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Retrofitting social housing in the UK: Home energy use and performance in a pre-Community Energy Saving Programme (CESP)

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ABSTRACT

Improving household energy efficiency is regarded as key to significantly curtailing domestic greenhouse gas emissions. Various policy instruments have been introduced to retrofit the existing domestic building stock in the UK; however, many fail to acknowledge the significant role that occupants' lifestyle play in energy use. The research discusses the results of a survey questionnaire administered to the residents of one of the pilot CESP schemes in Aspley, Nottingham. Factors affecting domestic energy consumption are explored, some of which relate to the building design, while others are under the direct control of the occupants. Significant findings related to home performance, home energy use, and tenants' lifestyle are investigated in the first phase of the research. The total number of responses to the survey represents 10% of around 900 properties eligible for the CESP scheme that have not been approached for the scheme uptake. It is evident from the survey results that the majority of the sample is aware of the basic energy-saving actions in everyday life but are not likely to take up the more difficult actions. In summary, retrofit programmes will reduce carbon emissions to some degree, whereas the bigger challenge is addressing habitual household energy consumption.

1. Introduction

Energy use in the UK domestic sector accounts for a significant proportion of total national energy consumption. In 2012 domestic energy consumption accounted for nearly 29% of the total UK consumption of energy products [1]. Statistics, as may be expected, show that a significant proportion of household carbon emissions are due to space and water heating [2] and it is estimated that these activities account for around 83% of energy consumed in homes [1]. At present, it is estimated that the annual consumption of an average UK household is approximately 16,500 kWh gas and 3300 kWh electricity [3], which accounts for almost 5.5 tonnes of carbon dioxide emissions per household, per annum [4]. The UK Government has set a target for the reduction of carbon emissions by 80% by 2050 [1]. In order to meet the UK Government carbon emissions reduction targets, domestic emissions have to reduce by 17 $MtCO_2$ per annum by 2050 [5].

Policies targeting newly built stock have failed to improve the UK's current domestic energy situation by meeting short- and medium-term environmental targets. Of those government initiatives: Warm Front, Smart meters programme, Carbon Emissions Reduction Target (CERT), Renewable Heat Incentive (RHI), Community Energy Saving Programme (CESP), amongst others. Thus, retrofitting existing domestic stock is considered a major priority to significantly reduce carbon emissions from the domestic sector; the current vision is to upgrade seven million homes by 2020 [6].

The CESP is designed to target income-deprived homes in defined areas through a house-by-house, street-by-street approach. The CESP is particularly focussed on barriers to the uptake of energy efficiency measures in low-income areas and 'hard-to-treat homes'.[1] In the CESP target areas, there are barriers to implementing energy-efficiency measures for householders including lack of capital, lack of awareness, hidden costs and landlord/tenant split incentives, among others. The scheme promotes a 'whole house' approach by installing a combination of measures that include internal wall insulation, loft insulation, replacing

[1] According to the BRE (2008) report, a 'Hard to Treat' dwelling is defined as "one that, for whatever reason, cannot accommodate 'staple' or cost-effective fabric energy efficiency measures. Four categories of dwellings have been considered HTT; dwellings with solid walls, dwellings off the gas network, dwellings with no loft and high-rise flats."

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inefficient boilers, and fitting modern kitchens and bathrooms [7]. Those measures are delivered through partnerships between local authorities, energy companies, housing associations, and community groups. These partnerships have been designed to involve community-based organisations which are more engaged with their communities, alongside energy suppliers, thus facilitating the level of scheme uptake.

Despite considering policy initiatives a potential instrument for driving pro-environmental and sustainable behaviour [8–13]; the probability for policy and programmes to control energy consumption within households is relatively low when it comes to people's personal privacy and comfort concerning their own lifestyles and behaviour [14]. While there is evidence of a reduction in household carbon emissions in response to policy initiatives [15–18], this does not necessarily indicate that people are changing their way of life in order to lower their household energy consumption [12,19]. A significant implication to energy consumption behaviour is the 'rebound effect' [20] which may happen with energy efficiency improvements. With lowered energy consumption through, for example, energy efficiency measures, it has been mooted that cost savings (and as a result availability of more disposable income) could be diverted to other, equally environmentally damaging means such as purchasing more energy consuming appliances, increasing frequency of travel, purchasing of cars and so on [21]. Indeed, the UK Energy Research Centre predicts that the rebound effect could offset 10–30 per cent of energy savings [22].

