
13 groups to fulfil. It is evident from the visualisation that particular actors/links play a mediating
14
15 role in components of the network. Still, some components are too small to have any significant
16
17 influence.
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23 With regard to issues of homophily and heterophily the data indicate that there is a tendency
24
25 towards internal ties (homophily) to a degree that is slightly higher than expected for a network
26
27 of this size and group composition: the observed E-I index is nearer the value of -1 than would
28
29 be expected in a random network. This results primarily because business organisations, which
30
31 dominate the network, tend to link to other businesses. Government (national and local) and
32
33 civil society associations are more likely to form out-group ties, usually with businesses.

34
35 Although the network is fragmented into components there is evidence of cohesion at the local
36
37 level as transitivity is high: when two actors are linked to the same third actor, they will be
38
39 directly connected themselves in 67.43% of cases.
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41
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44
45 A number of actors with high betweenness centrality are identified (such as EDF, Vital Energi,
46
47 LB Southwark) however their role is limited to their respective components. Hence, network
48
49 centralisation (the dependence of the network on particular central actors) is very low.

50
51 Since the network is disconnected there is a lack of intermediaries at the global level. This
52
53 observation is consistent with the view that there is a lack of centralised mechanisms for the
54
55 implementation of community energy policies.
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The network of projects is represented in Figure 4 but does not include isolated nodes (unconnected projects). Here, there is a strong presence of CHP technology (up triangles-24 projects) and solar energy (PV panels) installations (circle nodes-19 projects).

Figure 4: London community energy projects featuring technologies

Insert figure 4 here

Figure key

| | |
|----------------------------|-------------------|
| Biomass/waste incineration | Inverted triangle |
| CHP | Triangle |
| Geothermal | Cross |
| Hybrid | Circle in box |
| Landfill gas or AD | Diamond |
| Solar | Circle |
| Wind | Square |

The number of CHP projects indicates a potential pathway towards this technology although there are limited links among projects of this type. One component of the network includes the projects financed by Thames Water. Another component includes a set of anaerobic digestion projects (diamond shaped nodes-16 projects) using landfill gas. The literature review suggested limited uptake of biomass yet it appears that anaerobic digestion/biogas projects are more established than predicted. The incentives behind these projects may relate mostly to concerns about appropriate methods of waste disposal (other than landfill) than with energy issues.

Regarding the role of isolated projects these can only have limited effects on the evolution of the network since they lack links to other projects. Although the actors involved in such a project exchange expertise and resources, they cannot benefit from experience developed in other projects. It could be the case that some of these actors are involved in non-London based projects. Even so, they would lack access to information about the particular requirements of

1
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3 microgeneration in Greater London. As outlined in earlier sections, there are particular policy
4
5 issues regarding sustainable energy in an urban environment.
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10 Like the network of organisations, the network of projects also indicates high transitivity
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12 (55.96%). Although the overall network is disconnected there is potential for knowledge
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14 exchange at the local level. In addition, analysis of the prevalence of in-group versus out-group
15
16 ties shows that projects are more likely to be linked to projects of the same energy type to a
17
18 greater extent than would be expected in a random network: considering that projects are linked
19
20 through organisations this suggests that organisations are more likely to engage with a
21
22 particular technology.
23

