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The ageing population and smart metering: A field study of householders' attitudes and behaviours towards energy use in Scotland

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ABSTRACT

Smart grids, smart metering and in-home displays (IHD) are expected to contribute to demand side management partly by increasing user knowledge whilst improving comfort, safety and the ability to cope with increasing costs. With an increasingly ageing population, the awareness and views of older people on energy use, technology, smart meters, smart grids are becoming progressively more important. Their behaviours regarding energy and technology use differ from the majority as they are usually living on low incomes and are at risk of fuel poverty. It is therefore important to understand their acceptance, engagement or resistance to smart metering, IHDs and external control of home appliances and heating. Their willingness and capacity to change time-use behaviours and reduce consumption is crucial.

A study of older tenants in rural Scotland is presented. Sensors and IHDs were installed to measure and display electricity costs and consumption of large appliances and the electricity supply for each house, and show internal household and external temperatures. Householder's use of energy, habits and routine, strategies for keeping warm and attitudes towards technology, smart metering, IHDs and direct external control of appliances and heating were explored through interviews. Conclusions identify significant implications for future research and policy.

1. Introduction

In the UK, as elsewhere in Europe, there are energy policies which attempt to arrest climate change and others which seek to eradicate, or endeavour to lessen, fuel poverty [3,7,24]. Reducing energy use is the focus of climate change policies, aided through the implementation of smart technologies. However Walker and Day [55] identify that under-consumption of domestic energy co-exists with over-consumption and, therefore, reducing energy use of those who already under-consume may be inconsistent with the policy of eliminating fuel poverty [28]: together these policies may generate contradictory messages and prescriptions. Complementary pricing proposals to shift demand peaks through changing habits similarly can be expected to impact differentially on particular groups [9]. To explore the interaction between these divergent policy areas, this paper reports on the findings of research into the perceptions, attitudes and behaviour of older people to energy use, smart technologies and associated developments.

These are especially important given increasingly ageing populations [56,51], yet the implications of demographic change are not generally recognised in national strategies (e.g. [12]). In the UK for instance, by mid-2037, the number of people aged 80 and above is projected to more than double, to represent one in 12 of the population [34]. Within Scotland, the trial site for this research, the number of people aged 75 and over is expected to increase by around 28% from 420 thousand in 2012 to 780 thousand in 2037 – an increase of 86% over the 25 year period [32].

Following retirement, although there are differences in income, housing tenure and technological experience, each family unit is likely to have a reduced amount of disposable income and to spend progressively more time at home, and this impacts now and in the future on their energy needs [18]. Whilst there are differences between cohorts, family age-composition patterns are found to have a distinct impact on household energy use behaviour; elderly households having lower levels of knowledge about energy use and placing more importance on financial savings [29]. There is also evidence of increasingly differing attitudes and competences with regard to having and using new information and communication

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technologies, with both ageing and cohort effects applying [19]. Previous 'demand response' research has not exclusively explored the views, knowledge, perceptions and behaviours of older people towards their current home energy use, nor their perceptions of home energy management through smart technologies; yet it is shown elsewhere that needs will differ with age [50].

Balta-Ozkan et al. [4] and Balta-Ozkan et al. [58] identifies three categories of smart home services (2014, p1179), two of which, Safety and Lifestyle Support, may be linked with extensive and current health literature focused on older adults. For example, ageing safely at home, assistive technologies for older people, health and ageing [25,57]; Matlabi et al., [59]. Thus the third category, Energy Consumption and Management, given in this holistic approach, should also be considered as a service, which could offer the opportunity of improving the quality of life for an ageing population.

Remote self management of home energy is already available through smart technologies e.g. smart phone access to turn appliances and heating on or off in your home; [9] also noted that technology is available for Time of Use Pricing (TOUP) or Real Time Pricing (RTP) by utilities and that householders could choose to self-manage their energy consumption in future, via an IHD or smart device via the internet, according to price. Or they may choose a completely automated system, managed externally by others e.g. energy provider. Again, currently little is known on how older people feel about using the associated technologies, nor towards the existing energy management choices. A specific in-depth study of older people's perceptions and feelings, in this changing environment, will enhance and extend this literature.

