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Local energy generation projects: assessing equity and risks

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Micro- and small-scale low-carbon energy generators embedded within villages, towns and cities can provide a valuable income stream for local communities among other potential benefits. There are a range of social, political, technical and environmental factors that may impact upon the success of a planned energy generation project; however, these factors are rarely considered in unison. The aim of this research is to investigate and understand the concerns relating to equity and distributional justice that impact upon local groups interested in developing energy projects and to determine whether a whole systems approach can be used to draw out perceived issues. This has been achieved by working with two small village groups to test a newly developed energy equity assessment tool. This paper reports research findings from two villages in the UK both planning energy projects that intended to benefit their respective villages and examines perceived issues relating to equity and distributional justice associated with the proposed schemes. The research highlights some challenges facing community groups when planning micro- and small-scale energy projects and demonstrates the commitment, tenacity and high levels of personal risk that these groups have to bear in order to bring their projects to fruition and comments as to the type of actions that may be required to more wholly consider equity issues while developing future energy policy.

Keywords: equity; risk; community; energy; policy

Introduction

Distributed micro- and small-scale low-carbon energy generation is acknowledged to have an important role in the future energy mix while contributing to the low-carbon transition as envisaged by the UK government (DTI 2003, 2006). Potentially it could reduce the estimated 17% of UK carbon dioxide emissions attributed to the domestic sector (DECC 2011). The incumbent regime of centralised energy systems creates both geographical and psychological distance between energy generation and consumption (Pasqualetti 1999). One challenge for the low-carbon transition is to engender engagement with energy consumption and production, which for many people is currently an invisible concept (Guy and Shove 2000), and promote changes in people's energy practices against a backdrop of the perceived convenience of current supply arrangements. The use of micro- and small-scale distributed energy generation systems with outputs ranging

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between 1 W to 5 kW and 5 kW to 5 MW, respectively (Ackermann *et al.* 2001), shifts energy generation from central plants and embeds it within villages, towns and cities.

Locally based energy projects provide residents with an opportunity to own and operate their own generation systems, making them directly responsible for energy production as well as consumption (Lovins 2002, Walker and Cass 2007). This potentially offers a tangible and proximate link between energy supply and use that is beneficial for raising awareness, education and the promotion of environmental citizenship (Walker *et al.* 2007). The withdrawal of local funding and services (such as schools, village halls, post offices and bus routes) in some areas means that local energy generation holds out new possibilities for community renewal and greater economic security through its potential to create sustainable income streams to support community facilities and activities. Environmental benefits of micro- and small-scale energy generation systems are recognised by the Energy Saving Trust (2005) which estimates that micro-generation could supply 30–40% of the UK's electricity requirements by 2050. The carbon savings realised from the installation of micro- and small-scale energy generation projects can be greater than those directly associated with the kilowatts produced by the installed generator due to the double dividend effect (Caird and Roy 2010) whereby consumers place a higher value on energy produced by their proximate installed system and alter energy practices to reduce consumption.

There is debate as to whether micro- and small-scale generation has a role in reducing the incidence of fuel poverty, chiefly due to its high capital cost (Walker and Devine-Wright 2008). Bahaj *et al.* (2007) consider the impacts of building integrated photo voltaics (PV) for reducing fuel poverty and find that PV on social housing developments can make a significant (15–20%) contribution to electrical demands and reduce electricity bills. Their research reveals shortcomings in billing structures and highlights the need to match the use of household appliances with peak output from installed PV systems (i.e. by using more appliances at midday) for maximum benefits to be realised. Some researchers view energy efficiency measures as the most effective way of combating fuel poverty (Chawla and Pollitt 2012). One indirect way in which micro-generation installations might contribute to reducing fuel poverty is illustrated in Chawla and Pollitt's study where participating groups are developing a programme to use a portion of income generated by a proposed wind turbine to improve insulation standards at households within their village communities.

Devine-Wright (2005) signals how such programmes for fuel poverty alleviation are likely to be rare, given that few low-carbon energy projects in the UK have a high degree of local ownership or involvement. The majority of renewable energy developments in the UK have been led by the private sector and are driven by purely economic interests (Devine-Wright 2006). Walker (2008), however, suggests that this situation is likely to change in the near future and foresees the expansion of locally based or community-led renewable projects.

Though there are many benefits associated with community energy projects, the path from conception to implementation is not always straightforward and there can be many barriers to success (Walker 2008). Community energy groups require a high degree of tenacity with individuals prepared to invest much time and effort in navigating potential pitfalls to their plans. Obstacles include local opposition, planning constraints, ecological concerns (e.g. conservation of protected species) and technical difficulties associated with retrofit or connection of electrical generators to the distribution network. Shaw and Mazzucchelli (2010) cite disparities between the level of community capacities and the capacities required to develop local energy projects as one reason why their adoption is less common than the adoption of energy efficiency initiatives. Mixed messages and lack of clear impartial advice relating to technology choice and use, embodied energy and lifespan of micro-generation technology are cited as threats to successful deployment both in literature (Devine-Wright *et al.* 2007, Bergman and Eyre 2011) and by the people involved in this study. Benefits of community-based generation systems include stimulation of markets for low-carbon energy systems and the skills sector associated with their installation and upkeep (Walker *et al.* 2007), local empowerment and awareness raising.

