The Case for Localised Energy Management to Support Resilient Cities

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ABSTRACT: Localised energy generation, ownership and management provide a mechanism to address issues of affordability, energy security, infrastructure resilience and the need to reduce greenhouse gases emissions. There is potential for the growth of community energy schemes in the UK. However, small to medium-sized schemes find it hard to compete with large energy providers. Energy Service Companies (ESCOs) are created to manage the local production and distribution of energy. In Nottingham, the Meadows Ozone Energy Services (MOZES) is a community-owned organisation that aims to reduce their carbon footprint, support experimentation and learning in relation to sustainable energy, support energy self-sufficiency, help to provide access to affordable energy, and contribute to socio-economic development.

In this paper, the authors described some of the benefits that an ESCO can bring to a community drawing on examples from MOZES. The benefits and challenges associated with the implementation of community energy schemes were examined and the results of a questionnaire administered to residents of the Meadows community are presented for the first time. Conclusions are drawn and recommendations are made on how the model developed by MOZES in Nottingham can benefit other communities and contribute to resilient cities for the wider development of distributed energy storage in the UK.

Keywords: energy management, localised energy, resilient cities, community resilience

INTRODUCTION

Across the world, cities are over-reliant on fossil fuels. Besides leading to an increase in greenhouse gases, which are the main cause of climate change, this has also an impact on energy security and has increased the incidence of fuel poverty (EEA, 2015, IPCC, 2014). Households and communities are often left vulnerable to exogenous changes on a global and regional level. To meet these challenges, communities are exploring strategies that can make them more resilient.

In the UK, the way in which energy is generated and used is slowly transforming. This change is largely influenced by the introduction of low carbon energy sources and the drive to be more energy efficient. Currently, a significant part of this change is seemingly being led by large energy providers in a quest to offset their carbon targets (Department of Energy and Climate Change, 2014). However, community energy schemes can also help to decrease carbon emissions and increase the resilience of local energy provision systems through the introduction of localised or distributed energy ownership.

The UK government has recently recognised the role of community energy schemes in meeting future energy and climate change targets (Department of Energy and Climate Change, 2014). Even so, these smaller schemes still find it difficult to compete with the larger energy providers. In the UK, there is a need to set up inclusive energy management schemes that serve to meet both community and government energy goals.

Despite the setbacks, a number of community-led initiatives have been initiated in the UK (Fenna, 2015). From these initiatives, including one in the Meadows in Nottingham that was examined in detail, we can learn the benefits and challenges associated with their implementation and give recommendations for their wider development to benefit other communities and contribute to more resilient cities.

A HISTORY OF ENERGY IN THE UK

Before the advent of the industrial revolution, energy needs in the UK were considered rather modest in comparison to today's technologically driven standards (Fouquet and Pearson, 2012). During this period, energy tended to be derived from sources such as animal power, fire, wind or water mills. Importantly, these energy sources tended to be organised on a community ownership and distribution basis (Williams and Martin,

2003). Evidence of this was revealed in the Domesday survey of 1086, where it was stated that there were 5,624 water-powered flourmills in England. This translated into one mill for every three hundred people (Williams and Martin, 2003).

Later, trade success, rural industrialisation and urban growth led to an industrial revolution where the exploitation of coal gave a major source of 'cheap' energy (Fouquet and Pearson, 2012). Concurrently, the transition into new manufacturing processes led to even higher demand for energy. In turn, this amplified the need for labour and resulted in a significant number of people being employed in the production of energy. Further, a significant number of technological developments led to a change in the way we distributed and used energy at both an industrial and domestic level (Wiser, 1999).

By the early 20th century, the UK was supplied with electricity by a patchwork of small supply networks (Hannah, 1979). However, this supply was deemed inefficient and fragmented. To provide a steadier supply, a synchronised nationwide grid was set up based on a series of regional grids with auxiliary interconnections for emergency use. The grid allows for a mix of different energy resources, which supply the country's electricity as per the local demand. Today, the national grid continues to supply the majority of consumers in the UK.

The generators and suppliers of the national grid consist mainly of the 'Big Six' - a term used to refer to a group of vertically integrated energy companies that were consolidated between 1995 and 2002 following energy privatisation of the gas and electric markets in the 1990s. With a market share of over 90%, the Big Six are often criticised for having possible tacit coordination and being driven by profitability over customer service. This has led to high energy bills which have more than doubled over the last decade (OVO ENERGY, 2015).

