



Original research article

# Low-carbon retrofits in social housing: Interaction with occupant behaviour



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## ABSTRACT

The turnover of the UK housing stock is such that CO<sub>2</sub> emissions reduction targets will require extensive refurbishment of existing homes. Both within the literature and in practice, there is limited understanding of the interaction between housing energy efficiency refurbishment and occupant behaviour. The authors implemented interview-based qualitative research into energy-related behaviours before and after an energy efficiency refurbishment project on social housing in the north east of England. Half of the sample also received an information intervention. Template analysis identified seven key patterns affecting energy behaviour: access to knowledge and skills; nature of technical intervention; habit; external circumstances; quality of technical intervention; convenience of technology; and thermal comfort. These findings were discussed in relation to Social Practice Theory and competence, material and image as components of practice. The research provides an insight into the interaction between occupants and retrofit technologies in the context of a social housing retrofit. It is recommended that policy makers and implementers of retrofit programmes ensure that competence, material and image considerations are integral to retrofit programmes for energy use practice to change and more optimal CO<sub>2</sub> emissions reduction achieved.

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## 1. Introduction

As part of national and global efforts to reduce carbon dioxide (CO<sub>2</sub>) emissions, the UK Government has developed a range of energy efficiency policies aimed at the domestic sector. For example, the Low Carbon Transition Plan [1] outlines targets for the domestic sector including a 29% reduction in greenhouse gas emissions for the domestic sector by 2020 (2008 baseline) and smart meters (meters capable of remote monitoring of energy for the supplier) in all homes by 2020. The Energy Act 2011 [2] created the legislative framework for the Green Deal, an energy efficiency support scheme launched in 2013. The Green Deal scheme is a financing mechanism from energy efficiency improvements, which enables the occupier to pay for the improvements through savings in their energy bills. It is mainly aimed at supporting retrofits by private owner-occupiers.

Extensive refurbishment of existing homes is central to achieving a reduction in CO<sub>2</sub> emissions because the UK's turnover of housing stock is relatively slow compared to most developed

countries and approximately 87% of the current housing stock will still be standing in 2050 [3]. There is great potential for the proposed national retrofit programme to reduce carbon emissions from homes, contribute to economic growth and provide other benefits such as the reduction of fuel poverty. The Energy Saving Trust [4] has estimated that about 24 million homes, that either exist now or are built before 2016, will still exist in 2050. Therefore, on average 600,000 homes per year, or about 12,000 homes per week will need to be refurbished with energy saving and low carbon technologies in the next four decades, to meet the 80% emissions target.

As third sector organisations, approximately 1900 Social Landlords across the UK have a key role to play in the programme of housing refurbishment, as they are responsible for 3.8 million homes [1]. Gentoo Group is one of the largest Social Landlords in the UK. In order to establish the most effective retrofit measures to both increase energy efficiency and reduce CO<sub>2</sub> emissions for its housing stock, Gentoo Group undertook a project named 'Retrofit Reality' which began in 2008. As part of the project, research was undertaken to address the question: *How does an energy efficiency retrofit project impact on energy use practice?*

This research is a contribution to the understanding of energy consumption using methods from social sciences. The research

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team was multi-disciplinary and included Gentoo Group as a practitioner; both of these factors are unusual for research in the energy sector [5]. There is a recognised need for depth of investigation into routines, statuses, beliefs and knowledge which interact with energy consumption [5,6].

This research aimed to investigate factors which impact on energy use practice, whilst the physical infrastructure underwent retrofit. The objectives of the research were:

- To identify, through comparisons of pre- and post-retrofit interviews, interactions between self reported energy use practice and physical infrastructure
- To identify, through implementation of a written information intervention to 50% of the sample, the impact of advice with retrofit on energy use practice

An understanding of occupant energy use practice can assist in the design and performance measurement of retrofit programmes. The findings of this research are therefore timely and contribute to a greater understanding of barriers and enablers to retrofit energy saving effectiveness.

Section 2 provides a summary of some literature on energy use practice. In Section 3 the method of this study is described. Section 4 explains the results of the interviews, and the conclusions from the study are provided in Section 5.

