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Modelling the potential to achieve deep carbon emission cuts in existing UK social housing: The case of Peabody

Andrew Reeves *, Simon Taylor, Paul Fleming

Institute of Energy and Sustainable Development, De Montfort University, Leicester LE1 9BH, UK

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ABSTRACT

As part of the UK's effort to combat climate change, deep cuts in carbon emissions will be required from existing housing over the coming decades. The viability of achieving such emission cuts for the UK social housing sector has been explored through a case study of Peabody, a housing association operating in London. Various approaches to stock refurbishment were modelled for Peabody's existing stock up to the year 2030, incorporating insulation, communal heating and micro-generation technologies. Outputs were evaluated under four future socio-economic scenarios. The results indicate that the Greater London Authority's target of a 60% carbon emission cut by 2025 can be achieved if extensive stock refurbishment is coupled with a background of wider societal efforts to reduce carbon emissions. The two key external requirements identified are a significant reduction in the carbon intensity of grid electricity and a stabilisation or reduction in householder demand for energy. A target of achieving zero net carbon emissions across Peabody stock by 2030 can only be achieved if grid electricity becomes available from entirely zero-carbon sources. These results imply that stronger action is needed from both social landlords and Government to enable deep emission cuts to be achieved in UK social housing.

1. Introduction

Over the coming decades, the UK faces the considerable challenge of achieving deep cuts in carbon emissions from its existing housing stock, as part of the global effort to combat climate change. Social housing makes up around a fifth of UK homes, and social housing providers are likely to be at the forefront of efforts to comprehensively refurbish existing UK housing to achieve substantial emission cuts. This research has explored the viability of achieving deep carbon emission cuts (defined here as reductions of the order of 60% or beyond) within existing social housing. This was carried out through a case study focusing on one UK housing association, Peabody (formerly the Peabody Trust), which manages 18,000 homes in London. The stock refurbishment measures required to achieve deep emission cuts for Peabody's existing stock have been assessed, alongside the impact of a number of contextual factors (such as resident demand for energy) that influence the measures that Peabody are able to carry out and the emission cuts achieved. The research reported here is part of a more extensive study incorporating analysis of the affordability, viability and acceptability of the measures considered in this paper, reported in full in Reeves (2009).

Progress on carbon emission reduction was assessed against the GLA's target of a 60% reduction in London emissions by 2025 relative to a 1990 baseline (GLA, 2007) and the aspiration of achieving zero net carbon emissions for Peabody stock by 2030. The former is the key political target applying to Peabody for the period considered in this study (up to 2030), and is based upon the same aspiration for stabilisation of atmospheric carbon dioxide levels as the UK Government's longer term target of achieving 80% emission cuts by 2050 (DECC, 2009). Based upon the carbon budget given in GLA (2007) for existing housing emissions in 2025, and assuming further emissions arising out of the construction of planned new housing up to that date, the GLA target translates into an average reduction of emissions from existing housing in London of 57.4% by 2025 (Reeves, 2009). This was used to assess progress by Peabody in meeting the GLA target. The zero carbon target is put forward as an upper level aspiration to explore the viability of the calls from some studies (such as CAT, 2007; PIRC, 2008) for much more rapid decarbonisation of the UK economy.

2. Background

2.1. The context of low-carbon refurbishment in the UK

The need for a substantial programme of refurbishment of the UK's existing housing stock to both mitigate climate change and

* Corresponding author. Tel.: +44 116 2551551X6848; fax: +44 116 2577981.
E-mail addresses: areeves@dmu.ac.uk, reevesie@gmail.com (A. Reeves).

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reduce levels of fuel poverty is well-established amongst practitioners and researchers in the fields of housing and energy efficiency (Boardman et al., 2005; EST, 2008; UKGBC, 2008).

Despite this identified need, progress to date in carrying out this work has been slow. Government policy and grant funding is still largely focused on carbon reduction measures with low upfront costs and short payback periods such as cavity wall insulation and loft insulation. Installation rates for more costly measures, such as solid wall insulation and micro-generation technologies, are at present considerably below those required for a pathway towards meeting the government's long-term carbon reduction targets (WWF, 2008; CCC, 2009). Comprehensive whole-house refurbishments, incorporating measures to reduce the rate of heat loss, control ventilation and generate heat and power, are likely to be required to achieve deep emission cuts in the housing sector, but to date very few homes in the UK are being refurbished to such a standard (Killip, 2008).