In 1970, the UK used almost 57 million tonnes of oil equivalent to coals and fuels (DECC, 2009). This proportion has risen swiftly due to recent technological advances. This overreliance on fossil fuels has made the UK and other developed countries more susceptible to the effects of climate change and rising energy prices. In 1997, the Kyoto Protocol established legally binding obligations for developing countries to curb greenhouse gas emissions (UN, 1998). In keeping with this, the UK government committed to a number of efforts that aimed to reduce dependence on fossil fuels. For instance, in 2006, the UK government committed to having all new homes built at 'zero carbon' level by 2016 (Department for Communities and Local Government, 2007). Further, in 2008, they signed up to an EU energy target that aims to increase the contribution of renewable energies to 20% by 2020 (Department of Energy and Climate Change, 2011).

More recently, the UK government seems to have reneged on a number of these efforts – including the removal of the zero carbon homes target and the end of the 'green deal' (a deal that offered homeowners finance to pay for energy saving home improvements). This lack of clarity in matters of community energy, energy conservation and generation in general risks undermining the attainment of energy goals and has resulted in a lack of trust from communities.

Nonetheless, the quest for clean energy has continued to gain momentum. Recent statistics indicate that electricity generation from renewables increased by 21% between 2013 and 2014 in the UK (OVO ENERGY, 2014). However, to meet the 2020 EU targets, the UK must increase the proportion of total energy from renewables to 15%. To meet this target, the government aims to ensure that almost a third of Britain's electricity comes from renewable sources by 2020 (Department of Energy and Climate Change, 2011). It is quite possible that community energy groups could go a long way in contributing towards meeting these national targets (Department of Energy and Climate Change, 2014).

COMMUNITY ENERGY IN THE UK

There is growing interest in energy savings programmes and energy schemes at the community level. This has been marked by the growth in homegrown low carbon generation and a quest for energy efficiency. It is suggested that individuals and communities can make an important contribution to maintaining energy security, tackling climate change and reducing costs. According to the Department of Energy and Climate Change (2014) community led action can produce energy, reduce energy use, manage energy demand, purchase energy and supply enough electricity for one million homes by 2020.

Community energy initiatives tend to emphasise local participation, including aspects of leadership and control, with the local community benefitting collectively from the outcomes. Therefore, to work as intended, the system around it needs to be inclusive to community members to encourage participation that fosters community cohesion. It is suggested that community energy schemes have the potential benefits of economies of scale including lower energy costs and less energy poverty, less carbon emissions and less pressure on the national grid resulting in higher stability (Walker, 2008).

In comparison to other European countries, the sector is relatively small in the UK. For instance, community owned energy schemes make up 40% of renewable energy generation in Germany compared to 1% in the UK. Despite this, the sector is growing rapidly and shows significant scope for further growth in the UK.

ENERGY SERVICE COMPANIES

Energy service companies (ESCOs) are companies that are designed to manage the local production and supply of energy (European Parliament, 2006). ESCOs play an important role of providing the structure through which a community can run community energy projects and manage local energy as per their requirements. Through them, communities can access competitive energy prices and get involved in local energy issues (Hannon and Bolton, 2015). ESCOs have become increasingly popular in the UK. In 2014, there were approximately 30 to 50 ESCOs in operation, an increase from about 20 ESCOs in 2009 (Bertoldi, 2014, p167).

The first step of setting up ESCOs often involves the identification of a suitable case by community members. Often, there will be a group of enthusiastic people within a community who realise the potential benefits of setting up community energy schemes. However, for this to work, this requires the involvement of other community members. Normally, it is useful to have members of the community who are keen to encourage others and get things started. This may be a long process and may take a lot of determination on the part of those concerned.

CASE STUDY: THE MEADOWS

The Meadows is a mainly residential area that is centrally located in an area south of Nottingham City Centre in the UK. Originally, the area consisted of a large area of wetland that was later drained and gradually developed for a variety of uses including housing, public houses, factories, warehouses and public buildings. Today, the largely residential area reveals a tight community structure with a high level of community cohesion (O'Doherty et al., 2015).

The Meadows is one of the poorer areas of Nottingham city and the fuel poverty rates are relatively high. In the UK, a household is considered to be in fuel poverty if they have fuels costs that are above the national median level and if they are left with a residual income below the official poverty line after paying of energy bills (Department of Energy and Climate Change, 2015). The key drivers of fuel poverty are poor energy efficiency in households, the cost of energy and the household income.

