

RESEARCH

Just energy transitions? Social inequities, vulnerabilities and unintended consequences

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Abstract

The transitions literature has framed energy transitions as a process involving material and social consequences. Such radical changes can also be viewed as constituting discursive dimensions, involving debate, idea exchange and value positioning. The implementation of a biomass energy system in residential buildings in a socioeconomically deprived community near Liverpool, UK, is investigated for its acceptance by, and impacts on, the community. A mixed-methods approach involving questionnaire, focus group and interview data reveal how practical, on-the-ground energy transitions are understood at the community level. Given the changes to how residents pay for their energy in the study community, from prepayment meters to pay-as-you-use methods, considerations of 'efficiency' are debated and framed on the cost of energy rather than from an environmental performance perspective. Although the intention of low-carbon energy transitions in low-income communities is to deliver economic and environmental benefits, many unintended social consequences arose from top-down decision-making choices and implementation mechanisms. These processes exacerbate economic inequalities and inequities. Justice implications arising from this study have clear repercussions for future implementation of similar, and additional, sustainability interventions that attempt to address climate change in the built environment.

Practice relevance

The successful implementation of a decentralised energy system requires more than a technological approach. This case study emphasises the need for extensive community engagement when undertaking local energy transitions. In particular, attention needs to be given to how vulnerable people are affected by pricing and given clear information on how to use the new system. Policy recommendations include: the choice of energy technologies should not disrupt vulnerable residents' daily routines and ability to pay; the provision of substantial pre-, during and post-installation community engagement is needed to improve familiarity with new energy systems; and adequate opportunities for listening and responding to residents' concerns prior, during, and after the installation of low-carbon energy systems.

Keywords: climate justice; energy inequities; energy justice; energy transition; fuel poverty; public engagement; renewable energy

1. Introduction: towards a new sustainable energy paradigm

1.1. Decentralised energy systems and sustainability transitions

As is the case in most developed countries, the UK energy system is currently characterised by a lock-in to centralisation of energy production. The development of more decentralised sustainable energy systems relies on technological approaches but also on political, social and economic innovations (Chmutina & Goodier 2014). The main drivers of this transition reflect a necessity to reduce carbon emissions as part of the UK Climate Change Act as well as increasing the share of renewables in the energy mix and making energy use more efficient. These drivers go hand in hand with increasing concerns over energy security, rising electricity demand and the price of fuel have also played important roles in encouraging decentralisation of energy systems. Given the need for radical transformations to the ways in which energy is produced and consumed, the energy sector is undergoing changes towards a more diversified, low-carbon and decentralised production model.

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Despite its many definitions and interpretations, the concept of 'transition' has become increasingly central to futures-oriented thinking (Feola & Nunes 2014). To that end, deeply embedded socioecological problems such as climate change urgently require novel approaches with long-term orientations to address environmental sustainability (Geels 2012). The sustainability transitions literature identifies the need for new models of sustainable energy generation and consumption (Geels 2002; Foxon *et al.* 2010; Markard, Raven, & Truffer 2012).

To date, the transitions literature has framed energy transitions as a process involving material and social consequences. Such radical changes can also be viewed as constituting discursive dimensions, involving debate, idea exchange and value positioning. This important discursive element has not received the same level of attention in past academic studies, and significantly in energy system decision-making; primarily undertaken by politicians and stakeholders already established in the energy system. In addition, the importance of local contexts is frequently underestimated or completely overlooked. Issues of uneven development and social inequalities have not featured sufficiently as a core focus of transitions studies. These issues are increasingly receiving attention from transitions scholars. Hansen & Coenen (2015) argue that sustainability transitions happen in situated, particular places. Murphy (2015) points to a need for more in-depth engagement with socio-spatial and socio-technical embeddedness, multi-scalarity, and the role of power in transitions. Bridge *et al.* (2013) argue for research that investigates policy proposals for the low-carbon economy, and the influence of these on current patterns of uneven development. Low-carbon transitions may in fact offer an opportunity to move towards more sustainable societies. Researchers such as Walker & Baxter (2017) point to the potential for community-based energy as a vehicle for addressing both procedural and distributive fairness and justice. However, there is a real risk that transformative change in energy production, distribution and consumption will exacerbate existing socio-spatial inequality and further disadvantage already marginalised groups. The democratic dimension is therefore of crucial importance to address in low-carbon transitions.

The socio-spatial implications of low-carbon energy transition remain under-researched, representing a key knowledge gap. The social acceptance and acceptability of the changes needed for low-carbon energy transitions remain an important area of research. For example, Devine-Wright *et al.* (2017) report that social acceptance of renewable energy storage has been overlooked to date by energy social scientists. A lack of appropriate evidence to inform policy-making and practice may lead to resistance towards technical solutions due to flawed assumptions about user or public expectations. A lack of local support for renewable energy initiatives can be indicative of environmental injustices which can in turn lead to social barriers that slow or stop the progress of renewable energy uptake and proliferation (Walker & Baxter 2017). Stern (2017) argues that, too often, the need for (social science) research on public acceptance is not recognised until a technology begins to face organised public opposition, underlining the need for social science research on public acceptance at early stages of technology development.

The aim of this paper is to explore the ways in which practical, on-the-ground energy transitions can lead to unintended consequences that result in social inequities for vulnerable and low-income communities.

This paper is structured as follows. Section 2 discusses the importance of implementing decentralised renewable energy systems and engaging residents with such projects as part of the transition towards sustainable communities. Section 3 provides an overview of the methodological approach applied in this study. Findings are presented in section 4, relating residents' experiences with how the energy system was implemented and changes to the pricing structure. The paper concludes that the resulting unacceptability of, and resistance to, the energy system is a result of these inequities and vulnerabilities that have numerous implications for future sustainability-related interventions that need to be addressed. Policy implications and recommendations are provided.

2. Energy generation and public engagement in deprived communities

2.1. Social sustainability and energy justice

Although the concept of sustainable development originally included a clear social mandate, the social dimension has been neglected in biophysical environmental issues, or been subsumed within a discourse that conflated 'development' and 'economic growth' (Vallance, Perkins, & Dixon 2011). With the widening influence of the social ecology framework that was enhanced by ecofeminist, eco-socialist and indigenous movement theories, the debate eventually shifted toward an explicit recognition that human social order is vulnerable when facing environmental externalities, natural disasters, and climate change (Eizenberg & Jabareen 2017). Broadly, a social sustainability perspective places society alongside the economy in terms of overall importance and as an end goal in and of itself of development processes (Purvis, Mao, & Robinson 2019). However, the literature describes a diversity of conceptualisations of 'social sustainability'.

The World Energy Council (2019: 11) defines energy sustainability as 'based on three core dimensions energy security, energy equity, and environmental sustainability'. These three goals constitute a 'trilemma', entailing complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual behaviours. Gunningham (2013) describes the complexity of addressing the demands of energy security, climate change mitigation and (particularly in developing countries) energy poverty; these issues are not easily resolved, in the first instance as stand-alone issues, but in particular, when considered in tandem as part of an overall energy trilemma. Heffron *et al.* (2015) argue that the solution to resolving the energy trilemma is through an *energy justice* perspective on the interlinked constituent issues. Energy justice can foster a just and equitable balance between the three dimensions of the energy trilemma. Such a perspective suggests a move away from a primarily

economic or technology perspective on energy. It is noteworthy that the aims of *just* and *equitable* differ qualitatively from aims of *efficiency* and *economy*, which have dominated energy discourse and energy policy to date. Research with energy stakeholders suggests support for this change from outside of academic discourse. Demski *et al.* (2017) suggest policy actions to address affordability concerns should go beyond energy prices, and include additional considerations such as distributive justice and equality, following large-scale consultation with householders in the UK.