Government policy is beginning to focus on mechanisms for delivering these measures on a large scale and for removing financial barriers to undertaking this work (DECC, 2009). Two new mechanisms that will be trialled in the near future include the Community Energy Saving Programme (CESP), which will trial area-based whole-house refurbishments (DECC, 2009) and Pay As You Save (PAYS) funding approaches, which remove the upfront costs of installing more capital-intensive measures (UKGBC, 2009). The potential effectiveness of the PAYS approach may be limited, due to the intention that it will only fund measures which achieve a financial payback within their lifetime (UKGBC, 2009). Evidence from prior research indicates that many of the technical measures required to achieve deep emission cuts may not achieve such a payback, even if fuel prices significantly increase over future years (Reeves et al., 2009).

2.2. Research on achieving deep emission cuts

A number of studies have explored the technical feasibility of reducing carbon emissions from the UK housing stock over the long term (Boardman et al., 2005; BRE, 2005; Boardman, 2007; Natarajan and Levermore, 2007; EST, 2008; WWF, 2008). Carbon emission reduction targets for 2050 of either 60% or 80% were explored, and each study concluded that the target considered could be achieved. In each case the most extensive deployment of technical measures considered, coupled with an assumed supportive context, was found to be necessary to meet carbon dioxide (CO_2) reduction targets (Boardman et al., 2005; BRE, 2005; Boardman, 2007; Natarajan and Levermore, 2007; EST, 2008; WWF, 2008). In the study conducted by the Energy Saving Trust this was characterised as "throwing everything at the housing stock" (EST, 2008).

Although the findings of these studies differ according to the type and extent of technologies installed, in each case a widespread uptake of micro-generation technologies alongside measures to reduce the rate of heat loss of dwellings was advocated. For example, Boardman et al. (2005) called for the use of an average of two "low or zero carbon technologies" per home, so that in a 2050 scenario that achieved 60% emission reductions, 60% of dwellings had solar thermal water heating installed, 30% had solar photovoltaics (PV), nearly 40% were heated by small-scale combined heat and power (microCHP), and 20% were heated by district heating.

In addition, a number of contextual factors that play an important role in achieving deep emission cuts were identified, including decarbonisation of grid electricity, reduced demand for energy and a rapid take-up of carbon reduction technologies (Boardman, 2007; EST, 2008).

Whilst these studies each addressed the UK stock as a whole, there has been little research to date addressing the viability of achieving deep carbon reductions in particular housing sectors (e.g. owner-occupied homes, or the private rental sector). The present research addresses this gap in knowledge for the social housing sector.

2.3. The case of UK social housing stock

The UK social housing sector exists to provide affordable housing, with provision being approximately equally split between local authorities and housing associations. It differs markedly from other housing sectors in that it is regulated and heavily influenced by Government policy. This is exemplified by the works currently ongoing to meet the Decent Homes standard in social housing stock, which is triggering the installations of central gas heating systems and cavity wall and loft insulation.

Government policies to drive stronger action to reduce emissions in social housing, for example, by mandating interventions to insulate solid-walled homes or to achieve minimum energy efficiency standards, have to date not been forthcoming. As a result, the extent of carbon reduction refurbishments carried out in the sector is similar to the UK housing sector as a whole, with refurbishment being largely restricted to low to medium cost measures (loft insulation, central heating installations, improved heating controls, etc.) and a small number of grant-funded demonstration projects, such as European Union-funded photovoltaic installations at Peabody.

A lack of funding has been identified as a key barrier to action to retrofit existing social housing stock (Cooper and Jones, 2008). This issue is not addressed in the present paper, but was explored as part of the wider research project (Reeves, in press; Reeves et al., 2009).

3. Methods

3.1. Overview

A case study method has been used for this study, enabling a detailed understanding of the technical and regulatory issues to be developed for one housing association, Peabody. The research focuses only on carbon emissions that result from direct and indirect energy use in the home, so issues such as transport and waste are excluded from the analysis. Only physical improvements to homes and changes to energy supply systems have been considered, as these are the primary responsibility of a social landlord. Measures to encourage behaviour change are therefore outside the scope of this paper, although their use by Peabody was explored in Reeves, in press.

The effects of distinct approaches to stock refurbishment for Peabody's existing homes were modelled up to the year 2030. The Peabody Energy Model (PEM) was developed for this research to meet this aim, using spreadsheet software to quantify energy use in the Peabody stock on an estate by estate basis for 189 existing estates, from the base year 2006 (the base year for the London Climate Change Action Plan) to 2030. It is assumed that Peabody's current planned work to meet the Decent Homes standard, which incorporates low-cost insulation measures, continues as planned to 2010. From 2011, the impacts on carbon emissions of various approaches to refurbishment were modelled. Four scenarios were used to specify the broader external context under which refurbishment takes place, affecting model variables such as demand for energy and the availability of district heating network connections.