Figure 1 Aerial view of the Meadows (highlighted in green) and greater Meadows catchment area (highlighted in red).

In 2009, with the help of the Meadows Partnership Trust (MPT) and the Nottingham Energy Partnership (NEP), a group of local residents from the Meadows set up an ESCO, the Meadows Ozone Energy Services (MOZES), to produce and manage the local delivery of energy in the Meadows and the greater Meadows catchment area (Figure 1). Prior to setting up MOZES, a funding bid was made to help the Meadows become Nottingham's first low carbon community. During this process, with consultation with community members, a full energy and carbon profile was drawn up for the Meadows and ways of enabling energy savings and sustainable energy were drawn up to help reduce fuel poverty and provide local employment. Unfortunately, the project did not get the full amount of funding that it sought. Even so, a group of community members decided to go ahead with the idea of trying to do something about rising energy bills and global warming; this eventually led to the formation of MOZES in 2009.

Since then, MOZES has continued to play a significant role in the community. It has offered a number of programmes to address energy related issues in the community and raised awareness regarding technical and behavioural aspects of sustainability. MOZES offers advice regarding energy efficiency and debt issues to the local community. This provides community members with knowledge to help overcome barriers and inform attitudes towards renewable energy.

In addition to providing valuable awareness, these community information sessions and energy workshops tend to add to the social cohesion of the community. As part of this outreach, MOZES has undertaken campaigns in local primary schools to engage children in energy efficiency matters. Further to this, there are a number of volunteer and employment opportunities in MOZES that aim to get community members even more involved in local energy matters. Owing to these community engagement activities, MOZES has developed a good rapport with community members. This has helped lay the platform for a series of community energy projects in the Meadows.

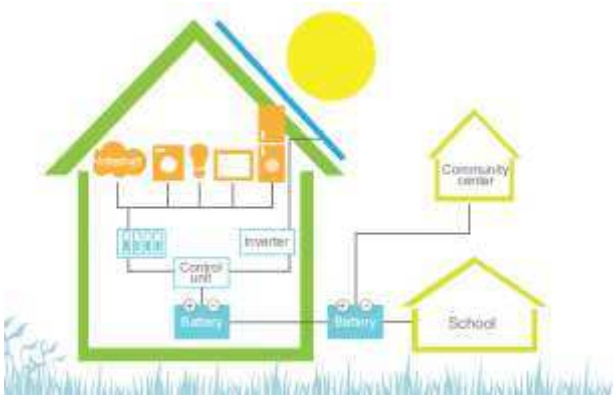

Figure 2: A diagram of the Meadows Community Energy Scheme in Nottingham.

Figure 3: The buildings being considered for inclusion in the Meadows Community Energy Scheme in Nottingham.

Through MOZES, the local community has had access to funding from large organisations and state agencies. For instance, supported by Scottish Energy, MOZES has offered interest free loans for energy retrofit measures to some of the most vulnerable households in the community. Further, MOZES was awarded a grant to install wall insulation or energy efficient boilers. MOZES has been particularly interested in setting up solar photovoltaic (PV) panels for energy generation (Figure 2). In partnership with British Gas, it was awarded £650,000 funding in 2009 from the Department of Energy and Climate Change (DECC) to install solar PV in 65 homes, 3 schools and 2 community buildings in the Meadows. Whilst the sun is shining, residents get the energy that they use for free, the remainder is fed to the grid.

A representative from the University of Nottingham sits on the MOZES board and collaborates with its members on several academic research projects. More recently, the Meadows was selected as one of the demonstrator sites of a major European Union (EU) funded project: Storage-Enabled Sustainable Energy for Building and Communities (SENSIBLE). The SENSIBLE project aims to explore the technical, social and economic aspects of micro-generation of electricity and heat in conjunction with different types of energy storage (O'Doherty et al., 2015). In addition, MOZES collaborates on another EU Project called TURAS, which examines how urban communities become more resilient and more sustainable.

In the Meadows, the SENSIBLE project will examine storage integration in buildings and communities, local renewable energy generation and energy-market participation (Figure 3). It is suggested that the introduction of the battery technology will help individuals to make more efficient use of the energy that they generate. Additionally, community members will be able to come together around a shared energy resource, which they can control.