There are a range of scales and types of low-carbon and renewable energy generation systems available to communities; either as a suite of individual micro-generators such as PV systems on roofs or as a small-scale (below 1 MW) wind turbines. This paper discusses the risk and equity issues associated with the development of local micro- and small-scale energy generation projects and describes how a whole systems energy equity assessment tool (EEAT) was developed by an interdisciplinary network of energy stakeholders (Adams *et al*. 2012) and subsequently applied to two communities in the UK. Their inhabitants are alert to the benefits of installing community-owned generation and currently in the process of planning energy projects. This paper records and evaluates how the EEAT was used to assess the choices being made in terms of their implications for equity and considers the outcomes. Finally, the utility of the EEAT and the issues of risk and equity raised by participants in the process are assessed.

Two separate groups of people within two villages in County Durham were involved in this study, each at different stages in planning two separate electricity generation projects. We asked members of the two groups to apply the EEAT to their particular circumstances and analysed the findings according to the following questions:

(1) What are the main equity issues linked with the development of community energy projects?
(2) Can a whole systems equity analysis method be used effectively by communities to explore these issues?
(3) How can policy and other incentives be used to address these issues?

A model for assessing energy equity

Energy equity issues

Energy is intrinsically linked with human activity but the social and economic costs of its exploitation, generation, distribution, financing and consumption may not be equitable, i.e. the costs, risks and impacts of its use may be distributed unevenly among people and places (Newell *et al*. 2011). Equity has aspects of both distributive and procedural justice (Walker and Bulkeley 2006) and is linked to the fairness of mechanisms by which social exchanges take place between different groups of people (Brashear *et al*. 2004), as well as intended and unintended desirable and undesirable outcomes of human interventions upon the environment (Ikeme 2003). Hall (2013) highlights the lack of clear definition for the term "energy justice"; however, for the purposes of this research, the factors described with respect to micro-generation technology, have dimensions of both justice and equity and can be described in terms of the following:

(1) The distribution of *impacts*. With respect to uptake of small- and micro-scale generation systems, a system installed in the UK could create economic returns for the owner/operator and reduce local carbon emissions but the materials for its constituent parts could have been sourced elsewhere (nationally or globally) where the impacts of its exploitation may remain.

(2) The distribution of *responsibility*. Should countries that have the wealth, technical know-how and capacity to generate low-carbon energy (Ikeme 2003) or reduce energy demands through social interventions such as the promotion of behavioural change be made to do so? For example, in the UK, micro-generation systems could be mandatory on all new homes by amending building regulations and excessive consumption curbed by introducing penalties for higher energy users (while appreciating that high energy demands are not always associated with the user and may be related to building fabric or the energy system installed).
(3) The distribution of *costs and benefits*. Early adopters of micro- and small-scale generation systems may pay a higher price for installing micro-generation when markets are less well developed. This problem is partly addressed through policy instruments such as feed-in-tariffs (FiTs) so early adopters may benefit from higher initial FiTs. At a universal level, installing micro-generation can benefit everyone by reducing overall carbon dioxide emissions.

Micro- and small-scale energy generators represent scaleable technology options in the sense that they are likely to be added to or replaced by different actors over periods of time. Their legacy from commissioning to disposal covers a much shorter time scale – probably just that of a single lifetime – when compared to other low-carbon technology options such as nuclear power stations or carbon capture and storage schemes. Decisions made in the present regarding the latter options may be non-reversible and have implications for many future generations.

More locally, benefits of installing micro- and small-scale generators can also accrue from the development of community capacity by enhancing the ability of communities to cope with the complex and multidisciplinary challenges involved in establishing an energy project. Lessons learnt through participating in energy projects expand community members' capacities for collaborative tasks and improve abilities to access resources through training, networking and participatory events. These activities increase social capital by developing peoples' aptitude to achieve shared goals and purposes (Park 2012). Letcher *et al.* (2007) also highlight the need for communities to have access to a "trusted resource base" with expertise in both managing community relationships and technical aspects in order to develop sustainable energy projects.

Need for and attributes of an equity assessment tool

Methods for assessing and subsequently choosing micro- or small-scale generation systems are often made from the perspective of a single discipline, using a specific approach, e.g. life-cycle analysis, cost–benefit analysis or multi-criteria decision analysis[1] (mcda) or focus on a subset of issues relating to specific economic criteria, policy targets or a single technology. Methods that include energy equity and distributional justice by employing a broader approach that integrates technology into coherent whole systems, socio-technical frames are rare. However, they are important not least because perceived unfairness can be potentially damaging to social well-being within a community (Gross 2007). Assessments are most often directed towards one particular generation technology (Rankine *et al.* 2006, Staffell and Ingram 2010) or one particular setting (Dalton *et al.* 2008). These approaches are necessary to map against targets, or make an economic case for or against technology adoption, but are insufficient for examining the role of micro- and small-scale generation with respect to equity because their narrow focus excludes broader factors such as location, time and social rights and responsibilities all of which have dimensions of equity and distributional justice.