Energy justice depends upon three key aspects: distributional, recognition and procedural justice (Jenkins *et al.* 2016; Klinsky & Mavrogianni 2020). Distributive justice concerns the ways the distribution of costs, risks and benefits between different actors is perceived. Procedural justice concerns the perceived fairness of a decision-making process, and is closely related to the degree of participation of different actors within these shared ownership arrangements (Goedkoop & Devine-Wright 2016). Recognition justice allows individuals the freedom to participate, be fairly represented and be offered equal political rights (Jenkins *et al.* 2016). Healy & Barry (2017) argue that more democratic processes are required in relation to engagement with energy systems, in order to actively realise energy justice principles. Equity represents an important dimension, with three defined elements (Eizenberg & Jabareen 2017):

- *Recognition*: revalues unjustly devalued identities.
- *Redistribution*: suggests that the remedy for injustice is some form of economic restructuring.
- *Parity of participation*: promotes substantive public involvement in the production of space.

The transition from a fossil fuelled energy system to one built on renewable energy technology may not resolve environmental injustice if communities still have no say in the decision-making process, according to Newell & Mulvaney (2013). It is clear therefore, that along with a transition in the technology used for generation and supply of energy, an energy justice model mandates radical changes to the social infrastructure enveloping energy systems.

Energy justice scholarship has, for the largest part, paid limited attention to the ways in which people and communities might contribute towards an energy just future from the ground-up (Forman 2017). The need for multi-scalar analysis of energy and low-carbon systems is becoming more apparent as a way to assess the holistic socioeconomic and environmental impacts of energy transitions across a variety of scales (Sovacool *et al.* 2019). The importance of justice issues to community and local energy initiatives in a time of energy transition is an emerging strand of energy justice research. Bottom-up and local perspectives on energy justice are explored by Forman (2017) and Lacey-Barnacle & Bird (2018). Forman (2017) examines how energy justice is negotiated and contested at community-scale through a focus on issues of distributive and procedural justice. Lacey-Barnacle & Bird (2018) focus on distributive and procedural justice, but add recognition justice as a core tenet, that is, considering how marginalised or deprived communities can achieve greater recognition in energy systems. Distributional, recognition and procedural justice constitute the three key tenets of energy justice, as defined by McCauley *et al.* (2013).

Martiskainen, Heiskanen, & Speciale (2018) explicitly connect fuel poverty and community level action, examining how community groups in the UK have addressed fuel poverty via grassroots initiatives to exchange information and advice on energy bills. This work builds upon the research of Walker (2008) which explores decentralised energy and fuel poverty risks. Fuel poverty is recognised as a distinct form of inequality which, while fundamentally an issue of distributive justice, is also implicated in the lack of recognition of vulnerable and marginalised groups (Walker & Day 2012; Lacey-Barnacle & Bird 2018). Spatial, contextual and power-oriented concerns frame energy justice issues for emerging local low-carbon energy transition processes (Lacey-Barnacle & Bird 2018). Energy justice is emplaced, situated and realised in diverse ways depending on the context in question (Forman 2017). The spatial domain of energy justice has been highlighted by Bouzarovski & Simcock (2017), who argue that geographical differentiation in domestic energy deprivation measures constitute a key component of energy justice. Policies to alleviate energy poverty must take into account factors such as the targeting of resources, geographically sensitive stakeholder prioritisation, and means to achieve democratic legitimacy. These questions are directly related to previously mentioned distributional, recognition and procedural justice (McCauley *et al.* 2013).

Sen's seminal work on capabilities is also important when considering energy justice at the community level. As articulated by Sen (2008: 78):

[capabilities] would seem to demand attention in any theory of justice and more generally in social assessment, such as the freedom to be well nourished, to live disease free lives, to be able to move around, to be educated, to participate in public life, and so on.

The significant differences in capabilities distributed across society should be recognised for effective policy development (Catney *et al.* 2014).

2.2. Public engagement with renewable energy

Typically, most forms of public engagement employ consultation-type techniques that often 'informs' individuals and communities about changes to energy supply, service provision and management practices (Arnstein 1969; Morrison & Dearden 2013). In these examples, there appears to be a lack of understanding regarding how to

effectively and meaningfully engage individuals with complex and challenging issues around energy consumption, sustainability and climate change. An emerging literature is beginning to address these gaps in understanding particularly the reasons why, and the ways in which, individuals become involved in such projects, and how these features in turn influence stakeholder responses to such projects (Alexander, Hope, & Degg 2007; Rogers *et al.* 2008; Warren & McFadyen 2010; Axon 2016). This literature has outlined the reasons why individuals and communities need to be better engaged with energy transitions; in order to ensure that individuals are at the heart of such transitions (Arnstein 1969; Morrison & Dearden 2013; Whitmarsh, Seyfang, & Neill 2011; Steg, Perlaviciute, & van der Werff 2015). It is well established that the concept of having 'people on board' supports the implementation and development of new sustainability projects; lack of stakeholder support results in a significant rise in opposition and NIMBYism (Warren & McFadyen 2010; Devine-Wright 2009, 2011). Consequently, public engagement is integral to the success of such projects.

Warren & McFadyen (2010) state that attitudes towards, and acceptance of, renewable energy projects typically follow a 'U'-shaped progression over time. In the beginning, positive responses (when no schemes are planned) are replaced by negative responses (when a local project is proposed and development has begun). A return to positive attitudes is only likely once local residents have gained positive personal experiences from the project. Through understanding these attitudes, it is clear that the perspectives of individuals are predicated on several different perspectives: acceptance, tolerance, indifference, rejection and, even, resistance (Rogers *et al.* 2008; Devine-Wright 2009, 2011; Warren & McFadyen 2010). Engagement has been referred to as 'a personal state of connection with the issue of climate change' (Wolf & Moser 2011: 550). This personal state of connection suggests that engagement has three key components, comprising what people know, feel and do with respect to energy transitions (Lorenzoni, Nicholson-Cole, & Whitmarsh 2007; Wolf & Moser 2011; Ockwell & Whitmarsh 2015). Engagements with sustainability transitions are not fixed, they are dynamic and vary over time dependent on how individuals are influenced by, and can influence, such initiatives.

2.3. Implementing decentralised renewable energy systems

In contrast to energy produced in power plants located hundreds of miles away by the national grid, decentralised energy is produced close to where it will be used. There are significant differences between centralised and decentralised energy systems. For example, consumers do not have to rely on few, large and remote power stations while local generation reduces transmission losses and lowers carbon emissions. Financially, long-term decentralised energy can offer far more competitive pricing structures and have been demonstrated to do so (Alexander *et al.* 2007). Furthermore, decentralised energy systems can address issues of 'distance' whereby individuals feel removed, geographically and psychologically, from the energy they consume and the causes and consequences of climate change (Devine-Wright 2013). There are numerous examples of decentralised energy, these include combined heat and power, waste plants, geothermal, biomass and solar energy (Alexander *et al.* 2007; Chmutina & Goodier 2014). All these decentralised energy systems face particular challenges and drivers that need to be addressed to support their development (Chmutina & Goodier 2014).

