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Householder engagement with energy consumption feedback: the role of community action and communications

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HIGHLIGHTS

- We examine the challenge of householder engagement with energy consumption feedback.
- The potential of 'community action' and 'communications' is explored.
- These approaches are shown to support long-term engagement by householders.
- These approaches are also shown to support greater engagement by women.
- Recommendations for future IHD platforms and smart meter roll-outs are presented.

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ABSTRACT

The provision of energy consumption feedback on in-home displays (IHDs) has a prominent role in government strategies for domestic energy demand reduction. Research suggests that IHDs can support energy consumption reduction, but also that engagement with IHDs can be limited to men and is often short-term. In this paper, we draw on research carried out in Smart Communities, a two-year project in which electricity and gas consumption feedback played a key role. This study was distinctive because it was accompanied by a weekly email communications programme and was provided within the context of community action. Project findings suggest that, although by no means panaceas, approaches such as these can support long-term engagement with energy consumption feedback, including by women, and can support behaviour change.

1. Introduction

This paper is concerned with the role of energy consumption feedback as a route to householder action on energy consumption reduction. Drawing on empirical observations in a project called Smart Communities, our objective is to examine the potential of community action and communications programmes as routes to greater householder engagement with energy consumption feedback. The provision of electricity and gas consumption feedback to householders on in-home displays (IHDs) is an important energy demand reduction and management strategy in parts of Europe, the US, Canada, New Zealand and Australia (Darby, 2010). In the European Union, IHDs are encouraged by the Energy Efficiency Directive (European Commission, 2012). In the UK, where this case study is based, a nationwide roll-out of smart meters with IHDs in some 30 million homes – at a cost of between £11–12 billion – began in 2015 and is due for completion by 2020 (Department of Energy and Climate Change (DECC), 2015a). For advocates, smart meters with IHDs have a number of benefits. Most importantly from the perspective of this paper, IHDs provide householders with two forms of energy consumption feedback: near real-time feedback of current consumption and feedback of historical consumption in charts. The expectation is that householders will use this information to reduce their energy consumption and associated carbon emissions. Meanwhile, commercial organisations – such as British Gas (2015), iMeasure (2015) and OPower (2015) – are offering their own web and app based historical energy consumption feedback products. In addition, smart meters provide automated meter readings to energy suppliers, they communicate with smart appliances in the home and they make switching suppliers easier (DECC, 2015a).

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1.1. Research into the impact of energy consumption feedback

In early 2015, DECC published the results of its Smart Metering Early Learning Project, a large-scale qualitative and quantitative research project designed to understand the ways in which IHDs are being used by householders and ways in which their use might be enhanced (DECC, 2015b). This report is highly positive about the potential for energy consumption feedback via IHDs, stating: 'The vast majority of consumers involved in the research recalled being provided with an IHD, and in most cases they were still continuing to use them, up to two and a half years after installation. Continued use of the IHD to monitor consumption was associated with consumers being more likely to report energy saving benefits' (DECC, 2015b: 5).

The broader quantitative and qualitative research literature – which tends to focus on the electricity consumption – presents a more mixed picture. Meta-analyses of the extensive body of consumption data studies suggest that the impacts of IHDs vary widely – with average reductions in consumption of between 3% and 19% – depending on feedback formats, programme designs, and cultural, market and infrastructural contexts (Darby, 2006; Ehrhardt-Martinez et al., 2010; Stromback et al., 2011).

In common with DECC (2015b), qualitative studies have noted that engagement with IHDs can increase the visibility and salience of energy consumption and related behaviours, contribute to householder knowledge about their energy consumption, and prompt behaviour change and consumption reduction (e.g.: Grønhøj and Thøgersen, 2011; Hargreaves et al., 2010, 2013; Oltra et al., 2013; Strengers, 2011, 2013; Rettie et al., 2013; van Dam et al., 2010; Buchanan et al., 2014). However, these studies also note a number of constraints on the impacts of IHDs. In particular, studies note widely varying levels of engagement with IHDs across participants. For example, in their study, Murtagh et al. (2014) used qualitative data to broadly characterise the distribution of this variation as 20%/60%/20%, from low levels of engagement through to medium and higher levels. Studies identify a number of factors that constrain engagement. For instance, while energy, data, technology and management are motivating factors for some householders, for many more they are not (Strengers, 2013). For this reason, some of this work suggests, engagement with feedback is often limited to one household member, typically a man (Hargreaves et al., 2010; Strengers, 2013), although Murtagh et al. (2014) did not observe this gender distinction. Further, research suggests that differentiated levels of engagement within households often leads to negotiation and conflict between household members that can undermine efforts to change behaviour (Hargreaves et al., 2010). In addition, studies note that engagement is constrained since energy consumption feedback often lacks salience for many householders. This is partly because energy is invisible and is consumed only indirectly, but also because the units of measurement of energy are confusing to many householders (Hargreaves et al., 2010; Strengers, 2011).