24 25 **5. Discussion and Conclusion**

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27 The section reflects on the findings of the study, as they pertain to the contribution to
28
29 knowledge it makes regarding the nature of community energy or microgeneration projects and
30
31 the specific research questions underpinning the project. Overall, the paper finds that the
32
33 classification of ‘community’ urban energy projects is more complicated than was apparent in
34
35 the earlier work of Walker and Devine-Wright (2008). For example, in relation to ‘process’
36
37 issues it is necessary to unpack notions of ownership of and involvement in local energy
38
39 generation initiatives. There ‘are many forms of project being given the community label’ as
40
41 Walker and Devine-Wright (2008: 499) recognised but this heterogeneity requires closer
42
43 scrutiny.
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49
50 The first research question concerns the content of microgeneration projects. On the basis of the
51
52 analysis presented here, relating to selected microgeneration projects in Greater London, the
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54 content of initiatives varies widely in scale, technology and purpose. However, projects
55
56 featuring combined heat and power technology dominate, a finding consistent with Hinnels’
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2
3 (2008) remarks regarding the suitability of CHP in cities. Thus their popularity in London is
4
5 expected. In relation to the second research question, the paper shows that in many projects the
6
7 central actors are not residents, local activists, or energy firms. In terms of ‘outcomes’, the
8
9 accrual of benefits from the projects needs to be set in the light of the identity and interests of
10
11 promoters, whose orientation had much to do with waste or water resource management, for
12
13 example, rather than energy reduction or generation per se. Here one sees the centrality and
14
15 motivation of specific non-energy focused firms and utilities, such as: Veolia (waste
16
17 management); Viridor; and Thames Water (which had land resources available and funding
18
19 necessary to support Crossness and Beckton projects, for example). This is consistent with the
20
21 observation that the development of anaerobic digestion is partly driven by the need to reduce
22
23 waste sent to landfill (Levidow and Papaioannou, 2013). **Projects run by non-energy**
24
25 **corporations demonstrate how energy is linked to the provision of other public services such as**
26
27 **waste management and sanitation, so that more integrated policies may be necessary.**
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32 Recognising this, it appears that the social character of benefits to ‘the community’ connected
33
34 with heat or electricity supply are by-products of project activities driven by other concerns.
35
36 There is a spatial dimension in that the main promoters are organisations that are distant from
37
38 the communities being served by the projects by dint of the international nature of their
39
40 ownership and spread of activities.
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45 The third research question related to the role of community and other actors, and to the
46
47 relationships among actors and projects. Here, the paper showed that the LDA development
48
49 agency and regional and borough councils assumed a more significant coordinating role than
50
51 either central government or London-wide bodies such as the London Assembly or the Mayor
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53 of London’s office. Specific local initiatives are thus partly shaped by the activities of local
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55 councils and the business strategies of large national and international corporations, and much
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3 less by community organisations or private residents. Project level learning is impaired since
4
5 the network lacks actors that could play a central co-ordinating role and transfer expertise
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7 between projects in different boroughs. The isolated character of some projects further
8
9 exacerbates this problem. It could be argued that local councils have a mediating but
10
11 contradictory role in both representing and supporting but also silencing local communities.
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16 The majority of the projects rely on more popular renewable energy technologies such as CHP
17
18 and PV rather than more untested technologies such as heat pumps. The participation of local
19
20 authorities in a substantial number of projects indicates a potential pathway of institutional
21
22 arrangements for community energy where local authorities may substitute for the lack of
23
24 London-wide co-ordinating actors. The engagement of large corporate actors suggests a
25
26 pathway more compliant with the distant and private/closed and institutional quadrant in the
27
28 Walker and Devine-Wright (2008) typology.
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34 Our representation indicates a lack of actors that are conventionally classified as community
35
36 (community groups, social enterprises, residents association). However, their paucity does not
37
38 necessarily indicate that they bear no influence on community energy developments. As Rogers
39
40 et al (2008) note, community actors may not wish to take the initiative regarding the
41
42 development of projects but retain a more discreet role. The strong presence of local
43
44 government actors would suggest that they represent the local communities through the political
45
46 and planning process. Energy utilities are an additional group of actors with minimal
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48 representation in the network. However, this may attributed to the relatively small scale of the
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50 selected projects.
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3 Reflecting on the above, it is apparent that in the future research should examine and categorise
4
5 the different promoters of and motives for ostensibly community-driven initiatives, and tease
6
7 out the various roles that they and other actors play in related projects, as well as interactions
8
9 among them and the activities they perform. This will require scrutiny of the purposes, work
10
11 and networking of (local) governmental organisations, waste, building and energy companies,
12
13 and community groups and residents in urban energy and related community projects, as this
14
15 relates to policy-making as well as to activities ‘on the ground’. A benefit of doing so could be
16
17 to generate further insight into the relative merits or complementarity of micro-, meso- and
18
19 macro-level studies of community energy, by examining the conventions, assumptions and
20
21 practices which constitute behaviour of and relations among protagonists, or which leave others
22
23 out, mindful of wider patterns of change. The accomplishment of the latter in terms of the
24
25 adoption of more sustainable energy technologies is in itself only part of the story. Without
26
27 attention to their effective use in practice mere installation of sustainable urban or
28
29 microgeneration energy technologies will not make the required contribution to climate change
30
31 targets. This aspect, too, requires further examination from the perspective of adopting a
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33 longitudinal approach tracing developments through from project gestation to post-adoption
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35 everyday use.
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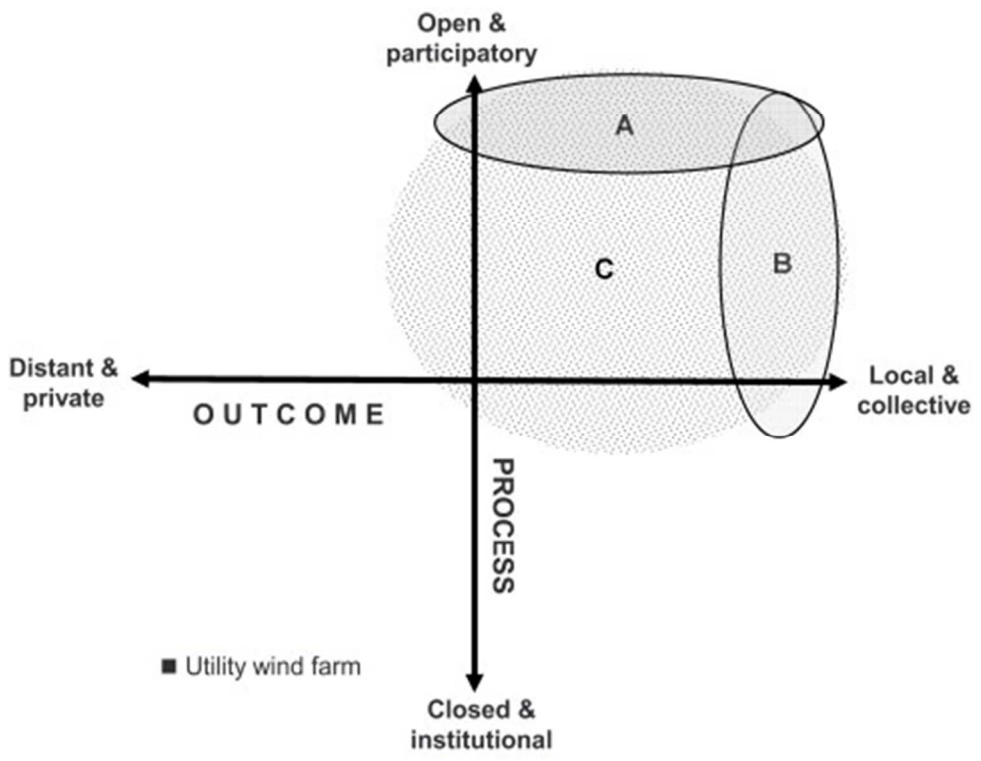
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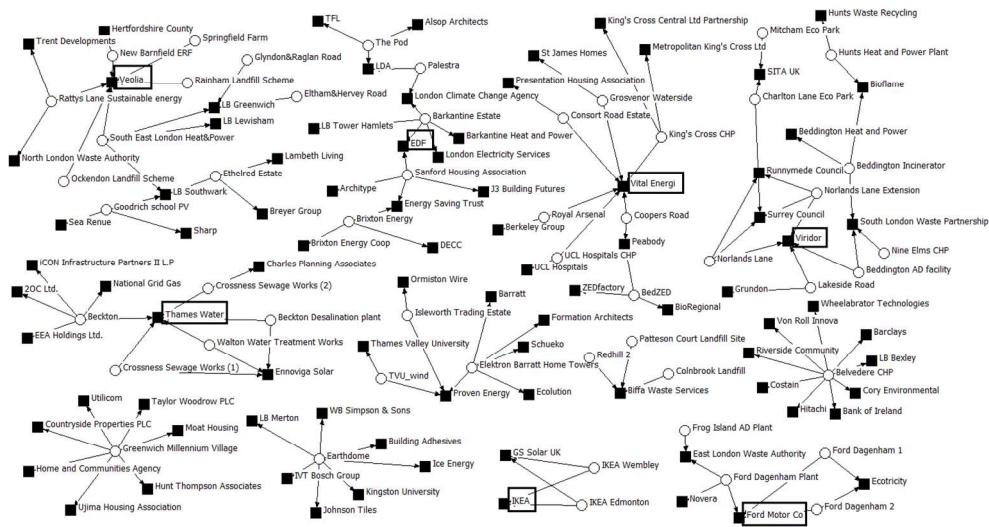
26
27 *Disclaimer*
28