2.4. Sustainability in socioeconomically deprived communities

While there has been some focus on opposition to energy sources in communities (Warren & McFadyen 2010; Devine-Wright 2011; Stram 2016), the literature on energy transitions and decentralised energy systems has, so far, not afforded sufficient attention to issues of public engagement with local projects, the challenges of engaging communities, and how such projects can be established in deprived communities (particularly those facing fuel poverty) in-depth. These issues are further compounded by social inequities and inequalities in energy access (Bartiaux *et al.* 2019) that are the result of unintended consequences of attempting to bring about affordable energy to socioeconomically deprived groups. Previous research in this area has not addressed these issues directly, and have drawn upon secondary data analyses to come to conclusions on the role of improving the equitable distribution of opportunities for wider communities to engage in sustainable energy generation (Park 2012; Johnson & Hall 2014). This paper seeks to bring these components together within one case study of a transition in practice, at the time of implementation using primary data collection, that ultimately led to a failure to ensure an equitable energy transition. As such, this research begins to address the gap and highlight avenues for policy and practice to ensure community engagement and equity as part of decentralised energy systems in socioeconomically deprived communities.

Public engagement is vital to the success of decentralised energy systems implemented as part of a community-based sustainability project (Whitmarsh, O'Neill, & Lorenzoni 2013), yet such initiatives have limited strategic direction to meet their aims and objectives given their membership of mostly volunteers with limited prior experience of socio-technical systems change (Alexander *et al.* 2007; Feola & Nunes 2014). However, not all segments of the population are willing to participate in sustainability initiatives, and often sustainability initiatives do not 'work' for deprived and low-income communities that often face challenges of food and/or fuel poverty (Bouzarovski & Cauvain 2016; Simcock, Walker, & Day 2016). Fuel poverty is now widely recognised as a distinct form of social inequality and injustice. It can result in substantial negative consequences for health, education and economic development (Bouzarovski & Petrova 2015; Simcock *et al.* 2016). The challenge for deprived and low-income communities is to address fuel poverty and its consequences whilst also ensuring that sustainability initiatives are tailored to the needs of communities. Addressing

these challenges and placing the needs of communities and their residents at the heart of sustainability initiatives contributes to more enriched understandings of the human dimensions in the energy system (Steg *et al.* 2015; Axon *et al.* 2018).

3. Methods

Focusing on the implementation of a biomass energy system in residential buildings in a socioeconomically deprived community near Liverpool, UK, this paper draws upon focus group, survey and interview data to investigate how practical, on-the-ground energy transitions are debated and framed at the community level. A mixed-methods approach was employed to provide both breadth and depth of understanding, as well as rich contextual and explanatory insights around how practical, on-the-ground energy transitions are debated and framed at the community level in Stockbridge Village. This consisted of semi-structured interviews, questionnaire survey and focus groups.

Semi-structured interviews and focus groups were conducted to explore the views of key stakeholders on the future of the energy system. Qualitative research has been employed to explore the character of energy transitions and particular initiatives within them previously (*e.g.* Martiskainen *et al.* 2018) to refine understandings of the practices embedded within community-based sustainability projects (Axon 2020). Crang & Cook (2007) state that given the main aim of interviewing in ethnographic research is to allow people to reveal their own version of events in their own words, it is important to ask follow up questions in such a way as to encourage, and critically question, the stories told. As such, interviews provide a flexible methodological approach for this study. Given that no two interviews are to be considered 'similar', interviewees have the opportunity to craft their perspectives towards decentralised energy systems with more precision and have the time to 'flesh out' any specified elements to accompany this.

Focus groups and semi-structured interviews are a useful approach to study the dynamics of emotions and perceptions on issues such as climate change, and on people's participatory experiences and interactions with environmental issues (Longhurst 2003; Conradson 2005). These qualitative approaches have been successfully employed to explore the complex understandings and interactions that people have with their everyday environments (Conradson 2005). Qualitative methods, such as focus groups, explore individual perceptions and actions towards such issues in a dynamic, social context (Bryman 2015; Stoll-Kleemann, O'Riordan, & Jaeger 2001). Importantly, focus groups and semi-structured interviews provide insights into why certain relationships do, or do not, emerge and thus perform an explanatory function (Creswell 2009). Moreover, they allow participants to express their beliefs, feelings and behaviours in their own words and expose how individuals construct issues around energy practices, the energy system and its future by drawing on different forms of knowledge, values and experiences (Conradson 2005). Zolfagharian *et al.* (2019) indicates that employing qualitative approaches seeks to answer 'whole questions' to explain the whole, or part of, a transition. The justification for applying semi-structured interviews and focus groups as the primary stage of this research was to provide in-depth understanding of how residents had formed the attitudes they did towards the biomass energy system.

While 82% of energy transition studies employ qualitative approaches, only 9% adopt a mixed methodological research design (Zolfagharian *et al.* 2019). To complement the rich qualitative data from semi-structured interviews and focus group discussions, a bespoke survey was also conducted. For this, a short questionnaire was developed, with the primary aim to discover residents' visions for the future of the energy system. The goal of survey research is to acquire information about the characteristics, attitudes and behaviours of a population by administering a uniform questionnaire to a sample of individuals (McLafferty 2003; Bryman 2015). Survey research is particularly useful for eliciting public attitudes and perspectives regarding social, economic, political and environmental issues; and valuable for investigating complex behaviours and social interactions (McLafferty 2003; Parfitt 2005). Zolfagharian *et al.* (2019) state that quantitative approaches are useful in to answer questions regarding transition policies, otherwise referred to as 'pathway questions'. The survey was employed to indicate the acceptability of energy sources residents would like to comprise the future of the energy system and provide a profile of residents related to whether they struggle to pay their energy bills.

3.1. Community profile: Stockbridge Village

Stockbridge is located 6 miles east of Liverpool, and is one of the most deprived communities in England (Knowsley Council 2014). The community itself is one of the least socio-demographically diverse communities in the UK with substantial numbers of residents recorded as being in fuel poverty. An overview of the socio-demographic characteristics is provided in **Table 1**.

3.2. Biomass energy system change

In February 2016, UK-based contractor Forrest was chosen to handle £7 million of upgrade works including biomass energy installation across five tower blocks in Stockbridge replacing natural gas energy generation (ForViva 2016). As part of this investment, Village Housing Association (which is a ForViva group member) introduced a new energy-efficient biomass heating system to replace electric storage heaters. Two biomass boilers, 500 and 300 kW, respectively, burn wood pellets to provide heat for 450 homes. The installation is expected to reduce CO₂ emissions by 22,000 tonnes over the system's lifetime compared with fossil fuel energy generation (*Insider Media* 2016). The project was completed in October 2016. This investment is part of Village's wider strategy to improve 1200 homes in Stockbridge and follows

Table 1: Socio-demographic characteristics of Stockbridge Village (Knowsley Council 2014).