Some methods weight the variable criteria, for example, Burton and Hubacek (2007) and Afgan and Carvalho (2002) undertake a multi-criteria assessment of a range of new and renewable energy power plants weighting each type of plant using sustainability indicators, e.g. CO_2 emissions, capacity factor, cost and space occupied by the plant. Specific modelling packages designed to assess energy projects may contain data or coding that could become outdated (for example, by being based upon current energy prices or technology limitations such as system efficiencies that may change with market or technology development, respectively), while the use of complex mathematical functions to weight options can deter certain users. Another major disadvantage of these more rigid, weighted assessment methods is the failure to include other important factors such as stakeholder preferences (Oikonomou *et al*. 2011) and socio-political aspects. This wider perspective could include queries such as who benefits from and who contributes to FiTs, tensions between those who can and cannot afford to install micro-generation systems, as well as investigating new forms of government support for micro-generation and other low-carbon technology.

These shortcomings in modes of assessment cause important factors to be overlooked leading to poorly implemented policy or unsatisfactory technology deployment. An example of focusing too broadly and without little social consideration is illustrated by current planning policy, FiT structures and power buy-back agreements. Small community groups planning energy projects based within their local area for the purpose of revenue generation for community benefit compete with developers who have in-house expertise and may have a portfolio of sites and whose key driver is to provide economic returns for their business. Conversely, policies such as the UK's Green Deal (DECC 2010) may be technology blind and focus on people in their homes but fail to consider larger energy projects planned for the local area that could minimise the potential for carbon savings. For example, a street of terraced houses could be recommended for solar hot water but should there be a plan to develop a biomass fired district heat network, these homes could ultimately have a lower carbon footprint if PV were installed so that their heat and some of their electricity could be supplied from low-carbon resources.

The assessment tool described in this paper is novel because it considers equity within a range of themes associated with the development of energy generation projects. Additionally, it has been created by 30 multidisciplinary energy stakeholders, who collaborated to provide intensive input at several stages throughout the method's development process (Adams *et al*. 2012).

A whole systems approach

A whole systems approach involves identifying the elements of the system and sub-systems of interest, then focusing enquiry upon the interactions between them (Meadows 2009). This approach aims to interpret the dynamic attributes of complex systems and to identify and prevent problems arising from unseen and unintended consequences. When applied to micro- and small-scale generation, a whole systems approach involves taking a wide ranging view of the many aspects associated with its deployment among a range of users who, ideally, are involved at various stages of decision-making across the whole life cycle of an installation. This approach should ensure that micro-generation has optimal technical efficiency while encouraging citizen engagement and acceptance (Bergman and Eyre 2011).

Development of an equity assessment tool (EEAT)

The energy equity assessment methodology (EEAT) presented here is not restricted to any one form of generation. It could be used to assist in decisions about what technologies might be most suited to particular locations and circumstances; just as readily it can be used to address questions concerning a favoured technology (Figure 1). It was developed by a team of 30 multidisciplinary stakeholders who attended a mapping event and devised the six key themes around which to explore equity issues (entry points) to act as discussion prompts when using the EEAT (Figure 1).

The EEAT has carbon and equity at its core and the six-theme entry points each refer to an accompanying checklist to promote discussion under that theme, thereby giving users a balanced framework to explore ideas. The EEAT has an iterative structure that prompts decision-makers to promote mutual compromise by discussing the equity implications of proposed energy projects among an interdisciplinary team. It has been tested using synthetic and real case studies and has value for multidisciplinary groups when planning energy projects (Adams *et al.* 2012).

The six themes should be viewed sequentially through a lens – as if using a microscope – and explored using a checklist for each theme. Using this approach any single theme can be viewed through a high definition focus, while other related themes offer background and context. The iterative structure prevents sticking points in the discussion, as themes can be revisited at a later stage, and also allows for links between themes to be identified and explored.

Once the EEAT was developed, it was tested during a stakeholder workshop with some participants drawn from the original group and other new recruits. The stakeholders tested