As a result of this project, 40 households stand to benefit from receiving equipment that will help to manage their energy generation and energy storage to decrease their energy bills. In addition, participants may be offered the option to switch energy tariffs, which in conjunction with the installed system will decrease their energy costs. Importantly, the learning outcomes from this project will be used to inform future projects in the Meadows and other EU cities.

As part of this project, 32 participants made up of Meadows residents completed questionnaires. The aim of this survey was to investigate energy awareness and energy efficiency measures on a community level, with particular focus on energy generation and storage technologies. From this, the researchers were able to get feedback from community members on a number of issues including views on climate change and energy efficiency, community initiatives and energy storage and energy generation, supply and use.

The results of the questionnaire indicated that a significant number of MOZES members were eager to take part in the SENSIBLE project for a number of reasons (see Figure 4). Interestingly, the participants' foremost reasons for taking part included the chance to engage more in the community power initiative and the chance to be 'greener'. This revealed a significantly high level of community togetherness and environmental awareness amongst the participants. The participants also cited the chance to potentially increase energy savings and save money. This showed that they were aware of the potential energy and monetary benefits of micro-generation of electricity and heat and the storage of energy. Other reasons included increased community resilience and the chance to share energy in the community.

Community members' views on climate change and energy efficiency were also explored. Up to 90% of the participants agreed that the issue of climate change was

personally important to them and felt that they could influence the rate of climate change if they applied energy efficiency measures in their homes. This was compared to 73% who actually felt that their homes were energy efficient and 67% who noted that the carefully monitored the use of energy in their properties. Further, 77% of the participants noted that regulatory measures should be employed to encourage energy efficiency households in the UK.

The issue of the cost of energy for electricity and heat was also addressed. From this, it was revealed that only 33% of the participants were satisfied with the price that the currently paid for energy. Additionally, up to 44% of the participants noted that they had been concerned about not being able to pay their energy bills in the past, revealing an indication of fuel poverty. On the other hand, only 31% were concerned by the prospect of not being able to pay their energy bills in the future.

In addition, it was revealed that up to 94% of participants had considered ways of reducing energy consumption in their properties. This included checking energy labelling information when buying appliances. Of these measures, up to 80% of participants were willing to consider investing in low cost measures (of up to £500) to make their home more energy efficient. This number dropped to 59% when considering high cost measures (over £500). However, up to 43% of participants were willing to seek private sources of funding to make their properties more energy efficient.
The community members revealed that they would be more likely to cut down on their energy consumption if they received incentives to do so – key among which included financial incentives for the implementation of renewable energy sources and tighter building regulations (see Figure 5).

Mostly, it was found that the community members had positive attitudes towards community energy initiatives and energy storage. In particular, 97% of the participants agreed that shared community initiatives can help to improve energy efficiency. Further, 90% believed that the shared energy schemes could help to improve infrastructure resilience and social cohesion; whereas 93% believed that they can help reduce energy cost for individual households. In addition, 97% noted that would like to see their community take charge of producing and managing their own energy, with 100% noting that they would be willing to share excess electricity generated in their properties with other community members. Similarly, the commitment levels to the community energy initiative were high with up to 70% noting that they would be open to committing a few hours a month to help run it.

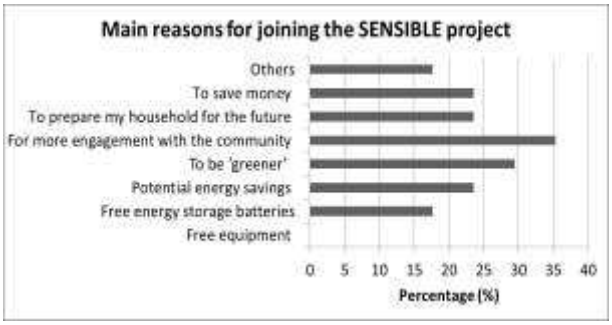

Figure 4: The main reasons MOZES members chose to participate in the SENSIBLE project.