Characteristic	Stockbridge	England (average)
Male	52.5%	50.7%
Female	47.5%	49.3%
0–4 year olds	7%	6%
5–15 year olds	12%	13%
16–64 year olds	64%	63%
65+ year olds	17%	18%
Population who are 'White British'	95.9%	79.8%
Households with one or more children	50%	43%
Houses owned by residents	32%	63%
People who say they are in 'very good' health	43%	47%
People who have level 4 qualifications or above	10%	27%
People with no qualifications	44%	22%
Households with two or more vehicles	12%	32%
Overall claimant count	5.7%	1.8%
Economically active	58%	70%
Retired	15%	14%
Students	4%	6%
Looking after home or family	6%	4%
Long-term sick or disabled	13%	4%

external wall insulation and internal improvements to the five high-rise blocks (Macro 2017). The total cost of the biomass system is estimated to be £4,846,436, with half of the costs provided by the European Regional Development Fund (ERDF) (REECH Project 2014). The biomass project is also supported by payments through the UK government's Renewable Housing Incentive (RHI) scheme, which will contribute to a return on investment in under four years. The new system replaced the existing electric storage heaters, which had a weekly fixed charge of £8 for residents energy bills. The new biomass energy system also changed the in-flat meters to pay-as-you-use metering systems. Residents have protested against the cost of the newly installed energy system previously, having been told the yearly cost would be between £350 and £450, yet some residents have complained that their energy bills have cost £360 in the first three months. It has been reported that some residents have described feeling 'suicidal thoughts, tears and anger' (*Liverpool Echo* 2017). Furthermore, other reports have led to residents with health conditions to sleep in their cars rather than their homes after paying 20–30% of total income on energy bills (*The Mirror* 2017).

3.3. Data collection

From June 2016 to January 2017, questionnaires were distributed to residents in Stockbridge during the community engagement phase and reported testing phase (which lasted from June to September 2016 in a small number of residential units). Responses were conducted as part of a face-to-face engagement method to ensure higher ratios of completion rather than undertaking other methods of survey data collection such as postal and online surveys (McLafferty 2003; Bryman 2015). Respondents were approached in the geographical centre of the community and asked to participate in the study. For the survey, respondents were asked about their preferences for the future of the energy system including what energy sources, identified stakeholders and interventions to be applied that would support their desired energy transition. In total, 99 respondents completed the questionnaire during this time period. An overview of the socio-demographic profile of respondents is provided in **Table 2**.

Focus groups and interviews were conducted between October 2016 and February 2017, shortly after implementation of the biomass energy system within the five tower blocks. Participants were asked a series of questions relating to the future of the energy system including what energy sources they believed should support energy system transitions. As part of the focus groups and semi-structured interviews, participants discussed their perspectives towards energy issues and their experiences of the recently installed biomass energy system between 45 minutes and 2 hours. The socio-demographic characteristics of participants are shown in **Table 3**.

Table 2: Socio-demographic profile of questionnaire respondents.

Male	46
Female	53
<i>Total</i>	<i>99</i>
18–25 years	11
26–35 years	17
36–45 years	20
46–55 years	22
56–65 years	13
66–75 years	5
76+ years	5
Not known	6
<i>Total</i>	<i>99</i>

Table 3: Socio-demographic profile of focus group and interview participants.

Date	Data collection	Code	Age (years)	Gender	Ethnicity	Occupation
November 2016	Focus group	FG1P1	31	Female	White British	Communications officer
	Focus group	FG1P2	24	Female	White British	Full-time mum
	Focus group	FG1P3	42	Female	White British	Full-time mum
	Focus group	FG1P4	28	Female	Black British	Full-time mum
	Focus group	FG1P5	49	Female	White British	Parent mentor/admin
	Focus group	FG1P6	40	Female	White British	Unemployed/mum
	Focus group	FG1P7	32	Female	White British	Carer
	Focus group	FG1P8	34	Female	White British	Childminder
December 2016	Focus group	FG2P1	56	Female	White British	Unemployed
	Focus group	FG2P2	55	Female	White British	Unemployed
	Focus group	FG2P3	53	Female	White British	Unemployed
	Focus group	FG2P4	55	Male	White British	Unemployed
	Focus group	FG2P5	45	Male	White British	Unemployed
October 2016	Semi-structured interview	IP1	49	Male	White British	Community volunteer
January 2017	Semi-structured interview	IP2	50	Female	White British	Administrator
January 2017	Semi-structured interview	IP3	55	Female	White British	Unemployed
January 2017	Semi-structured interview	IP4	53	Male	White British	General labourer
January 2017	Semi-structured interview	IP5	37	Female	White British	Mother/carers
February 2017	Semi-structured interview	IP6	39	Male	Black African	Food waste consultant
February 2017	Semi-structured interview	IP7	45	Male	White British	Teacher

3.4. Data analysis

Data arising from the closed-ended questions from the survey were analysed using a frequency analysis, after the method reported by Bryman (2015). Qualitative data arising from the questionnaires (specifically responses to open-ended questions), focus groups and interviews were recorded with informed consent of the participants, were transcribed verbatim, and analysed as part of a thematic analysis approach. Analysing qualitative data using thematic analysis is a widely used qualitative analytical framework focusing on identifiable themes of living and/or behaviour (Braun & Clarke 2006). Thematic analysis involves different stages such as becoming familiar with the data; generating initial codes; and developing, reviewing and defining themes. Initial codes were defined into broader themes that

were reviewed and validated to ensure all coded data fitted within each theme and that the themes represented the data accurately. Examples of themes that arose from the thematic analysis of the focus groups and semi-structured interviews were current expense of energy and conscious energy use to reduce costs; renewable energy preferences in the context of uncertainty of long-term viability of the fossil fuel industry; evaluations of biomass energy system from direct exposure of implemented changes; weighted considerations of energy efficiency from the new biomass system opposing paying more for energy use; and the limited scope of long-term community engagement before, during, and after system change. These themes, largely, provide an appropriate narrative to present our discussion, following an 'emic' (participant-led) approach (Bryman 2015).

4. Results

4.1. Profile of energy poverty

Questionnaire respondents were asked how much they spent on their energy bills per month under the newly installed system as well as how often they struggled to pay them. These findings are illustrated in **Figures 1 and 2**.

The findings show that while that majority of respondents pay less than £100 a month on their energy bills, 90% of questionnaire respondents struggle to pay their energy bills every month, with just under half of respondents stating they struggle to pay their bills every week. Knowsley, where Stockbridge resides, is the second most deprived district in the country where the average total income ranks in the bottom 20% of districts nationally and 72% of individuals have experienced fuel poverty. A total of 86% of those who live in social housing and 82% of those with a private landlord are more likely to be in fuel poverty in Knowsley (The Energy Advisory Service 2014). This demonstrates the substantive social inequities and vulnerabilities of the study population.