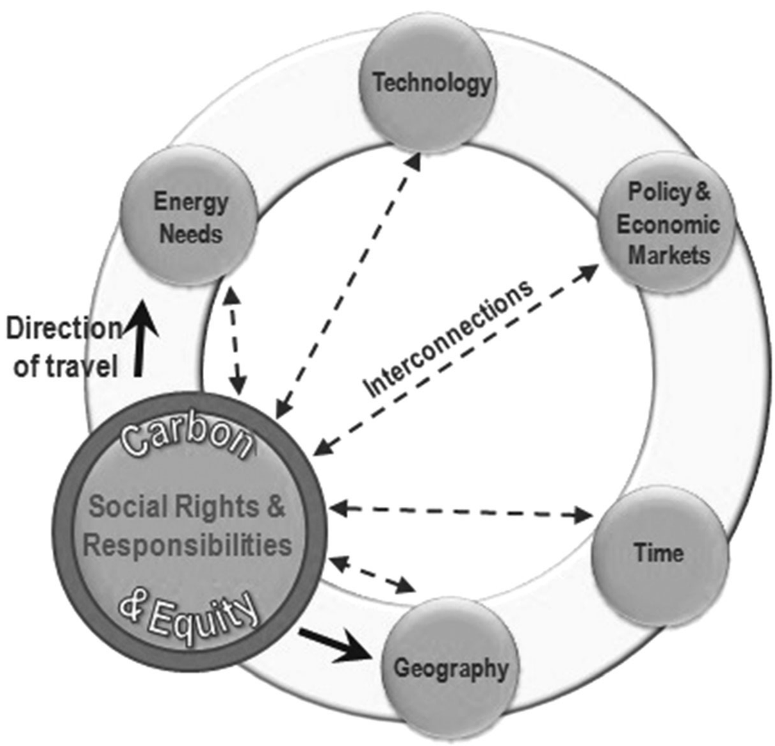

Figure 1. The InCluESEV EEAT.

the EEAT using four simulated case studies chosen to be broadly representative of the main groups of domestic energy users present within the UK (Adams *et al.* 2012). The tool was evaluated by the new stakeholder group who agreed that it formed a sound basis for considering equity issues associated with the selection of energy systems by providing a series of prompts for discussion that have value for decision-makers working outside their field of special expertise, e.g. leaders of community groups planning energy projects. The simulated testing allowed for further improvements to the EEAT and demonstrated the need to further test the tool using real case studies. Subsequent Engineering and Physical Sciences Research Council (EPSRC) Impact funding facilitated "real-life" tests at pilot scale that are the focus of this paper.

Selection of case studies

Two villages within County Durham, UK, Oakenshaw (OS grid reference NZ 206 365) and Witton Park (OS grid reference NZ 174 301), were selected because residents of each contain working groups that have been successful in obtaining funding to carry out feasibility work. At the start of our research, both groups had established ideas about their preferred type of shared energy project and were interested in using the EEAT as a self-assessment tool for their project. The two villages are sufficiently different to enable comparison (Table 1), both are of similar size (each comprising around 200 homes) and come under the jurisdiction of Durham County Council.

Oakenshaw is planning a wind turbine and Witton Park plans to exploit hydropower from the River Wear, which runs adjacent to the village. The two projects are at different developmental stages, Oakenshaw being much further through the process than Witton Park. A further significant difference is that Witton Park currently has retained more local facilities such as school, churches, village hall and sports field than has Oakenshaw. Hence, Witton Park has more existing community-organised activities and organisations.

Research methods

Research methods included attendance by the authors at pre-arranged village meetings in order to meet officers of the village groups, gauge local opinions relating to the proposed

Table 1. Summary information for Oakenshaw and Witton Park villages.

	Oakenshaw Village Co., Durham	Witton Park Village Co., Durham
Village size	Approximately 215 homes	Approximately 250 homes
Tenure	Mainly owner occupied	Mainly owner occupied
Community facilities	None	School, village hall, two churches, football club and play park
Mains gas available?	Yes	Yes
Proposed generation technology	500 kW wind turbine	40–50 kW hydro generator
Feasibility assessed	Yes	Yes
Estimated installation cost	£1.35M	£400 K–500 K
Projected annual income	£300 K–£475 K	£32 K–£40 K
Stage	About to make planning application	Investigating initial feasibility

generation projects and to introduce the purpose of the research based on the EEAT. Research project-specific activities included arranging a workshop for each village and following this up with a qualitative questionnaire survey to assess the utility of the EEAT. Local consultation was also achieved via regular telephone and email contact with key village contacts throughout the project.

Application of the equity assessment tool

Six villagers from Oakenshaw and nine from Witton Park attended separate workshops at a local resident's house and village hall, respectively. The people who attended both workshops were primarily retired or semi-retired, most were professionals and there was a mix of people local to the area and those who had moved there during their working lives. The workshops lasted for around two hours during which time people applied the EEAT to their village's proposed energy generation project. Following an introduction to the research aims and objectives and further information relating to the EEAT, the villagers were split into groups to use the EEAT then brought back together at the end of the exercise when two researchers facilitated a feedback discussion (see findings) and the community members were provided with a questionnaire on which to record their experience of using the EEAT. The researchers were not present while the participants were using the EEAT but noted down feedback during the discussion. The checklists from each group and comments on the appropriateness of the EEAT from each person were collected from the participants at the end of the workshops. The findings are classified by theme although there is some cross-over between themes.

Findings

Energy needs

As found by Walker and Cass (2007), the people in both groups had made a strong connection between their energy use locally and global sustainable energy issues. Under this theme, competition from developers, the availability of grant funding and the potential for income generation from FiTs are some reasons why local groups of people are becoming empowered to develop energy projects:

> There is money available from government via FiTs and Oakenshaw village should wholly benefit from it rather than a developer who may not share profits with us. (Oakenshaw Informant 1)
>
> If we are subsidising FiTs through our bills then we may as well get something back. (Oakenshaw Informant 2)

These insights reflect the findings of Devine-Wright *et al.* (2007) in that community energy projects are linked with temporally and spatially immediate needs. The equity issues here relate to perceptions that the groups may lose out if developers install generation systems in their area without offering any benefits to communities in those areas.