## 2. Literature review

Population growth, increasing demand for new housing and an ever-increasing standard of living means that domestic energy use, and the associated level of domestic carbon emissions, is higher than ever, and is continuing to rise [7–9]. Previous research has shown that the amount of energy used in homes is partly dependent on the behaviour of the occupant(s) [10–13] and that domestic energy consumption can vary widely, even ‘between similar households in nominally identical houses’ [14]. This makes any prediction of energy efficiency retrofit performance with regards energy saving complex, further complicated by issues of comfort ‘take-back’ [15] and ‘rebound’ [16,17].

Energy consumption is a subject of research in the field of *practice theory*. Energy use is a form of consumption as the consequence of a range of different social practices as Warde [18, p. 131] points out: “Consumption occurs as items are appropriated in the course of engaging in particular practices”. Accordingly, much consumption is ‘inconspicuous’, and energy consumption in particular is ‘invisible’ [19]. Shove [20] described social practice as an integration of three elements:

- Material (objects, things, also infrastructure)
- Image (symbolic meanings, conventions ideas and interpretations)
- Competence (procedure, skills)

Hand et al. [21] have illustrated these elements in the context of the practice of daily showering. In this case, ‘image’ is the concept that getting clean and fresh daily is socially acceptable; ‘material’ would be the plumbing infrastructure, water heating and showering equipment; and ‘competence’ the skills and knowledge to make that equipment work, and to fit the practice around other daily practices.

Shove and Southerton [22] used practice theory as a framework to examine the adoption of the freezer in British households. This example is framed in terms of the way in which freezers have fitted into the changing organisation of domestic life, particularly the

increasing participation of women in the workforce and associated sales narratives. # Moreover, the authors emphasise that the freezer partly creates the conditions that it alleviates – by helping to solve the problem of limited domestic time under conditions of increased working hours, it in part perpetuates that condition by enabling it to continue. # Gram-Hanssen [23] analysed standby consumption of appliances in ten households in Denmark, and found, using a practice theory framework, that families adjusted technology and routines after receiving information which challenged their perception of social norms and provided relevant knowledge. # From the same project Gram-Hanssen [24] considered practice theory, to understand difference in heating energy consumption for five families in identical properties.

Midden et al. [25] noted that technology and behaviour are closely interwoven in many respects, and they described four main roles that technology plays: as *intermediary*, where the technology is a conduit between the behaviour an individual carries out to reach a goal; as *amplifier*, where the technology amplifies, enhances or extends the individuals goal attainment; as *determinant*, where the technology creates context or environment surrounding the individual, thus influencing or shaping behaviour through the technology’s existence, and; as *promoter* of environmentally significant behaviour, where technology is specifically designed to promote behavioural choices leading to the conservation of natural resources.

The emphasis which practice theory gives to material makes this a useful construct to use in interpreting this research, given the objective to analyse the impact of a change in material (the infrastructure of the home) on energy use practice. Midden et al.’s consideration of the role of technology shall also be used in interpreting the results.

In analysing the energy research of three leading journals over a fifteen year period, Sovacool [5] identified that human-centred methods such as interviews were a less common method of analysis. He proposed that these human-centred methods are needed to provide the depth of understanding of routines, statuses, beliefs and other factors which influence energy consumption. Stern [6] proposed that convenience was a major factor in the effectiveness of weatherization promotion schemes, and that determinants of energy consuming behaviours are “many, complex and context dependent”. Araujo [26] called for depth in research on practices, perceptions, knowledge and finance in relation to the energy transitions research field. This research attempts to address these issues of depth, of human-centred methods and of context dependency.

The research team wished to investigate whether a retrofit intervention would lead to greater impact if combined with an information intervention. Previous research on information interventions indicate that they can lead to changes in energy use behaviour [27]. This includes evaluation of prompts [28], individualised social marketing approaches in which information is tailored to the needs, wants and perceived barriers of individual segments of consumers [29,30], commitment strategies [31], eliciting implementation intentions in which people indicate how they plan to reduce their use [32], and modelling and providing information about the behaviour of others [24,33]. Assessments of smart meters (i.e. that show consumption clearly) found their impact was linked to the ways the monitors are domesticated into the social practices of the household [34].

The success of CO<sub>2</sub> emission reduction policies and strategies rely on feedback from practical and ‘real world’ research projects to build the knowledge base. Drawing on experience from a recent large-scale retrofit project: ‘Retrofit Reality’ by Gentoo Group, we present results regarding the energy use practice self-reported by the tenants involved in the project.

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