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'Domesticating' low carbon thermal technologies: Diversity, multiplicity and variability in older person, off grid households

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HIGHLIGHTS

- We interviewed 17 households with conventional/low carbon thermal technologies (LCTTs) in South West England.
- Older adult, off grid households commonly use multiple, diverse and variable heating technologies and fuels.
- Reducing fuel costs was a key reason for installing LCTTs.
- LCTTs more commonly were integrated with, rather than replaced, conventional technologies.
- Expected reductions in domestic carbon emissions due to LCTTs may not be realised.

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ABSTRACT

The uptake of low carbon heating technologies forms an important part of government strategies to reduce carbon emissions. Yet our understanding of why such technologies are adopted and how they are engaged with post-adoption, particularly by older adults living in off-grid areas, is limited. Drawing on a contextualised, socio-technical approach to domestic heating, we present findings from 51 in-depth interviews with a sample of 17 older person households in the South West of England, with ages ranging from 60 to 89 years. Diverse and multiple configurations of heating devices and fuels were found that varied considerably, with some households using five different fuels. The design of the study ensured that approximately half the sample used some form of low carbon thermal technology, such as heat pumps and biomass boilers. Many factors were reported to influence the adoption of low carbon heating; environmental motives were not primary influences and the avoidance of financial risks associated with 'peak oil' was expressed. Low carbon thermal technologies were typically integrated into rather than replaced existing heating systems so that valued services provided by conventional technologies could be retained. Implications of the findings for policies to reduce carbon emissions, particularly in older adult, off-grid households, are discussed.

1. Introduction

Domestic energy use accounts for more than a quarter of carbon dioxide emissions in the UK and housing has been identified as a sector where energy use and associated carbon dioxide emissions may be cut (Palmer and Cooper, 2011). Understanding and reducing domestic energy use is not a new aspiration; research into energy consumption dates back several decades and has drawn on a range of disciplines (McDougall et al., 1981; Shove, 1998; Hazas et al., 2011). Increasing awareness of the impact of climate change and the importance of sustainability have highlighted the urgency with which energy consumption must be tackled (Hazas et al., 2011), reflected in the UK government target of cutting greenhouse gas emissions by four-fifths from 1990 levels by 2050. To achieve this, homes will not only need to become more energy efficient but there will be an increasing focus on householders using low carbon technologies for heat and power generation (DECC, 2011). The UK housing stock is old and government initiatives such as the Green Deal (DECC, 2012c) aim to help meet the 2050 target by providing funds to retrofit existing homes. Given that space and water heating totalled 60% and 18% respectively of UK domestic energy consumption in 2011 (DECC, 2012a), low carbon thermal technologies (LCTTs) such as heat pumps, biomass boilers and solar thermal provide an option for customers to change to 'greener', and potentially cheaper alternatives (OFT, 2011).

Gas is the main fuel used for domestic heating (83% of homes) in the UK; nevertheless 3.3 million homes are off the gas grid (Baker, 2011) and 51% of these are in rural areas (OFT, 2011). Off grid households rely on other fossil fuels such as oil, LPG, and solid fuels for heating, and often use other fuel sources in addition to their primary heating fuel (Baker, 2011; OFT, 2011); for example, wood or coal may be used to supplement the use of electricity for

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heating (SPA Future Thinking, 2011). Off grid rural householders are seen as ideally placed to take advantage of low carbon heating because of their reliance on more expensive fuels and their ability to house the 'hardware' associated with technologies such as ground source heat pumps and biomass boilers (DECC, 2012b). Uptake to date has been higher in rural areas (OFT, 2011); typically, early adopters of LCTTs have been middle class home owners, aged 45+, living in larger rural properties that are not connected to the gas grid (Roy et al., 2008). A field trial by the Energy Saving Trust suggested that households with heat pumps still commonly used supplementary forms of heating (Caird et al., 2012) but there was little emphasis in this study, and in the literature more generally, upon how LCTTs may be integrated, post-installation, into existing thermal comfort technologies and practices.

Research on domestic microgeneration has largely employed quantitative methods and concentrated on two areas: the adoption of LCTTs, drawing on innovation theory (e.g. Caird et al., 2008; ECL, 2008; Caird and Roy, 2010); and analyses of technical performance and system efficiencies post-installation (e.g. EST, 2010; DEE, 2011). Older person households will be an important consumer group for LCTTs, given that this social group is growing in size in the UK and other countries. It is estimated that the proportion of the UK population aged 60+ will increase from 14.4 million in 2012 to 21.6 million in 2050 (United Nations Population Fund and HelpAge International, 2012). The development of an ageing society is forecast to increase residential energy demand because retired people spend more time at home and potentially have higher energy requirements (Roberts, 2008), but an emerging research literature involving older people suggests that they may be less likely to invest in renewable thermal technologies. Mahapatra and Gustavsson (2008) reported that the percentage of respondents planning to install a new heating system decreased with age. The authors suggested that older owners might be less likely to install a new heating system if they did not expect to recoup their investment. Willis et al. (2011) found that older person households were less inclined to adopt discretionary microgeneration technologies such as solar thermal, solar PV and wind turbines and Sopha et al. (2010) found that older age was statistically significant for choosing electric heating over either a heat pump or a wood pellet stove. Owen et al. (2013) concluded that older people in fuel poverty might prefer to be 'late adopters' or 'laggards' in adopting air source heat pumps. Given the wider contexts of an ageing society and efforts to decarbonise domestic heating, there is a need to better understand the extent to which, and how, older adults are engaging with these technologies both prior to and after installation. As Caird and Roy (2010) noted, adopting these technologies is not the same as making carbon savings with them.