Time

Uncertainty surrounding future levels and duration of FiTs affected both village projects. This hinders the development of accurate economic projections and greatly increases the level of perceived risk among both groups, because the guaranteed tariff does not become fixed until the generator is commissioned and exporting power. Time taken between commencement of works and commissioning means that groups developing a local energy project start to incur costs although risking lower returns than anticipated should FiT structures change prior to commissioning:

> The biggest risk to our project is posed by changes to or removal of FiTs during the construction period prior to commissioning. (Oakenshaw Informant 1)
>
> We need assurance from government or the ability to insure against losses associated with undertaking this type of project. (Witton Park Informant 1)
>
> Who knows what the benefits will be? An income stream after 10 years? (Witton Park Informant 3)

Uncertainty surrounding Renewable Obligation Certificates (the predecessor to FiTs) was cited by Hain *et al*. (2005) as being a disincentive particularly to the development of smaller projects and remains a similar concern for FiTs. Changing national emphasis on favoured technologies, such as the recent announcement by DECC (July 2012) to cut wind power subsidies, causes further uncertainties. The villagers perceived that they will bear the financial risks during project development without being guaranteed a return on commissioning.

Geography

At Oakenshaw, there were signs of tensions arising between those who can and cannot afford to invest in the turbine scheme, with those living adjacent to the turbine site feeling they have most to lose through loss of visual amenity:

> Visual and noise effects concern a few people. The feasibility study has put a lot of effort into addressing their issues. We had some Luddite reactions too!! Some people believe they will have a wind farm on their doorstep!! Newspaper reporting doesn't help either. (Oakenshaw Informant 1)

Equity issues here relate to who is perceived to lose visual amenity and should they be compensated for something that is for the benefit of the village.

Technology

Concerns relating to where people lived in relation to the planned site for the micro-generator were perceived to be linked with acceptance:

> There are different attitudes depending upon location. Nearer to it there are different concerns. Some like and some hate. It depends upon the technology that attracts different attitudes. (Oakenshaw Informant 4)

Social rights and responsibilities

Access to vulnerable people, especially the elderly, can be difficult. At Oakenshaw, difficulties were noted by local people trying to undertake free home energy audits:

> Access to people and their homes within the village has been difficult, some elderly people have refused free energy audits. (Oakenshaw Informant 3)

Mistrust of committee officers engaged in the wind turbine project at Oakenshaw and how much return the owner of the turbine site will receive were also cited as concerns among the residents of Oakenshaw:

> There has been local suspicion relating to the committee and how they will benefit from the development. (Oakenshaw Informant 2)

Equity issues here relate to perceptions about who benefits from the development of such projects. Trust within community groups was cited by Walker *et al.* (2010) as being an essential attribute for the successful delivery of local energy projects, and pre-existing community dynamics also have a role in the successful development of community energy projects (Walker *et al.* 2007). At Witton Park, concerns were raised about loss of amenity by some groups:

> It could affect those who play in the river, could this be offset by improving the environment of the river? There could be conflict with fishing groups, fishermen might not like it. (Witton Park Informant 2)

Both groups noted benefits for their local community:

> Provides an income stream in the long term.
> Being socially responsible.
> More local generation means less reliance on imported fuel.

However, at Witton Park, where the planned project was at conceptual stage, the local community had not received as much information about the project as at Oakenshaw, thus people were more sceptical about the benefits:

> People would need to see the community is benefitting – free energy and cash returns.

At Oakenshaw, measures designed to address fuel poverty are being implemented using grant awards (and eventually income from the wind turbine) to benefit households on lower incomes who are least likely to be able to invest in the scheme. However, this was noted as a possible cause for conflict at Witton Park:

> Paying individuals to improve the fuel efficiency of their homes could cause aggravation as many have already funded their own improvements. (Witton Park Informant 1)

The comments in this section echo findings by Upreti (2004) who considered the development of community biomass projects in the UK and states that it is the processes by which a project is developed and who is perceived to benefit from it or be affected by it that is more likely to cause opposition than the type of project being developed.

Policy and economic markets

Seeking finance for purchasing generation equipment is complex. The wind turbine for Oakenshaw was chosen on the basis of several favourable technical and economic attributes. But potential lenders refused to fund the purchase of that particular turbine because they considered the German supplier company to be too small. Ironically, its size is a result of the firm occupying a niche market for turbines that are particularly appropriate for community energy purposes. A different turbine was selected on the basis of what the lender will fund leading to an alternative that carries new technical and economic ramifications associated with increased noise levels with reduced power output and income stream.

Members of both groups in this study felt that because their schemes are relatively small, they hold no interest for the major energy suppliers, leaving them with weak bargaining powers, for example, when negotiating power buy-back. The Oakenshaw group noted:

> We feel that big energy companies are not keen on community owned wind turbines. (Oakenshaw Informant 2)
>
> We have no influence. (Witton Park Informant 1)

Members of the Oakenshaw group perceive that energy supply companies are less keen on working harmoniously with local energy projects even though they believe that these relationships have the potential to enable supply companies to fulfil their obligations for renewable energy supply and enhance their reputation for social responsibility. One major energy supplier is currently exploring the possibility of paying upfront costs on the Oakenshaw wind turbine project in the form of a loan, which could speed up the project, secure local confidence in the scheme and promote the opportunity for local investment.

