Applied Energy 186 (2017) 226–233

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

All about size? – The potential of downsizing in reducing energy demand

Gesche M. Huebner *, David Shipworth

Energy Institute, University College London, United Kingdom

HIGHLIGHTS

- Building size has huge impact on residential energy consumption.
- There is significant underoccupation in English homes, even in cities.
- Huge energy savings are possible if people downsize (move into smaller homes).
- Lack of alternative, smaller accommodation structural barrier to downsizing.

ARTICLE INFO

Article history:
Received 9 September 2015
Received in revised form 12 February 2016
Accepted 14 February 2016
Available online 2 March 2016

Keywords:
Residential energy consumption
Downsizing
Underoccupation
Energy savings
Policy
Building size

ABSTRACT

Residential energy consumption is one of the main contributors to CO_2 emissions in the UK. One strategy aimed at reducing emissions is to increase retrofitting rates of buildings. In this paper, an alternative approach is discussed and its potential impact on energy use assessed, that of downsizing (moving to smaller homes).

Reviews of previous research show that a wide range of what can be termed psychological barriers exist to downsizing, such as the loss of ownership and independence, concern about what to do with possessions, not having enough space for visitors, and attachment to one's home. Benefits of downsizing from a personal perspective are economic, with lower bills and/or rent, release of capital, lower maintenance costs, and also potential lifestyle improvements including living in easier-to-maintain and more age-appropriate housing. Wider societal benefits include the potential to significantly reduce energy consumption, and mitigating the housing crisis in cities where not enough properties are available. Empirical analysis on a nationally representative sample in England showed that building size alone accounts for 24% of the variability in energy consumption (compared to 11% of household size). If single-person households with more than two bedrooms downsized by one bedroom, energy-savings of 8% could be achieved, and if single-person households occupied only one bedroom, savings of 27%. Data also showed a significant amount of underoccupation, with almost two-thirds of households having more bedrooms than considered necessary compared to the bedroom-standard. However, analysis also revealed a structural barrier to downsizing, namely the lack of available alternative, smaller houses.

The evidence would suggest that downsizing could realize significant energy savings, and address a range of other social benefits. However, against this stand significant personal interests, inadequate alternative housing and other infrastructure issues. Promoting downsizing as a means to achieve energy policy goals is therefore a potentially significant but socially challenging policy option.

1. Introduction

Energy use in buildings is one of the largest contributors to global and local energy consumption. In the UK, Palmer and Cooper [1] estimate that 26% of total annual carbon emissions arise from energy use during the operational phase of residential buildings' lifecycles. The UK Government established the goal of reducing emissions from homes by 29% by 2020 [2]. Energy efficiency improvements in UK homes form a central part of the decarbonisation plans, with millions of retrofits of residential homes planned over the next decades [3]. However, uptake of a main recent Government policy to promote energy efficiency renovations has been much lower than expected [4], casting doubt how successful energy reduction through retrofitting will be. Another strategy that has been tested repeatedly is to give occupants individual or comparative feedback on their energy consumption, with the aim of achieving energy reductions (e.g. [5,6]); however, whilst energy

* Corresponding author.
E-mail address: g.huebner@ucl.ac.uk (G.M. Huebner).

http://dx.doi.org/10.1016/j.apenergy.2016.02.066
0306-2619/

savings were achieved they were not near the region of energy savings needed and indeed, not always realized, often focused on electricity savings only, and reduced in magnitude over time (for a review, see [7]). In addition, according to current projections, the number of households in England is predicted to increase from currently 22.3 million to 27.5 by 2037 [8], which despite a falling household size is likely to be associated with increased national energy demand [9] which would dwarf savings from any feedback interventions.