29 The social network maps are based on data supplied from an Excel database compiled from
30 open access and publically available data. This database is maintained by the authors and access
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32 available by e-mail to the corresponding author.
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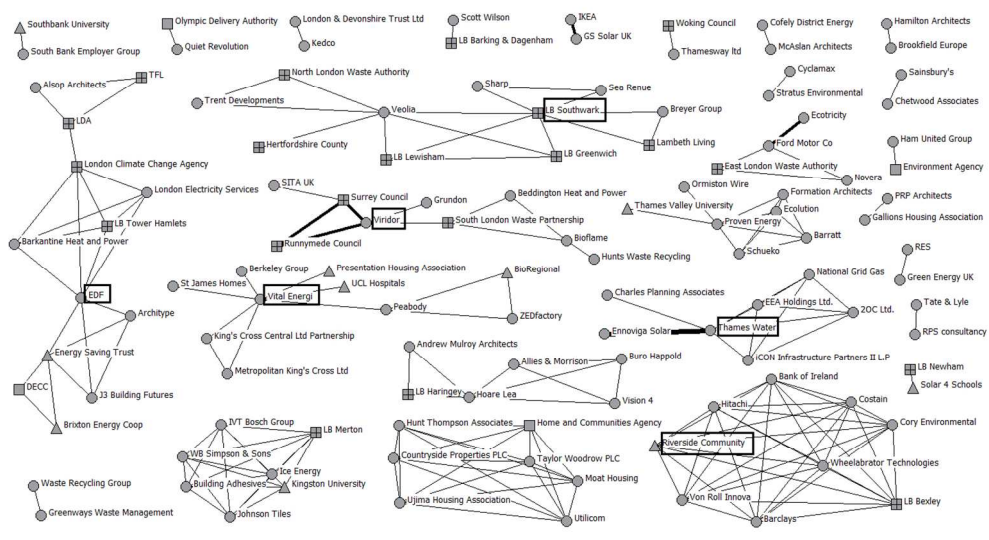