Competition from commercial renewable energy developers with in-house expertise and who often develop several projects at once in order to spread their risk was noted as a concern by people from each village. There were also worries that developers can progress projects more quickly than a local group can partly because they are not obliged to consult or to share control and benefits with local residents.

Assessing the utility of the EEAT

People from both villages in the groups who used the EEAT (14 people in total) were asked to evaluate their experience using a questionnaire and to provide reasons for the responses they made. Although the sample size was small, the groups that took part in this study, from the author's experience, are fairly typical of local village energy groups and their insights from testing and evaluating the EEAT methodology described are relevant to other UK-based local energy groups regardless of system size, type or location. Questionnaire feedback indicates that the equity assessment tool was useful to some extent to all of the community members who took part in the exercise. Respondents were asked to select whether they found it very useful, useful, slightly useful or useless; the results are shown in Table 2.

General comments about the usefulness of the EEAT included the fact that it made people think in detail about reasons for developing a community energy project and revealed areas where understanding of wider energy issues among their community group was lacking.

Table 2. Feedback on utility of EEAT by site.

Criteria	Oakenshaw	Witton Park
Very useful	1	0
Useful	3	3
Slightly useful	2	5
Useless	0	0

Those who classed the EEAT as useful specified its function in promoting dialogue, providing a forum for discussing the advantages and disadvantages of the proposed schemes and allowing differing opinions to be rehearsed in a non-threatening manner. These respondents thought some areas covered by the checklists were irrelevant to their particular project and these checklist items were not included in their discussion. This is not surprising because the heuristic nature of the EEAT and the fact that it was deliberately developed using a technology blind approach mean that all checklist items may not be applicable to all situations. We were alerted to the fact that when explaining the method to users in these kinds of contexts facilitators need to better explain the need for the EEAT to be broader, not least because of the many linkages between sections. Those who recorded that they found it "slightly" useful judged that the issues included in the checklist to be "too academic". The authors responded to this comment by the Oakenshaw group who used the EEAT prior to the Witton Park group, but as two people here also made a similar comment at their workshop we accept a need for more vernacular language. Some users judged that some of the themes were too complex for users with little background in energy matters. An additional comment was that in one of the groups certain dominant individuals made it difficult for everyone present to have their say. From this we learnt that if the larger group is split into subgroups facilitators need to spend time with each to make sure all voices are heard.

All groups recorded that the EEAT made members think about issues they had not previously considered such as their project's connection with wider global climate change issues, national policy issues and the attitudes of government and energy companies towards supporting community energy projects. When asked what, if anything, they had gained from the process of using the EEAT, respondents reported that they felt better equipped to think in greater depth about the concerns of neighbours and others currently opposed to the project. They also reported that they felt better able to make their neighbours more aware of energy issues and the support that is available to help monitor and save energy. In terms of equity, some respondents recorded that the process helped them better understand the need and potential for their project to be more inclusive and how the wider community could benefit from participating in a community energy scheme. Respondents also reported increased awareness of the possible conflicts that could occur that need to be addressed at an early stage. In the case of the hydro project that was at the inception stage, users welcomed the structured format the EEAT provides in facilitating discussion and enlarging participants' vision of the various issues the proposed project entailed.

When asked how the process could be improved, respondents agreed that the questions should be framed using non-scholarly language, but could form the basis of a study pack for new projects to promote sharing best practice. One of the villagers said that they needed more time to devote to the discussions engendered by the EEAT. The other echoed this comment by suggesting that the introductory session be briefer to allow more time for small group work.

After undertaking follow-up discussions with members from both village meetings, the EEAT was considered to have been of most use for the group who were looking at the hydro project (Table 2); not because of the technology being investigated, but because of the stage of the process when they were introduced to the EEAT. Because this group were at the start of their project and participants felt that the EEAT provided a useful working structure to guide future discussions and explore new avenues.

Reflections upon the feedback from the two groups suggest there could be some merit in phasing the use of the tool or devoting a full day event to it. The group planning the hydro project has expressed an interest in using the assessment tool again and has suggested the possibility of holding workshops that would concentrate upon the entry point themes. To prevent the dominance of individual community members, use of the tool should be facilitated by someone with a general understanding of energy issues but unconnected with the community and with some experience with group work.

To address the time constraints and depth of knowledge required, the process could be phased as suggested below:

- Phase 1 – Highlight the six-theme entry points and get the community to think about issues that may arise under each theme. This could be achieved by getting the community to list their questions and then collectively assigning the questions to each theme before answering them.
- Phase 2 – These questions and answers could be mapped against the EEAT checklists and remaining issues could be addressed in a follow-up workshop.

The EEAT was of less value to the Oakenshaw group with the wind turbine project because they had already dealt with many of the issues covered by the EEAT. However, some people reported that it made them think about wider issues that they had not considered before and in this instance it served as a useful cross-checking tool to confirm whether the key issues had been addressed by the project to date.