Such implications have been discussed in previous studies, particularly those surrounding the feasibility of achieving the UK carbon reduction targets and the level of impact that policy might have on users' behaviour to support achieving these targets [23–25]. Other studies [26–28] found that lifestyles, habits, and social-demographic characteristics have a direct influence on patterns of domestic energy consumption. Some of these implications are explored in the present study. The article presents an overview of the data collected and analysed regarding home performance and energy consumption, and occupants' lifestyle and behaviour. It critically examines and reflects on some of the key findings from the survey, to explore how a sample of 'hard-to-treat' solid wall dwellings performed, and to assess trends of energy consumption of tenants of those dwellings.

2. Research context and background

Household energy consumption is influenced by various societal factors (both internal and external); these comprise technological developments, economic growth, demographic factors, institutional factors and cultural developments (known as TEDIC factors) [29 as cited in 19,30]. These five general macro-level factors (TEDIC) form the societal context that inevitably influences individual behaviour. Furthermore, there are interrelated forces that drive household energy consumption behaviour which have been explained in several studies [10,11,19,31–33]. It has been noted that energy use depends on multiple factors within households, including the family size, lifestyle, energy consumption behaviour, and appliance ownership [10,11,19,31–33]. Nonetheless, the choices of individuals are a key factor in the process of energy consumption. What people are willing to do in the interest of the environment depends critically on life-course experiences, current life-course phase and physical infrastructure of households [34]. Significant energy use differences may also be observed between income groups and among ethnic cultures [11,35,36], besides attitudes, norms and beliefs which are very powerful energy consumption factors [8]. These are a few factors that dictate the demand for heating, cooling, and appliance use. However, it has been reported that full accounts of energy consumption determinants still do not exist [28].

It is inevitable that domestic energy-use determinants are interdependent and act within a range of combinations rather than additively according to each unique situation [33]. In order to encourage pro-social and pro-environmental individual behaviour, four key instruments were suggested by Gardner and Stern [36]: government laws, regulations and incentives; programmes of education, which attempt to encourage pro-social behaviour by giving people information and trying to change their attitudes; small social groups and communities, and the use of moral, religious, and/or ethical appeals. The first method, 'government law, regulations and incentives', is investigated in the present research as one of the potential instruments for driving sustainable energy consumption behaviour in the domestic sector.

In the UK, climate change policy planning has been closely related to energy policy. During the last decade, the UK has set a major priority to achieve low carbon emissions and to secure energy supplies driven by three core objectives; climate change, energy security and fuel poverty [37]. Given its contribution to energy consumption and carbon emissions, it is considered that the UK's domestic sector, consisting of both new and existing buildings, is a considerable domain where the Government's 2050 carbon reduction targets can be partly met.

The Building Regulations for new buildings set the target of zero carbon homes by 2016 and zero carbon buildings by 2019 [38]. The UK Government suggested a three-step policy approach to zero carbon homes. These steps are: good fabric energy efficiency, on-site heat and power technologies, and allowable solutions for further carbon emissions reduction on site [39]. Thus, all new homes are required to have a mandatory Code for Sustainable Homes (CSH) indicating whether they had been assessed, and the performance of the home against the Code. The CSH extends on the Energy Performance Certificate (EPC), which has been mandatory since 2008 whenever a building has been built, sold or rented out.

In order to help achieve this target through the existing domestic sector, the UK Government launched several initiatives and programmes in response to the diverse requirements of this sector. Primary among these is the Heat and Energy Saving Strategy (HESS), introduced in 2009 with a view to saving energy and decarbonising heating. The HESS incorporated several schemes such as the Carbon Emissions Reduction Target (CERT), Feed in Tariffs (FiTs), and the Community Energy Saving Programme (CESP) among others [40]. The Aspley Super Warm Zone (ASWZ) has been chosen for the research as one of the 100 pilot CESP schemes in England, particularly in the East Midlands. It has also been specifically chosen for the investigation as, at the date of writing, no comparable research has been undertaken on ASWZ or any other CESP scheme in England.

3. Research methodology

3.1. Research aim and design

The study investigates the interrelationships between home energy efficiency and performance, and household energy consumption patterns. The aim is to understand the physical and socio-economic variables that affect home energy performance and energy consumption behaviour of a sample of households prior to the CESP energy upgrade, and gauge the findings against a sample of households post energy upgrade. The main objective is to make recommendations to support successful delivery of current and future policy schemes related to energy efficiency in the domestic sector.

The research adopts a 'before-and-after' design, which is a set of measurements taken from a group of respondents who are then subjected to an experimental variable before being measured