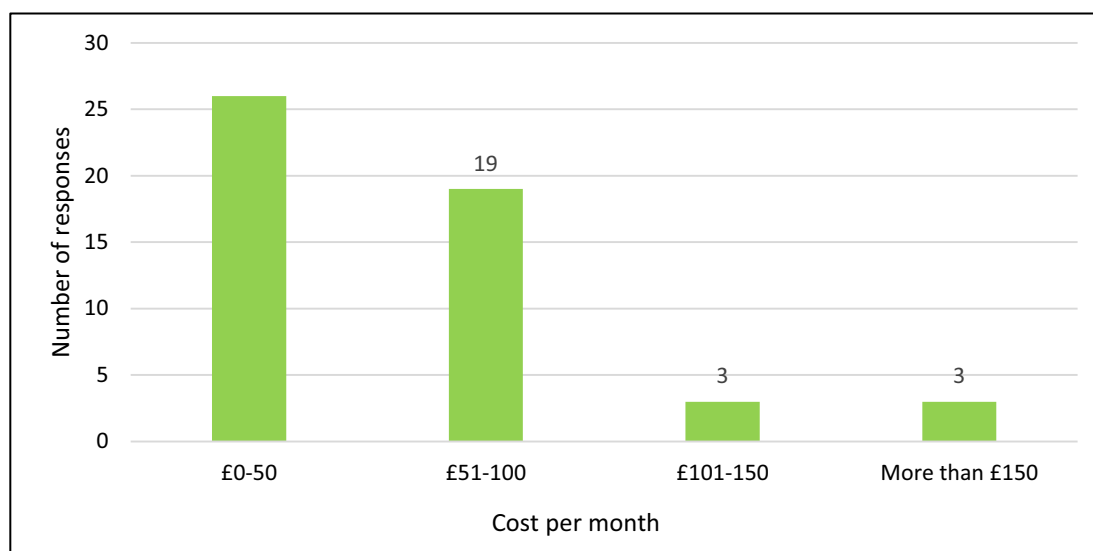


Figure 1: Monthly energy payments by survey respondents.

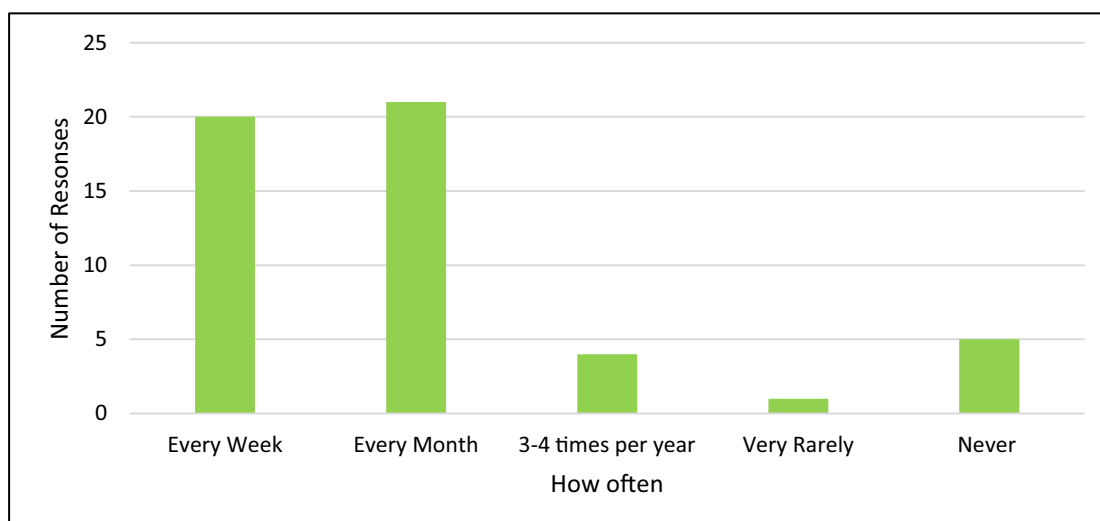


Figure 2: Frequency to which respondents struggle to pay their energy bills.

4.2. Framing energy in socioeconomic deprived communities

Initially, residents framed their perspectives towards energy within a generic support or opposition framework towards particular energy sources such as renewables, fracking of shale gas and fossil fuels. Yet, while these comments reflected positive or negative attitudes towards specific energy sources, they were also substantiated with respect to issues such as cost, information and uncertainty:

Renewable energy I think is the way forward. It's economical and more or less free. Probably (energy) from waste [...] convert it to gas and electric so we don't have to do fracking which a lot of people don't like and costs a lot. (FG1P8)

I would have solar panels if I trusted the companies that provided it but I don't trust them and I think they're trying to con me out of something. (FG1P1)

More renewable because you don't know how much longer the coal, oil and gas are going to last. I don't think people are comfortable with nuclear. (FG1P7)

I would like to know the benefits of nuclear and fracking. There's been a lot of news about it and I'd like to know more about it to make an informed choice. (FG1P5)

Participants justified their preferences and support for renewable energies in terms of financial gains and minimising environmental impacts whilst also attempting to reduce the dependency on fossil fuels. The UK's most recent energy policy highlights that reducing the dependency on imported fossil fuels is a key goal (DECC 2013). Moreover, negative attitudes towards fossil fuels and fracking appeared to further strengthen positive responses towards renewable energy. Such responses reflected perspectives that there was substantial uncertainty surrounding the benefits of, and lack of support for, both nuclear energy and fracking. These responses suggest that despite nuclear energy and fracking of shale gas to play an increased role in the future of the UK's energy system, social unacceptability and uncertainty remain high (Pidgeon, Lorenzoni, & Poortinga 2008; Whitmarsh *et al.* 2015), yet some participants wished to find out more about these energy sources. This suggests that while residents are not 'comfortable' with these energy sources, this may be a result of a lack of information for individuals to address a lack of understanding about how energy is produced, and the environmental consequences arising, from these methods.

One of the largest themes arising from the stakeholder engagement identified that residents within Stockbridge had difficulty with paying their energy bills. Justifying this perspective, participants outlined that since the installation of the biomass energy system their energy bills have, in some reported cases, increased:

It's (energy) too dear. A lot of people can't afford it (energy bills). Some people are paying £40 a week. (FG2P5)

I pay weekly for my energy. I put £25 on my gas and £25 on my leccy [electric]. (FG2P3)

I'm very conscious about the energy I use. I don't know whether I'm in credit or out of credit. I just go careful. My cat grows an extra coat in winter. (FG2P1)

Within a socioeconomically deprived community, it is unsurprising that participants highlighted that they have difficulty paying their energy bills. Given that Stockbridge has a high unemployment rate (40%), those who are unemployed and in receipt of a Jobseekers Allowance (currently £73.10) suggest that they pay over half of their weekly money on their energy bills. Consequently, energy is framed as a substantial economic issue within Stockbridge, and this has implications for social practices. Some participants stated they were uncertain about the pricing of energy and their credit status that resulted in conscious and conservative energy use. As such, some residents believed that frugal use of energy was an appropriate response. This illustrates how energy prices can impact on residents. Importantly for energy transitions it illustrates that tailoring approaches to the needs of residents within communities, particularly identifying the affordability of energy for citizens and potential issues of energy and fuel poverty in socioeconomically deprived communities should be taken into account. The challenges of engaging deprived and low-income communities that often face fuel poverty with sustainability has yet to be addressed in the academic literature or in practice (Bouzarovski & Cauvain 2016; Simcock *et al.* 2016).