This paper explores the opportunities of, and challenges associated with, a different route towards reducing residential energy consumption: housing downsizing, that is, people moving to a smaller dwelling. It is likely to be an option primarily for the elderly who continue to live in big family homes even once their children have moved out [10]. Only few estimates of the prevalence of downsizing exist, and "there remains considerable controversy even about what the facts are about downsizing at older ages" [11, p.3]. The authors estimated that over a 10-year period one in four British home owners over 50 years of age relocated whereas in the US it is one in three. Those within Britain who relocated reduced the size of their home on average by 1.4 rooms indicating downsizing (if of smaller magnitude than in the US with 2.2 rooms). Hence, data indicate that some downsizing occurs but only of limited prevalence and limited effect. Downsizing of equipment to realize energy savings has been discussed, e.g. with suggestions that energy-efficiency measures can have the added benefit of reducing the size of equipment such as HVAC [12,13]; or a smaller size engine in cars [14]. However, downsizing in the sense of reducing one's living space and its implications for energy use has received very little attention in both research and policy, making this paper novel in terms of its literature review, data analysis, and policy recommendations. It is to be expected that this topic will receive greater attention in the future in particular in cities which see continuous population growth. In fact, Policy Think Tanks have identified downsizing as an important topic (e.g. [15]). In the introduction this paper will present current thinking and findings on downsizing with a particular focus on prerequisites for, barriers to, and benefits of downsizing, and by showing evidence on the impact of building size on energy consumption. In the empirical part, it sets out to address four main aims:

- to make the case for downsizing by showing the impact of dwelling size versus other predictors on energy consumption;
- to exemplify the potential for energy savings through downsizing;
- to show in detail the mismatch between the number of bedrooms households have and need;
- to describe the socio-demographic characteristics of underoccupiers.

The discussion then draws together empirical findings and findings from the literature review.

1.1. Benefits of and barriers to downsizing

Beyond the central focus on energy savings and hence the reduction of carbon emissions, downsizing has other benefits. The one that has received most attention is the potential economic benefit [10,11]. Bills and, in the case of renters rent, will usually be lower for a smaller dwelling, reducing monthly spending. For owner-occupiers, maintenance cost might decrease, and in particular money freed up when selling one's home and buying a smaller one in return. In addition, the – not necessarily monetary – costs of maintaining a large home would reduce; such as cleaning. Also, a newly chosen property might be more age-appropriate, e.g. without stairs, with wide doors, and in close proximity to amenities or public transport. Leach [16] carried out interviews with home owners between 65 and 75 years who had downsized and they reported finding life after downsizing liberating, with lower household bills to pay and a smaller house to manage. Finally, if the elderly downsized to a smaller property, space would be freed up for younger people and families. The housing crisis, i.e. a lack of available, appropriate properties, and high housing costs, is often seen as a core issue of intergenerational justice [17] where the older generation is better off than the younger generation.

However, despite those benefits of downsizing most moving that happens in older age is for other reasons, in particular health reasons [18,19], widowhood [19], or to be closer to children [18]. In addition, various barriers towards downsizing have been identified.

Leach [16] had interviewed home owners between 65 and 75 who did not want to downsize, giving as reasons that moving to a smaller house would make it harder to store possessions and that new buildings were too tiny. The latter is corroborated by facts: The UK has indeed the smallest homes in Europe, and new builds are on average even smaller than existing buildings [15]. Interviews with a nationally representative sample in England showed that bungalows were the preferred housing option and only 1% of the elderly would chose to live in a modern building [20]; however, in particular in cities like London flats are currently predominantly being built.

Another barrier is the desire to protect property as a means to ensure inheritance for children [21–23]. When selling one home and buying another, most likely capital is freed up which then is subject to inflation, making it if anything decline in value whereas house prices have seen an increase in the last decades. Also, in the UK, buying a home demands payment of 'stamp duty land tax' when purchase price is above a certain amount of currently £125,000 [24] above which 2% or 5% of the purchase price need to be paid. This money is basically lost from the inheritance. In fact, Leach [16] found that both those who did not downsize thought that stamp duty concessions could encourage people to move. Selling a home and moving into rented accommodation is not attractive as it would expose occupants to insecurity in the sense of potentially rising rental prices [25]. Also, living in one's own home is seen as a sign of independence [26]. This again might make moving into rental accommodation unlikely, but may not prevent moving to a smaller home. Finally, strong attachment to one's home could prevent moving at an older age [27].

1.2. Prerequisites for and barriers to downsizing

In order for downsizing to be a viable option, a significant amount of under-occupying must occur. In the UK, the 'bedroom standard' as The Housing (Overcrowding) Bill of 2003 is usually referred to, determines how many bedrooms are deemed necessary for a given living situation [28]. A separate bedroom is allocated to

(a) A person living together with another as husband and wife (whether that other person is of the same sex or the opposite sex).
(b) A person aged 21 years or more.
(c) Two persons of the same sex aged 10 years to 20 years.
(d) Two persons (whether of the same sex or not) aged less than 10 years.