Findings from this small pilot study indicate that the tool works best when deployed in groups that are facilitated by a neutral figure. Most significantly we discovered that for the projects under consideration, the EEAT is most useful at the earliest stage in the life of a project and according to respondents, once used has appeal as a framework that can be referred to during later stages or even be adapted as a motif for thinking through the project to the point of achieving energy generation and beyond. We also learnt that in some circumstances the EEAT might benefit from being deployed in stages using one of the several entry points at a time.

Conclusions

Energy projects have an important role in offering communities a route for generating income that can sustain local services and facilities, while also making a contribution to carbon reduction targets and energy supply security. This study has explored the risks and equity issues that have been highlighted using a newly designed EEAT. The following three paragraphs summarise the findings with respect to the questions posed in the introduction.

The two local groups consulted in this study perceive the main energy equity issues to be the high levels of personal risk people have to subsume while competing with profit-driven development companies who are able to spread risk across their project portfolios and can draw upon in-house expertise. These two groups may also risk not attaining their projected income should FiTs change prior to commissioning. Accessing loans to fund the capital purchase of micro- and small-scale generators is perceived to be difficult by both groups. Perceived lack of confidence and lack of interest by lenders and energy suppliers has restricted the choice of energy generation system for one group and is perceived to hinder the ability to negotiate sound power buy-back deals. These issues are compounded by worries within both communities that a developer may "get there first": something that is associated with general feelings of powerlessness with respect to top-down nationally dictated energy policy and associated changing support for different low-carbon technology options.

When used from an early stage in the project an EEAT – such as the one designed for this study – was useful to enable groups of people to explore the wider issues that surround their particular project. Both groups who used the EEAT felt better equipped to think in greater depth about the concerns of neighbours and others currently opposed to the project and said that it formed a useful basis around which to hold project discussions. It was also effective in encouraging members to identify and decide how to tackle pockets of opposition within the community. At Oakenshaw, consensus was achieved only through intensive dedication to consultation. Many factors can weaken the likelihood of consensus, including previous divisions or old quarrels unrelated to energy. Project participants can draw on their knowledge of community relations as well as other aspects of local politics which need to be aired and considered. There is, therefore, great value to be gained from repeating the process throughout the project development phase to allow for more detailed discussion of specific areas.

Should the issues highlighted from this study be common for other groups, specific policy measures and other incentives could be formulated that could include incentivising developers and energy suppliers to work at the local level, for example, enhanced supplier obligation benefits for those who work with local groups. FiTs could be structured differently for local energy projects to encourage engagement with developers and energy suppliers. Also developers of site-specific, micro- and small-scale generation systems could be allowed to "lock-in" to an agreed tariff at an earlier stage which would increase lender confidence. A loan fund for local energy projects could be established to be repaid upon commissioning with a condition that the groups in receipt of the loan share knowledge and best practice with subsequent recipients. The planning process should be operated differently for local energy groups when compared with commercial developers, perhaps giving them an opportunity to gain outline planning consent at an earlier stage, to minimise onerous feasibility and pre-planning expenditure. There could also be an obligation for developers as part of their consultation process to canvass for local interest in involvement/ownership of all or a portion of a proposed scheme in addition to merely seeking local support and acceptance. Rogers *et al.* (2008) suggest that a clearer framework or process is required for more community energy projects to be undertaken, a whole systems approach such as the one piloted in this study and that includes a consideration of equity and distributional justice could form a basis for this.

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Note

1. The author's critique of mcda relates to application of the methodology rather than mcda as a methodology. There are examples in the literature of where mcda has been used at very broad scales, although the resources required for this mean it would be impractical to be applied at local scale.

References

Ackermann, T., Andersson, G., and Söder, L., 2001. Distributed generation: a definition. *Electric Power Systems Research*, 57 (3), 195–204.

Adams, C., Taylor, P., and Bell, S., 2012. Equity dimensions of micro-generation: a whole systems approach. *Journal of Renewable and Sustainable Energy*, 4 (5), article id 053122.

Afgan, N.H. and Carvalho, M.G., 2002. Multi-criteria assessment of new and renewable energy power plants. *Energy*, 27 (8), 739–755.

Bahaj, A.S., James, P.A.B., and Jentsch, M.F., 2007. Photovoltaics: added value of architectural integration. *Proceedings of ICE: Energy*, 160 (2), 59–69.

Bergman, N. and Eyre, N., 2011. What role for micro-generation in a shift to a low carbon domestic energy sector in the UK? *Energy Efficiency*, 4 (3), 335–353.

Brashear, T.G., Brooks, C.M., and Boles, J.S., 2004. Distributive and procedural justice in a sales force context: scale development and validation. *Journal of Business Research*, 57 (1), 86–94.

Burton, J. and Hubacek, K., 2007. Is small beautiful? A multicriteria assessment of small-scale energy technology applications in local governments. *Energy Policy*, 35 (12), 6402–6412.

Caird, S. and Roy, R., 2010. Adoption and use of household microgeneration heat technologies. *Low Carbon Economy*, 1 (61), 61–70.