Thus, there is a rationale for considering the evolving needs, demands, perceptions, attitudes and behaviours of different age groups separately in the move towards a smart energy environment. These older age groups have not previously been scrutinised on knowledge and experiences of energy usage alongside perceptions and attitudes towards management of household energy via smart technologies. This study[1] is addressing this gap and informing future policies.

The aim of this paper is to explore possible interactions between an ageing population, current energy use behaviours, fuel poverty and an increasingly smart environment whilst contributing to the literature through comparing and contrasting related literature findings with an in-depth analysis of experiences of older adults. The paper begins by examining relevant literature on fuel poverty and smart technologies, especially with regards to an older population. In Section 3 the context and methodological techniques used in the study are explained. Section 4 reports the empirical results from the pilot quantitative and follow-up qualitative study of older people on their attitudes to energy use, smart metering, IHDs and direct external control of home appliances and heating by their utility supplier. Current behaviours, habits and routine around energy use are also examined to gain a fuller understanding of whether or not there is scope to move consumption patterns if time-of-use tariffs were to be in place. Conclusions and implications for future research and policy are determined in the final section.

2. Literature

Through a review of the relevant literature this section sets out the context to the inter-connected areas of interest: energy use and engagement, fuel poverty and smart energy management, with particular regard to older adults.

2.1. Current energy use, engagement and fuel poverty

2.1.1. Energy consumption and visibility

In 2010 household electricity consumption in Scotland was estimated to be the highest in Britain, at 4800 kWh; this is higher than the average (4400 kWh) due to a higher percentage of households using electric heating systems and shorter days in the winter [42]. Generally, Boardman [5,p24] estimated that electricity consumption (lights and appliances) was close to half of all energy expenditure. She notes that this is price dependent, therefore if price is used to manage demand, through TOUP or RTP, this may detrimentally affect lower income, fuel poor households. Scotland also has the highest domestic gas consumption per consumer with an average of 15,900 kWh as compared to 15,200 kWh; 77% of households used mains gas as their primary heating fuel, 14% used electricity. Where there was mains gas available 96% of households used this as their primary form of heating and for the rest of the households – off the gas grid and likely to be in rural environs – 61% use electricity [42].

Brugess and Nye [6] emphasizes energy's 'double invisibility'; it cannot be seen nor linked to everyday actions (*cf* [20,21] because they are often made up of unnoticeable routines and habits [45]. Thus understanding the relationship between use and costs is difficult, if not impossible. Visibility and increasing awareness of usage and cost of energy through interactive IHDs have been expected to allow consumers to become proactively involved in understanding and managing their own energy use and ultimately to change behaviours through learning [8]. As a consequence of such change, demand should be reduced; however, comfort, safety and the ability to pay would need to be retained to make it acceptable and tolerable to consumers. In assessing the impact of awareness-raising, Darby [8,p450] highlights how important it is that the householder has 'new, actionable information on consumption that could be clearly understood'. Yet, Buchanan et al. [60] have identified a number of problems with feedback via IHDs, namely 'the need for user engagement' and 'the potential for unintended consequences' and, as they also note a scarcity of research for those on low income and suffering fuel poverty, suggesting further reductions in energy use for this segment of the population without good intelligence would not be advisable. A nationwide survey of electricity prepayment metering consumers in New Zealand, undertaken in 2010 and followed up in 2011, described a situation of considered self-disconnection among vulnerable older people, who faced potentially serious consequences from switching off their electricity but nonetheless were willing to do so if this meant that they retained their sense of control over personal costs and debt [35]; this suggests that ill-considered and ill-informed feedback could have negative outcomes for older people on low incomes who are fuel poor.

In an attempt to gain a 'visible' understanding of likely home electricity use, the Energy Saving Trust [61] measured use of electricity, for different household types, for particular appliances. They found that single pensioner households (65+ yrs) used, on average 144 kWh/yr for their washing machine, 344 kWh/yr for their clothes dryer; a multiple pensioner household used less at 111 kWh/yr and 287 kWh/yr. Those are the lowest users of energy for these appliances across household type, with a multiple household with no dependents using the greatest, 178 kWh/yr and 497 kWh respectively. The demand for lighting showed little variation in demand across the household types, although single pensioner households spent on average 33% more than multiple pensioner households: 548 kWh/yr and above the average of 537 kWh/yr for all household types.

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