4.3. Attitudes towards biomass energy systems

Residents in Stockbridge held particularly negative attitudes towards the implemented biomass system. These negative attitudes were predicated on their experiences so far (at the time of data collection within the first six months of implementation) and reflected issues such as increased cost of energy use, a lack of support for residents as well as a lack of effective and appropriate information during the initial consulting period:

Some do (like it) and some don't. But everyone to their own, isn't it? (FG2P4)

There's more that don't like it. (FG2P3)

I think that's one of the downfalls is that they're not willing to help you [...] the housing trust. (FG2P4)

But didn't you get offered £20 on a card to help you but you never got it? How many weeks did you wait for that? £20 doesn't work. They can't see how much they owe and if they're going to run out. (FG2P3)

They've fitted it in, threw a fella in here with 80 people and they've all screamed and balled, walked out not knowing what's going on and it gets fitted and you're left. You don't get the help. (FG2P3)

While some participants thought that overall community attitudes towards the biomass system were balanced, others suggested that there were more residents who held negative attitudes. These attitudes were substantiated within the context of several issues. Specifically, a lack of support for the residents in adjusting to the new technology, as well as a lack of compensation for correcting inconsistencies between payments of the previous energy system and the biomass system have contributed to negative attitudes. Moreover, a lack of appropriate information relating to the decentralised energy system during the engagement process prior to installation was criticised by residents who suggested that this resulted in feelings of bewilderment and confusion. It is essential that the engagement process effectively supports local communities (Arnstein 1969; Morrison & Dearden 2013) that are preparing for energy transitions in order to support acceptability and involvement (Axon 2016). If sustainability initiatives are pushed through irrespective of how well the engagement process takes place, this may have significant impacts on citizen engagement following implementation. There are lessons to be learnt here for the governance of energy transitions and decentralised energy systems particularly. While it may be seen as successful to install renewable energy systems, following installation it is citizens and everyday residents and energy users that are affected by such projects, and who will ultimately determine whether the transition has been a success or not.

4.4. Ambiguous sustainabilities: Energy efficiency versus economic efficiency

Given that the higher user costs of the biomass system were repeatedly identified as a substantial theme underpinning individual attitudes, this also reflected perspectives towards how economically efficient the renewable energy system was. Despite these comments no participant identified any energy efficiency related components of the newly installed system, instead identifying changes to pricing structures:

The system before you paid £8 a week and you could have your heating on 24/7 all year round. Then they took that away and put the radiators in. (FG2P2)

I was paying £13.77 for my heating a week but they've stopped taking that out now because you've got to pay for it yourself now. So you're paying for your electric and your gas, two different things. Which is not right, it should all come off the electric. I'm paying £20 a week. But one girl is paying £45 a week! (FG2P4)

Given the changes to how residents pay for their energy in Stockbridge, from prepayment meters to pay-as-you-use methods, considerations of 'efficiency' are debated and framed on the cost of energy rather than from an environmental performance perspective. This is striking, given that throughout the engagement process with residents, it was noted how much more energy efficient the implemented biomass energy system would be for residents. Yet, no participant mentioned energy efficiency when discussing the biomass energy system. The main result following the installation of the biomass energy system has been a relative increase on the cost of energy compared to the previous system. Previously, residents could use as much energy (heating and electricity) as they desired for a flat rate of £8 per week. The change in the metering system to one with current readings on energy use was unfamiliar to Stockbridge residents, who previously lived without a smart meter. While metering is essential to manage energy consumption, this requires individuals to be familiar with the newly installed metering technology. The findings from this study demonstrate that they are unfamiliar with smart technologies and are unable to account for what is, and is not, energy wastage within their lifestyle practices. Indeed, proponents of this argument further exacerbate social inequities given that carbon footprints for low-income communities are substantially lower than middle- and high-income bracket groups (Oswald, Owen, & Steinberger 2020; Steinberger, Lamb, & Sakai 2020; Wiedmann *et al.* 2020), placing the burden of addressing sustainability challenges on those most vulnerable.

Consequently, any changes in usage patterns are immediately viewed as related to financial aspects. It is understandable that residents' energy use has not changed despite the changes to the pricing structure as few interventions that support behavioural changes accompanied the implementation of the decentralised energy system. This reveals a lack of coherent strategy that did not place the residents at the heart of the energy transition. This reinforces the notion that energy transitions, even at the local level, are implemented from a top-down approach that fails to engage citizens effectively. A democratic deficit exists in the case study's energy policy and transitions.

4.5. Some implications

The installation of the biomass energy system has, for residents, resulted in several implications in addition to changes in attitudes and behaviour. While negative attitudes have been reported, a substantial number of residents have outlined that they have not received support with the new energy system installed in their homes. This has led to changes in energy use as well as uncertainty surrounding usability and how to change energy providers and pricing costs:

A lot of people have been over to the housing association and have been complaining loads and they're not getting no help whatsoever. (FG2P3)

I hardly turn my heating on. I can't read my meter, it's knackered. I can't even see what I'm using. Told them 4 weeks ago, I'm still waiting. (FG2P5)

It's taken a while to get used to and working it out [...] how long you have it on for, how long you don't have it on for, if you need to have it on and if you don't. (FG2P4)

People are frightened of change now. I've been with British Gas for years and I'm frightened to change because I think what is going to happen. I know they say it's cheaper but is it? Am I going to change and then it's more dearer? (FG2P3)

Fundamentally, participants outlined a substantial lack of support to enable them to read their energy meter and use their new energy system. Residents outline that straightforward and practical dimensions of using the new system (*i.e.* how long to have their heating on) have not been addressed by those who installed the biomass system. Consequently, residents asked for further support beyond the initial installation period and many reported that they have yet to receive support. This case highlights important implications for local engagement processes. These results indicate that it is necessary to provide practical and non-technical information to accompany changes to the ways in which people use energy. Applying behavioural interventions such as tailored information during periods of change (*e.g.* new energy system installation) have been shown to increase understanding of energy efficient appliances and lead to behavioural changes (Verplanken 2011). Additionally, the language used by some participants (*e.g.* feeling 'frightened') when used to describe their uncertainty surrounding changing their energy providers illustrates that there are substantial affective responses towards energy transitions. Affective responses are often overlooked in sustainability-related projects, yet their importance within everyday behaviours can help drive engagement practices with energy transitions (Axon 2016).

Such responses illustrate how changes in energy supply (even a transition towards renewable energy systems) can alter individual and community attitudes towards energy, and not necessarily for the better. While residents in Stockbridge generally held positive views towards renewable energy, it is clear that the engagement process, implementation period, governance of the system resulted in uncertainty and negative attitudes, irrespective of the environmental benefits of renewable energy systems. This illustrates that transitions to decentralised sustainable energy models involve more than just the energy source. The everyday responses and practices of citizens constitute a critical dimension of local energy configurations and are of primary importance given that acceptability and usage patterns are determined by these practices. Without effective engagement approaches during and following the implementation phase as well as interventions applied to support individuals, such energy transitions will fail to bring about meaningful change.