A classification of community energy projects (Walker and Devine-Wright, 2008)
40x31mm (300 x 300 DPI)

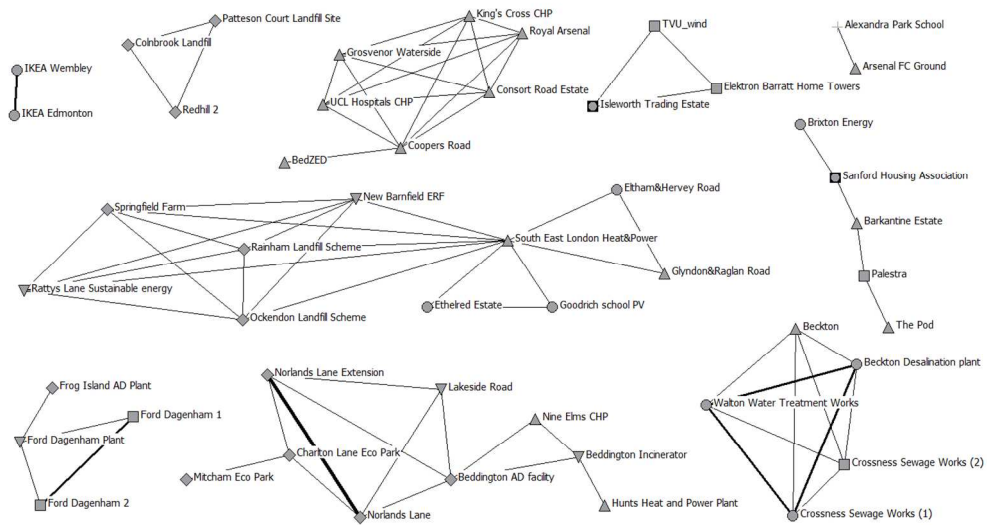


London community energy projects and linked organisations
123x66mm (300 x 300 DPI)

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London community energy actors
123x66mm (300 x 300 DPI)



London community energy projects featuring technologies
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