Work that has examined the longer term impacts of IHDs presents an interesting tension. Hargreaves et al. (2013) suggest that engagement with IHDs tends to be short-lived, often because users feel that they are not learning anything new, or because changes in behaviour do not yield noticeable reductions leading to disillusionment. In contrast, on the basis of their meta-analysis, Stromback et al. (2011) suggest that long-term engagement with energy consumption feedback is possible, and that reductions in consumption can increase over time (as discussed earlier, DECC (2015b) also tends towards the first part of this conclusion). This suggests, perhaps, that change in the household takes longer than has been assumed in some studies. This apparent tension between reductions in engagement over time and gradual change over time is puzzling and bears further examination. Finally, some of this work suggests that IHDs do not challenge – and may reinforce – a raft of energy-consuming practices that are treated by householders as normal or immutable (Hargreaves et al., 2013; Strengers, 2013).

Wilhite and Ling (1995) have observed that the rationale for energy consumption feedback relies upon a relatively straightforward and linear relationship between: increased feedback, increased awareness or knowledge, changes in energy-use behaviour and decreases in consumption. Support for this rationale can be found in a range of theory. For instance, neoclassical economics emphasises the ways in which individuals respond to price signals (Weintraub, 2007), and the behavioural models of social psychology point to the relationships between information, knowledge and behaviour (Ajzen, 1985; Triandis, 1977). Sociologically-informed commentaries, though critical of the simplistic nature of this rationale, nonetheless emphasise the invisibility and immateriality of energy, and suggest that energy consumption feedback has the potential to render energy visible and material (Hargreaves et al., 2010, 2013; Shove, 2003; Pierce and Paulos, 2010). From a practice perspective, Shove et al. (2012) have reflected on the ways in which feedback 'feeds forward', and has the potential to shape future practice.

However, a conceptual critique of energy consumption feedback as a route to demand reduction has also emerged. Above all, this critique maintains that the assumption of causal links between information, knowledge and behaviour represents an oversimplification; for instance, see Shove (2010) on the broader behaviour change agenda. Strengers (2013) locates IHDs as part of a broader – possibly illusory – vision of a 'smart utopia'. Strengers argues that this rests upon a limited technological perspective and is characterised by a number of misapprehensions: technology and data are reliable responses to social problems; energy itself and the units in which it is measured are relevant and understandable to householders; householders are inclined towards resource management; and, everyday life is amenable to straightforward change. Noting the empirical observation that those who engage with energy consumption feedback are often men, Strengers (2013) coins the term, Resource Man, to capture the archetypal data- and energy-minded domestic energy consumption manager. Strengers (2013) argues that domestic energy consumption feedback could be of more value if it can be implemented in ways that acknowledge these misapprehensions, and in ways that are meaningful to householders within the contexts of their everyday lives and practices.

1.2. Proposals for future development

This body of literature contains two broad categories of proposals for the future development of energy consumption feedback. Of central relevance to this paper, the first category of proposals relates to the *context* within which energy consumption feedback is provided. Drawing on their meta-analysis, Stromback et al. (2011) highlight the benefits of direct communication with householders as part of feedback programmes. From some perspectives, this is a surprising finding. In their review of 38 energy behaviour change studies, Abrahamse et al. (2005) note that, while knowledge often accrues, mass communication does not necessarily lead to behavioural changes or energy savings. Others have similarly noted that mass communications are not adequate in the context of the highly specific and practical forms of know-how that are most important in the context of energy consumption and behaviour change (Simcock et al., 2014; Royston, 2014; Wallenborn and Wilhite, 2014; Burchell et al., 2015). However, Stromback et al.'s findings suggest that this dynamic might be different within the more specific context of energy consumption feedback.

Expanding the range of possibilities, Hargreaves et al. (2013) suggest that the longevity of engagement with energy consumption feedback might be increased in combination with community-led activities. Described in greater detail in Burchell et al. (2014a), in the UK context, community action on energy demand is now a feature of landscapes in policy (DECC, 2014), the third sector (Communities and Climate Action Alliance, 2014; Transition Network/Hopkins, 2011; Marshall, 2014) and research (Middlemiss, 2008, 2011; Heiskanen et al., 2010; Simcock et al., 2014). In this context, workshops, home energy audits, open house demonstration events and collective purchasing schemes are typical approaches. Within the context of these proposals, it is notable that no studies have explicitly examined energy consumption feedback within the context of communications and community action.