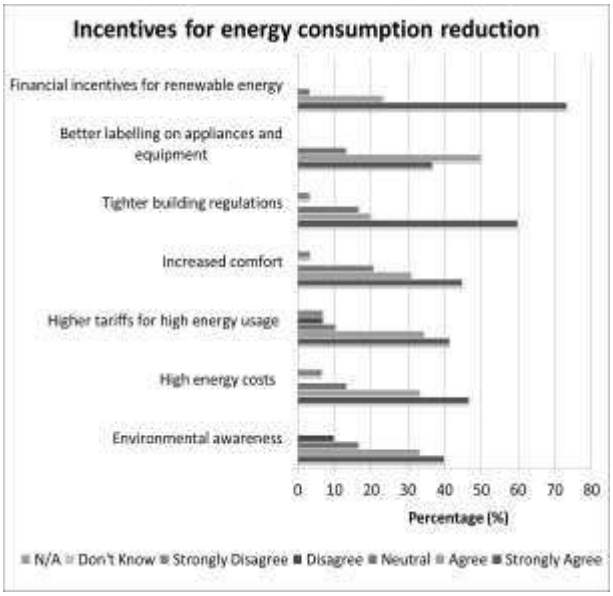

Figure 5 Incentives for energy consumption reduction.

The importance of energy storage to community members was also highlighted with 86% agreeing that centralised energy storage within communities can help improve energy efficiency. Further 100% believed that centralised energy storage within households can help improve energy efficiency. Over the course of the SENSIBLE project further monitoring of the technical and social aspects of the project is set to be conducted, to yield further insights into sustainable community development.

BARRIERS FOR THE IMPLEMENTATION OF COMMUNITY ENERGY SCHEMES

MOZES has done a considerable amount of work in engaging the community on energy matters and setting up of various projects. However, some barriers have been encountered during its implementation and running. These hindrances have stemmed from a number of reasons ranging from lack of funding access to poor government policy and regulatory measures.

In particular, the absence of clarity on community energy and energy conservation by the government has resulted in a lack of trust from community members. This has made it difficult to meet project goals such as was the case in the access of feed in tariffs (FITs) brought on by sudden changes to government state aid regulation. In this case, MOZES has opted to look at community energy storage as an alternative.

It has been highlighted that community energy initiatives require heavy community involvement. However, it was found that a lack of skills, knowledge, resources and capacity could sometimes threaten the meeting of more challenging community energy initiative objectives (such as with the case of renewables or energy storage). In the case of MOZES, this was addressed by various methods including the seeking of professional support (from MPT and NEP) – and the funding for it. The involvement of these bodies also helped to tackle potential technical issues as with the review of the feasibility of initial projects. Further, strong links with key stakeholders such as the University of Nottingham and Nottingham City Homes has also played a significant role that has resulted in productive collaborations such as has been the case with project SENSIBLE and TURAS.

MOZES has experienced some resistance to change within the community especially when discussing the possibility of a locally sited community wind turbine and when looking at external insulation initiatives that changed the appearance of the Victorian terrace houses. A community trip to Swaffham to see a large-scale urban wind turbine has been arranged to help people understand the issues with the wind turbine. In addition, alternative retrofit schemes have been proposed for the street elevations of the more 'sensitive' older houses. The reduction in heating bills for residents who have retrofitted external insulation has been very powerful in changing local residents' perceptions.

CONCLUSIONS AND RECOMMENDATIONS

The way in which energy is produced and used in the UK has developed over time. Currently, the need to reduce carbon emissions and improve energy efficiency is high on the UK government agenda. Community energy initiatives have been shown to have the potential to help meet UK energy targets. For communities, these initiatives also have the potential to help members save on energy costs and reduce their carbon footprint.

Using the ESCOs model, communities can set up local energy companies that help them manage local energy production and distribution. The results of this study have indicated that in the Meadows, MOZES has been instrumental in providing various benefits to community members including: raising community awareness on energy efficiency measures, advising members on debt issues and providing members with the knowledge to help overcome barriers and inform attitudes towards renewable energy.

Analyses carried out as part of the SENSIBLE project revealed that majority of the participants are well informed on community energy matters. Most participants cited that they engaged in community energy for economic and environmental reasons. Other motivations included social benefits and the quest to become more self-reliant. The involvement of partner organisations was also found to be instrumental in the provision of guidance, especially where professional and technical input was required. Further, community members revealed that incentives ranging from financial support or mandatory regulation would encourage them to be more energy efficient.

Overall, despite the limitations, evidence suggests that the main factors that would encourage the success of community energy projects include ready access to funding, organisational capacity, collaborating with key stakeholders (including the government, professionals and funders, among others) and having good relationships with community.

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