Considering the implications arising from the installation of the biomass energy system in Stockbridge, participants suggested how these barriers could be addressed. In so doing, participants outlined that there were a series of interventions and measures that could be taken to support residents within socioeconomically deprived communities. These measures include explaining the pricing structure changes and how to practically use new energy systems within their own home:

It's got to be more practical. (FG2P1)

Have someone that knocks at each flat and gives them a date to come in to your house and say 'this is how it works'. As it is, it's not caring about people. You need people to explain how it's going to work. (FG2P3)

I've only just got a smart meter but I've had none of it explained as how to use it yet. I know you put it on a wire and it tells you how much you use but I've not even looked at it yet. (FG2P2)

Have an open day. Have somewhere like a hall where you can get a couple of people from different companies and explain what's what and how it works and what the benefits are. (FG2P4)

Each individual has to come along to it (an open day). (FG2P2)

Residents identified that overcoming these barriers requires practical support provided to residents. Recommendations included one-to-one support, information provision and awareness raising to improve user interaction and engagement with the energy system installed within their home. Such interventions have been known to improve knowledge, and when applied during periods of change these measures have their most impact (Abrahamse *et al.* 2005). To support the implementation of the biomass energy system, participants acknowledged that smart meters were helpful when identifying accurate energy usage, yet some identified that they were unable to use the technology and required support. The suggestion that open days and similar community engagement activities should be established indicates a desire for multi-actor support (beyond immediate actors) and an extension to the engagement process. This illustrates a need for continuous engagement that goes beyond the installation of decentralised energy systems as well as a desire to improve their own acceptability of biomass energy. These responses highlight the importance of long-term engagements with energy transitions and place citizens at the heart of transitions (Axon 2016).

5. Discussion: A spectrum of engagement

If decentralised energy is to play a substantive part in the transition to a low-carbon future, implementation in communities needs to be supported by more effective public engagement approaches. The findings presented illustrate that the implementation of the residential biomass energy system in Stockbridge has not been initially successful in several ways. These specifically relate to changes in pricing structure, failings in public engagement approaches prior to the installation of the biomass energy system and a lack of support offered to residents that can effectively address issues arising following implementation. It is clear that this is a case of ineffective and poor practice that has failed to consider the intricacies and needs of the community. Consequently, this example neglects the human factor in the energy system that places citizens at the heart of energy transitions throughout the planning stages, engagement process, installation period and implementation phase. In so doing, the project has had several unintended consequences for residents.

Negative attitudes towards biomass energy (generally) arose as a result of how the system was implemented. The top-down implementation of the system could lead to individuals' resentment of decentralised energy systems in the long term. These negative attitudes may also spill over towards other sustainability-related interventions, *e.g.* behaviour change techniques.

The qualitative data from this study have demonstrated the capacity to which residents in socioeconomically deprived communities have little to no agency in energy transitions, while others appear to have little interest. While there is a willingness to take a more active role in decision-making on community energy matters, this is inhibited by a series of top-down governance factors. This comprises our *characterisation* of energy actors. Across large parts of the focus groups and interviews, many participants discussed how reliant they were on the previous energy system and its pricing as opposed to others that preferred renewable energy technologies (and other energy efficiency methods) and their benefits and/or disadvantages. These statements informed the *interaction with technology* section of our spectrum. The final category, *scope for engagement in transitions*, was comprised of participant comments identifying the various failures in the implementation phases and being clearly used as a test site while others identified engagement methods and spaces for engagement within the testing and implementation stages, as well as continued feedback following implementation to continually improve the system.

The capacity of stakeholders from across the entire socioeconomic spectrum to engage with the low-carbon transition is important from both instrumental and moral/ethical perspectives. On the instrumental side, proactive community engagement in any low-carbon transition would help to avert or mitigate social unrest which profound societal readjustment is inevitably going to produce as well as reduce opposition to proposed transition solutions. From a moral and ethical perspective, low-carbon transitions raise fundamental social justice questions. The challenge of a low-carbon economy is as much an issue of equity and social justice as well as of environmental protection. Citizens at the lower end of the socioeconomic spectrum are likely to be worst affected in any low-carbon transition due to higher proportional energy burdens and more constrained capacity to absorb additional costs, as evident from our case study findings. **Figure 3** presents a *spectrum of residential transition engagement capacity*, developed from the insights of this study. A distinction is made between six groups of residential energy actors, with different levels of capacity to engage in, and benefit from, low-carbon transitions processes. These groups include:

- *The energy excluded:* Groups with little/no agency in energy decision-making, including very marginalised groups, groups with high levels of dependency or energy users in institutional contexts with little to no influence on how they use energy. The key issue for this group is not exclusion from use of energy but exclusion from capacity to have any real agency over this use.
- *Precarious consumers:* Groups on low incomes and in energy and/or fuel poverty, very low levels of agency in energy decision-making and compressed and short-term energy decision-making time horizons.
- *Passive consumers:* Consumers not in energy/fuel poverty but who afford little thought to energy other than to consume and pay bills periodically. Levels of agency may range from minimal to significant, but under-exercised.
- *Fit and forget householders:* Residents who have engaged minimally in low-carbon transition initiatives through for example, engaging with home insulation schemes or through investments in energy efficiency appliances. Typified by some level of agency and some limited capacity to engage in low-carbon transition initiatives.

INCREASING FINANCIAL CAPACITY						
Residential Energy Actors	"Energy Excluded"	"Precarious Consumer"	"Passive Consumer"	"Fit & Forget Householder"	"Conscious Consumer"	"Active Prosumer"
Characterisation	- No agency in energy matters - May have limited to no access to electric energy - Developing World – not grid connected - Advanced Economies – Gender, Intersectional Aspects	- Access to energy under constraint - Typified by pre-pay meters, inability to obtain credit - Little scope to consider energy switching - Very limited agency	- Limited interest or awareness of energy matters - Reliance on energy utility - May /may not consider energy switching	- One-off installation of energy saving materials; - Potential installation of RE technology, but with limited engagement or active involvement	- Makes conscious choices to reduce energy wastage - May face structural, economic and contextual barriers - Would want to be more engaged if circumstances permitted	- Actively involved in management & ownership of energy generation - Energy Generation through investment in technology - Benefit from Feed-in-Tariffs
Interaction with Technology	Energy technology already in place – no capacity for influence	Energy technology already in place – no capacity for influence Reliance on: Pre-pay meters	Technology already in place – capacity for influence not fully exercised, if at all	Fitting of: ▪ Insulation ▪ Glazing upgrade ▪ RE Technology	Some high-impact technologies already in place – limited capacity to make structural changes	Fitting of: • Insulation • Glazing upgrade Management of: • Smart Meters • RE Technology
Scope for Engagement in Transitions	Actively Excluded From Engagement	No Capacity For Engagement	May be influenced by awareness levels and/or capacity issues	May be influenced by awareness levels and/or capacity issues	May be influenced by pricing and structural change	Active engagement in Transition; Scope for financial gain

Figure 3: Spectrum of residential transition engagement capacity.

- *Conscious consumers:* Those residents who make conscious and deliberate efforts to reduce energy use. These individuals may face contextual or structural barriers, e.g. renting their properties or inability to afford technologies, which prevent them from being active prosumers.
- *Active prosumers:* Those residents who are actively engaged in low-carbon energy transition through investment in, and production of, energy through renewable energy technologies. Typified by high levels of interest as well as high levels of agency and capacity to invest.