Chawla, M. and Pollitt, M.G., 2012. *Energy-efficiency and environmental policies and income supplements in the UK: their evolution and distributional impact in relation to domestic energy bills* (No. 1256). Faculty of Economics, University of Cambridge.

Dalton, G.J., Lockington, D.A., and Baldock, T.E., 2008. Feasibility analysis of stand-alone renewable energy supply options for a large hotel. *Renewable Energy*, 33 (7), 1475–1490.

DECC, 2010. *The green deal: energy savings for homes and business*. London: Department of Energy and Climate Change.

DECC, 2011. *UK climate change sustainable development indicator: 2010 greenhouse gas emissions, provisional figures and 2009 greenhouse gas emissions, final figures by fuel type and end-user*. London: Department of Energy and Climate Change.

Devine-Wright, P., 2005. Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy. *Wind Energy*, 8 (2), 125–139.

Devine-Wright, P., 2006. Local aspects of UK renewable energy development: exploring public beliefs and policy implications. *Local Environment*, 10 (1), 57–69.

Devine-Wright, P., *et al.*, 2007. *An empirical study of public beliefs about community renewable energy projects in England and Wales*. Working Paper 2: Community Energy Initiatives Project. Lancaster University.

DTI, 2003. *Our energy future – creating a low carbon economy*. London: Department of Trade and Industry.

DTI, 2006. *Our energy challenge power from the people*. London: Department of Trade and Industry.

Energy Saving Trust, Econnect, Element Energy, 2005. *Potential for micro-generation: study and analysis full report*. London: Energy Saving Trust.

Gross, C., 2007. Community perspectives of wind energy in Australia: the application of a justice and community fairness framework to increase social acceptance. *Energy Policy*, 35 (5), 2727–2736.

Guy, S. and Shove, E., 2000. *The sociology of energy, buildings and the environment: constructing knowledge, designing practice* (Vol. 5). New York: Psychology Press.

Hain, J.J., *et al.*, 2005. Additional renewable energy growth through small-scale community orientated energy policies. *Energy Policy*, 33 (9), 1199–1212.

Hall, S.M., 2013. Energy justice and ethical consumption: comparison, synthesis and lesson drawing. *Local Environment*, 18 (4), 422–437.

Ikeme, J., 2003. Equity, environmental justice and sustainability: incomplete approaches in climate change politics. *Global Environmental Change*, 13 (3), 195–206.

Letcher, M., *et al.*, 2007. *Mobilising individual behaviour change through community initiatives: lessons for climate change*. Report by the Centre for Sustainable Energy (CSE) and Community Development Xchange (CDX) for: DEFRA, Communities and Local Government, DTI, DfT and HM Treasury.

Lovins, A.B., 2002. *Small is profitable*. Ottawa: Bibliotheca Press.

Meadows, D.H., 2009. *Thinking in systems: a primer*. London: Earthscan.

Newell, P., Phillips, J., and Mulvaney, D., 2011. *Pursuing clean energy equitably*. United Nations Development Programme, Human Development Reports, Research Paper 2011/03.

Oikonomou, V., *et al.*, 2011. Linking least-cost energy system costs models with MCA: an assessment of the EU renewable energy targets and supporting policies. *Energy Policy*, 39 (5), 2786–2799.

Park, J.J., 2012. Fostering community energy and equal opportunities between communities. *Local Environment*, 17 (4), 387–408.

Pasqualetti, M.J., 1999. Morality, space and the power of wind-energy landscapes. *The Geographical Review*, 90 (3), 381–394.

Rankine, R. K., *et al.*, 2006. Energy and carbon audit of a rooftop wind turbine. *Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy*, 220 (7), 643–654.

Rogers, J.C., *et al.*, 2008. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy*, 36 (11), 4217–4226.

Shaw, S. and Mazzucchelli, P., 2010. Evaluating the perspectives for hydrogen energy uptake in communities: success criteria and their application. *Energy Policy*, 38 (10), 5359–5371.

Staffell, I., and Ingram, A., 2010. Life cycle assessment of an alkaline fuel cell CHP system. *International Journal of Hydrogen Energy*, 35 (6), 2491–2505.

Upreti, B.R., 2004. Conflict over biomass energy development in the United Kingdom: some observations and lessons from England and Wales. *Energy Policy*, 32 (6), 785–800.

Walker, G., 2008. What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy*, 36 (12), 4401–4405.

Walker, G. and Bulkeley, H., 2006. Geographies of environmental justice. *Geoforum*, 37 (5), 655–659.

Walker, G. and Cass, N., 2007. Carbon reduction, “the public” and renewable energy: engaging with socio-technical configurations. *Area*, 39 (4), 458–469.

Walker, G. and Devine-Wright, P., 2008. Community renewable energy: what should it mean? *Energy Policy*, 36 (2), 497–500.

Walker, G., *et al.*, 2007. Harnessing community energies: explaining and evaluating community-based localism in renewable energy policy in the UK. *Global Environmental Politics*, 7 (2), 64–82.

Walker, G., *et al.*, 2010. Trust and community: exploring the meanings, contexts and dynamics of community renewable energy. *Energy Policy*, 38 (6), 2655–2663.