



Energy efficiency uptake and energy savings in English houses: A cohort study



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ABSTRACT

The UK Government estimates that approximately 22 TWh of energy can be saved from English dwellings by 2020 from a range of fabric and heating energy efficiency retrofits. Yet the rate of retrofit uptake has been less than is needed to meet government targets and the retrofits impact on energy demand has been less than predicted. Two questions that must be addressed are: who have (and have not) taken up retrofits and what household factors affect this; and, what impact have these retrofits had on energy use and how does this differ among households. The purpose of this study is to provide a better understanding of the uptake of energy efficiency retrofits and the resulting change in energy demand. A cohort of 168,998 dwellings gas-heated English dwellings was used to examine retrofit uptake from 2002 to 2007 and the change in gas use from 2005 to 2007. The findings show that retrofits *do* have an attributable impact on reducing energy demand and that combining retrofits displays a dose–response like effect, after controlling for household and dwelling factors. Energy savings play a central role in meeting UK climate change mitigation targets and therefore understanding the take up of energy efficiency retrofits and their impact on energy demand and variations in these retrofits across the population is vital to understand their potential.

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1. Introduction

As part of the UK's commitment to reduce greenhouse gas emissions, energy demand in the existing English housing stock needs to reduce through a comprehensive package of efficiency retrofits alongside decarbonising energy supply [1]. The government estimates that through increased efficiency an energy savings potential of 22 TWh is possible by 2020, a reduction of ~4.4% from 2012 demand levels of 500 TWh [2], delivered through a range of energy efficiency measures that focus on dwelling fabric and heating systems. These proposals include: insulating 7.3 million solid walled homes, 5.1 cavity walled homes, 7.4 million lofts, 19.2 million double glazing installations, 17.6 million boiler upgrades, along with millions of dwelling needing heating controls, draught-proofing, heating recovery systems, and smart meters [2]. Further, retrofits

would help to mitigate household energy costs from price rises and protect against the effect of cold weather shocks on heating energy demand. Therefore, to address the priority of improving the energy performance of dwellings in the UK evidence is needed to advance understanding regarding the rate of uptake of energy efficiency retrofits across the residential sector and their resultant energy savings.

Approximately 12.2 million UK dwellings have received some form of energy efficiency retrofit since 2000 [3]. The majority of these retrofits were directed toward reducing space heating use through fabric insulation, ventilation control and more efficient heating systems, with many of the retrofits being installed in combination. Despite these installations, the rate of retrofit uptake across UK dwellings has been less than is required to meet UK targets [4]. Further, the impact that these retrofits have on energy demand has been less than predicted [5]. Together, the limited uptake and impact on energy demand pose a clear threat to meeting UK emission reduction targets.

A pressing question that emerges relates to who have (and have not) taken up retrofits and whether household factors affect this uptake over time? A second question is what impact have these measures had on demand and how does it differ among

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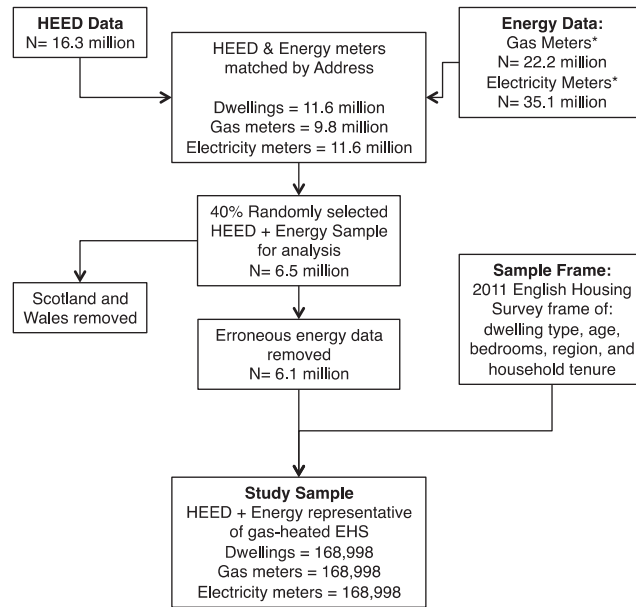


Fig. 1. Study sample selection process.

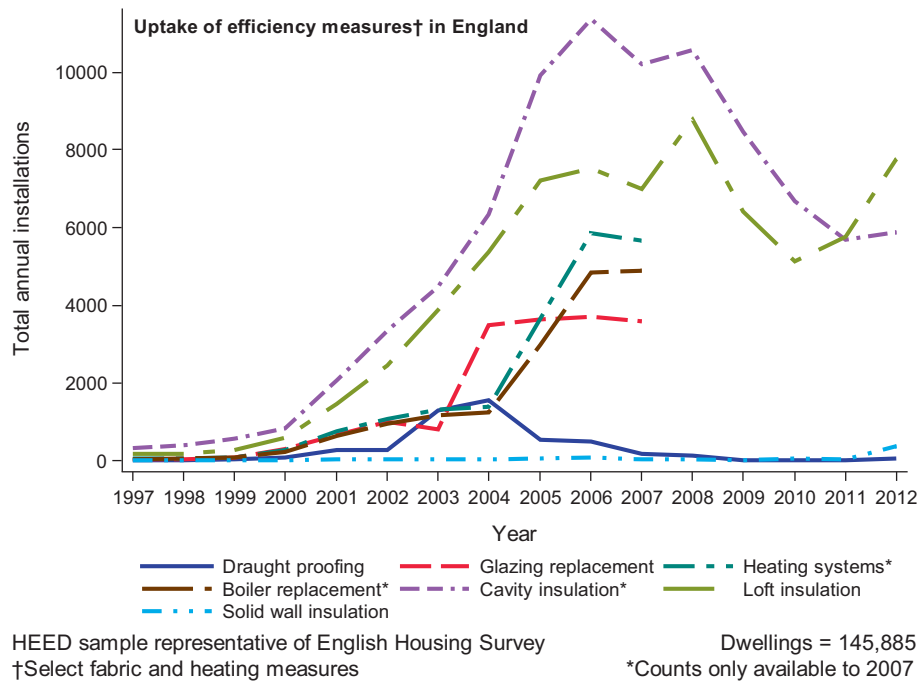


Fig. 2. Uptake of energy efficiency retrofits in England 1996–2012.

households? Several studies have shown that uptake has varied among English neighbourhoods by income groups, vulnerability, region and age of housing stock [3,6]. While several cross-sectional studies have shown how dwelling typologies influence retrofit take up, with older dwellings generally needing more insulation and others requiring specific types of retrofit (i.e. cavity filling insulation) and the influence of household characteristics on retrofit presence with lower income, privately renting households living in dwellings with the lowest levels of efficiency [7,8]. However, to date there has been little work to understand (a) how individual level household or dwelling characteristics modify uptake over time and the type and combination of retrofits, and (b) whether having a retrofit modifies the probability of installing subsequent measures. Further, while studies have attempted to quantify the impact that

retrofits have had on energy demand in UK dwellings [9–11], there has been little work to understand (a) the extent to which dwelling and household characteristics modify changes in energy demand; and (b) whether cumulative retrofits result in more savings.

The purpose of this study is to provide a better understanding of the uptake of energy efficiency retrofits and the resulting change in energy demand that accounts for individual dwelling and household characteristics, adjusting for potentially confounding and interacting factors. The research questions asked were:

- What is the rate of uptake of energy efficiency measures in the English housing stock, what dwelling, household and local area

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