We argue that understanding how LCTTs are engaged with requires a perspective that goes beyond linear, individualistic views of technology adoption. A co-evolutionary approach (Brand, 2005) views technological change as an inherently social and cultural process (Shove et al., 2009), involving the mutual shaping of material and non-material aspects. Moreover, we emphasise the importance of context, here pointing out important ways that LCTTs become emplaced within a particular kind of space—the home (Aune, 2007). 'Low carbon homes' have become a prevalent policy agenda over recent years, yet in ways that favour a narrow, technocentric perspective (Reid and Houston, 2013). In contrast, a contextualised, socio-technical approach to how LCTTs become adopted and used would view the home as more than a physical container into which technologies are installed (Easthope, 2004).

This socio-cultural conception of the 'low carbon home' is compatible with recent approaches to thermal comfort. Historically, thermal comfort research was informed by engineering-led approaches that focused upon measuring and producing 'optimal' thermal conditions for building occupants. The 'new approach' (Cooper, 2009) takes as a starting point the diverse, systemic and adaptive character of thermal comfort in which people respond to the environments and conditions they inhabit, and to the historical and cultural underpinnings of how comfort is played out in everyday life. Empirical research is accordingly less concerned with the experimental worlds of climate chambers, and more with capturing the ways that thermal comfort is experienced and adapted in situ by building occupants; how the 'demand' for comfort is socially and culturally produced (Wilhite, 2009) while being intimately wrapped up with its 'supply' through technologies, ideas and policies (Shove et al., 2009).

We draw on the concept of 'domestication' to reflect the process whereby technologies become integrated into the 'moral economy' of a household (Silverstone et al., 1992). Here a process of technological change such as moving from fossil fuel to low carbon domestic heating systems is not reduced to technological attributes such as cost or carbon emissions, or adopter attitudes and behaviour. Instead, the focus is to better understand how LCTTs become embedded within a complex assemblage (Latour, 1988) of people, artefacts, knowledge, practices and institutions (Sorensen et al., 2000). Pre-existing socio-cultural values, including notions of cosiness, sociability, status and autonomy, may play an influential role (Aune, 2007; Hards, 2013; Petersen, 2008; Wilhite and Lutzenhiser, 1999); and the physical/material setting, both internal and external to the home, will shape and constrain what options are considered practical or feasible in rural, off-grid contexts. Yet our current understanding of how novel low carbon thermal technologies become 'domesticated' into off-grid homes post-adoption, and how their use may be shaped by such values and meanings, is limited.

To address these gaps, this study aimed to deepen understanding of how low carbon heating technologies are accommodated within the household to provide thermal experiences which are valued by the occupants. Our focus is upon households off the gas grid inhabited by older adults, noting their reliance upon expensive fossil fuels (Baker, 2011), suitability for LCTT installation (DECC, 2012b), and the findings of existing research suggesting that these are less likely to adopt LCTTs (Sopha et al., 2010). Taking forward the primarily quantitative and individualistic survey work undertaken in the UK to date (e.g. Caird et al., 2008, 2012; Caird and Roy, 2010), we chose to use qualitative methods to provide in-depth accounts of how and why householders engage with both conventional and low carbon energy technologies. The central questions are: (1) What assemblage of people, technologies and fuels feature in rural, off-grid households, including those containing LCTTs? (2) What factors are reported to underlie the adoption of LCTTs? (3) To what extent do low carbon technologies replace conventional, fossil fuel technologies or become integrated within existing home heating systems?

2. Method

To recruit a mix of households with low carbon and conventional thermal technologies, a short survey was sent to members of three environmental groups based in Devon in South-West England, asking about domestic low carbon thermal technology usage in people aged 60+. Eight households were selected covering a range of low carbon technologies[1] (heat pumps ($n=4$), biomass log boilers ($n=2$), and solar hot water ($n=2$)) and asked if we could interview at least one occupant of the household. Six survey respondents agreed to participate; two people with heat pumps did not respond despite follow up emails and telephone calls. To recruit households with conventional thermal technologies, two short news items about the study were published in a local newspaper, inviting readers to participate in the

[1] We did not recruit solar PV users unless they also had an additional type of LCTT installed, on the basis that solar PV on its own does not alter the thermal environment.