The categories in **Figure 3** should not be considered as absolute, but rather as indicative groupings. There may be a strong crossover between the two categories of 'Fit and Forget' and 'Active Prosumer', for instance. Residents with rooftop solar photovoltaics (PV) installed who do not fully engage with the financial and energy savings potential of the technology might be more accurately classified as 'Fit and Forget' rather than 'Active Prosumer'. In addition, certain technologies will either require high or low levels of behavioural changes (including lifestyle changes) in order for the full environmental credentials of the intervention to materialise. For example, insulation would require low levels of behavioural change due to fit-and-forget qualities while solar renewable technologies would require high levels of behavioural responses, for the full potential of the technology to be realised. A detailed profile of householder engagement with a range of energy saving and energy generating technological interventions is available in Axon, Aiesha, & Morrissey (2017).

Figure 3 suggests the low-carbon transition raises the prospect of further lock-in in socioeconomic deprivation as those on lowest means not only continue to face energy poverty issues but are actively excluded in becoming participants in local energy generation activities and associated wealth generation from this. Findings further underline the key element of agency as a critical part of the human factor in the energy system; in terms of capacity to influence the system and ability to change circumstances at the individual level. It is clear that differentiated engagement strategies are needed from a policy standpoint for stakeholder groups with different levels of agency, control and capacity.

A current lack of alignment between top-down and bottom-up approaches is undermining progressive energy justice outcomes (Forman 2017). In addition, a limited recognition of the uneven capacities and complex nature of 'community' risks the development of policy frameworks which are untargeted and based on a 'reactive' approach (Catney *et al.* 2014). In policy terms, a capabilities approach directs government to think from the start about obstacles to full and effective empowerment for all citizens, as well as effective measures to address these obstacles (Nussbaum 2011).

From a fuel poverty perspective, the cultural and political recognition of vulnerable and marginalised social groups and the opening up involvement and influence in decision-making processes are key to deliver recognition and procedural justice outcomes (Walker & Day 2012). Clear recognition and procedural justice instruments can enhance the social acceptance of new technologies. Perceptions of fairness influence perceptions of legitimacy for energy infrastructure project outcomes and fairer processes increase acceptance of outcomes (Gross 2007). Social acceptance is crucial to successful uptake and proliferation of renewable energy infrastructure (Friedl & Reichl 2016).

The case study of biomass at Stockbridge clearly presents the challenges, frustrations and barriers faced by the 'energy excluded' and 'precarious consumers'. These groups are faced with energy justice challenges on both distributive and procedural fronts; the pressures of the low-income energy burden are especially evident for residents in Stockbridge. However, their capacity to influence future changes based on sustainability principles is very limited, if not outright restricted. The case study further emphasises the need for extensive community involvement in local energy transitions. In particular, the importance of community buy-in, support and acceptance of low-carbon solutions is fundamental to their long-term success. The Stockbridge example raises questions on procedural justice at the micro-local scale, particularly for disadvantaged communities who may already have limited agency in local decision-making. To date, energy justice issues have been framed predominantly on the extraction side. For example, Schlosberg & Carruthers (2010) and Kosmicki & Long (2016) detail the disproportional impacts on marginalised groups such as the poor, indigenous peoples and women from hazardous environmental sites. However, this case study further highlights the need for a forward-looking energy justice, particularly in view of the rapidly changing and highly dynamic nature of current energy system transformation. Swilling & Annecke's (2012: xiii) 'Just Transitions' concept is very important in this regard:

what is at stake is not simply a transition to a mode of production and consumption that is not dependent on resource depletion and environmental degradation, but as important is the challenge of a just transition that addresses the widening inequalities between the approximately one billion people who live on or below the poverty line and the billion or so who are responsible for over 80 per cent of consumption expenditure.

A 'Just Transitions' paradigm focuses on ensuring existing environmental inequalities are not reproduced or exacerbated, while preventing new ones (Dueholm-Rasch & Köhne 2017). In the Stockbridge case study, clear power asymmetries are evident. Furthermore, there is evidence of the use of 'transitions' language and concepts to enact change, according to the preferences of those more powerful actors. A more in-depth analysis of power relations in transitions processes, linked to behavioural features of relevant agents (Gazheli, Antal, & van den Bergh 2015) is required for a clear understanding of what a 'Just Transition' is.

6. Conclusions and policy recommendations

Without continuous and outright reference to 'equity' and 'vulnerability', it is clear that there are various contributing factors underpin the unintended consequences of implementing decentralised renewable energy generation projects in socioeconomically deprived communities. Evidence from the extensive stakeholder engagement conducted suggests that how decentralised (biomass) energy systems are designed, communicated, governed and implemented strongly influences how it is framed in the minds of users, and subsequently, their practices. The core contribution this article provides to the energy and climate justice literatures is the spectrum of residential transition engagement capacity: this case study demonstrates that residents in socioeconomically deprived communities have very little agency: very little capacity to engage in, and benefit from, low-carbon energy transitions processes apart from that at a tokenistic level.

These transitions need to be cautious in the treatment of consumers so as not to assume that technological interventions will be widely accepted amongst the community. Herein lies numerous multifaceted conceptions about socioeconomically deprived communities that result in the social inequities identified in our case study.

The injustice in this case study primarily lies in treating vulnerable people as 'guinea pigs'; as an experiment to identify whether a decentralised biomass energy system would work in high-rise tower blocks. Rather, this vulnerable population should have been provided with a decentralised renewable energy system that would have caused no, or even minimal, disruption to the fabric of daily life. Therefore, the first policy recommendation is to ensure that socioeconomically deprived communities and vulnerable populations are transitioned to tried-and-tested energy technologies that do not result in substantial disruption to daily routines and energy pricing. Installing energy technologies that are unfamiliar to residents who are used to different pricing structures and how this equates to their own routinised patterns of behaviour will, undoubtedly, affect the lifestyles and quality of life of those who have much lower carbon footprints as a result of lower consumption practices. Such disruption is environmentally, economically and socially unjust.

The exploration of an energy transition in practice has yielded valuable insights into the ways in which new decentralised energy technologies are tested and then fully implemented within these communities. There was a failure to consider the needs of the local community: knowledge on how changes in pricing structure would influence energy bills; being taught how to change settings on new smart meters, thermostats and timers; and requiring a period of time for familiarisation. A second policy recommendation is: implementation and testing phases require substantial pre-, during and post-installation community engagement with new energy systems that improve familiarity. Such engagement methods require practical techniques such as a pop-up shop or open days demonstrating the technical aspects of new systems. This would also minimise post-installation disruption and adverse lifestyle changes that may result otherwise.

Throughout the implementation and testing phase, numerous concerns were raised by residents and suggestions on how to ameliorate problems as they arose were offered. Observations of the community engagement process throughout the implementation phase supported residents' claims that requests for support (*e.g.* information, timeline clarifications,

and disruption minimisation) were denied. This leads to the third policy recommendation that: residents should be provided adequate opportunities to be listened to and supported prior, during, and after the installation of low-carbon energy systems. This support should be reinforced through a comprehensive community engagement process that, at its core, can attempt to address issues at their infancy rather than allowing them to develop; causing tension between residents and constructors as well as souring relations with housing associations. Based on the principles of distributive and procedural justice, real community engagement and empowerment potentially delivers the low-carbon transition, while simultaneously averting or mitigating the social unrest which profound societal readjustment is inevitably going to produce.

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The authors have no competing interests to declare.

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