The second category of suggestions – less significant in the context of this paper – relates to *content*, in particular increasing the extent to which feedback is contextualised or specific to the household (Hargreaves et al., 2013). Ehrhardt-Martinez et al. (2010) point to the value of the disaggregation of feedback into its component parts. Hargreaves et al. (2010) and Strengers (2013) endorse this point, noting that it is practices – such as cooking, keeping clean, staying warm or cool – that are meaningful and relevant within the context of householders' lives, as opposed to energy *per se*. In a similar vein, Harries et al. (2014) show that householders are highly engaged by the process of identifying particular appliances in their electricity consumption feedback. Stromback et al. (2011) also highlight the value of the provision of advice alongside feedback. Here, experiments are underway in which tailored advice is provided on the basis of householder-provided information (British Gas, 2015; Ford et al., 2014). Finally, Ehrhardt-Martinez et al. (2010) highlight the value of providing social norm feedback that allows householders to compare their consumption with other households like theirs.

Although Smart Communities was designed in late 2009, before many of these papers and reports were available, the project investigated a number of the proposals described above. In particular, in contrast to all of the studies that we are aware of, Smart Communities was designed with the objective of examining energy consumption feedback within the context of community action and a weekly email communications programme. Of course, the Smart Communities energy consumption feedback was provided in a particular format and with particular content (we discuss some of these issues later and further details are available in Burchell et al., 2014b). However, in this paper, we specifically focus on the ways in which community action and the communications programme shaped householder engagement. We do this for two reasons. The first reason is the rarity of such approaches in studies of energy consumption feedback. The second is the significant impact that the community action and communications elements of Smart Communities had on the project outcomes. In the next section, we discuss the community action and research methods that were employed in Smart Communities. Thereafter, we present our findings and a discussion. In the closing section, we offer a number of succinct conclusions and policy implications.

2. Methods

This section has two main parts. In the first part, we describe the principles upon which Smart Communities was based. In the second, we provide more specific information about what we did. Within the context of most studies of energy consumption feedback, Smart Communities was distinctive in a number of ways. Most importantly, Smart Communities drew on the principles of community action and the methodologies of *action research* (Reason and Bradbury, 2008). In action research, research is typically undertaken alongside normatively-driven action in collaboration with particular social groups. Typically, the objective of the research and action is a blend of direct change, mutual learning and broader dissemination. It is important to note that action research typically yields qualitative evidence from a range of sources. As well as more formal evidence (such as interview transcripts), the evidence from action research is often informal, gathered in the course of conversations and experiences during the implementation of the project action. The implication of this is that insights are emergent, context specific and anecdotal in form, and are therefore unlike more formalised forms of empirical data. Importantly, this approach does not reflect the emphasis on control groups, sample sizes, sampling methods and confounding variables that are associated with quantitative studies of energy consumption data. The community action activities in Smart Communities are described in more detail below.

At two years, Smart Communities was a longer intervention than most energy consumption feedback projects. This allowed the need and potential for long-term householder engagement with energy consumption feedback to be examined (Stromback et al., 2011; Hargreaves et al., 2013). A further distinctive element was that a manual consumption data collection method was used. Drawing on literature that emphasises the value of 'learning through action' (Harris, 2007; Lave and Wenger, 1991; Pink, 2009; Wenger, 1998), we were interested in the extent to which this action by project participants might prompt greater engagement and learning than is the case when feedback is automated. All households that joined the project were given an Owl micro energy monitor. The Owl micro is the most basic electricity monitor available; it consists of a sensor that clips around the mains cable and a simple display featuring a real time electricity consumption figure and a cumulative total electricity consumption figure (see the latest model: http://www.theowl.com/index.php?cID=185). At the outset of the project, just under 300 monitors were couriered to the households. Unfortunately, around 75 of these were for various reasons not installed. For this reason, the approach was adapted and the subsequent 100 or so monitors were installed by the team; this was time-consuming but valuable in terms of project participation and engagement.

In weekly emails – typically each Monday afternoon – project participants were reminded to enter the cumulative total from their monitor into the project website (since affordable gas monitors were not available, participants were encouraged to also enter readings from their gas meters). To support this activity, the phrase Metering Monday was used in the emails and all of the householders who entered readings in a given week were entered into a prize draw with a £20 gift voucher prize. On the basis of the readings that were entered into the website, participants were able to view feedback charts showing their electricity and gas consumption from the previous week. Echoing Ehrhardt-Martinez et al.'s (2010) comments on comparative feedback and Hargreaves et al.'s (2013) on contextualising, the average consumption of all of the participants and the average of the 20% of participants with the lowest electricity consumption was also displayed (Fig. 1). Drawing on the Social Norms Approach (Burchell et al., 2013), an explicit normativity was embedded within the feedback charts, for example through use of the word 'best' to describe the 20% of participants with the lowest electricity consumption and in the various messages that were displayed above the charts. Further context was provided by participants being able to use the website to view feedback relative to the number of people living in their home and relative to the size of their house, although – importantly – this clearly does not account for all of the variability within households.

Turning now to the specifics of the project, Smart Communities took place in Kingston upon Thames, a middle-class suburb of

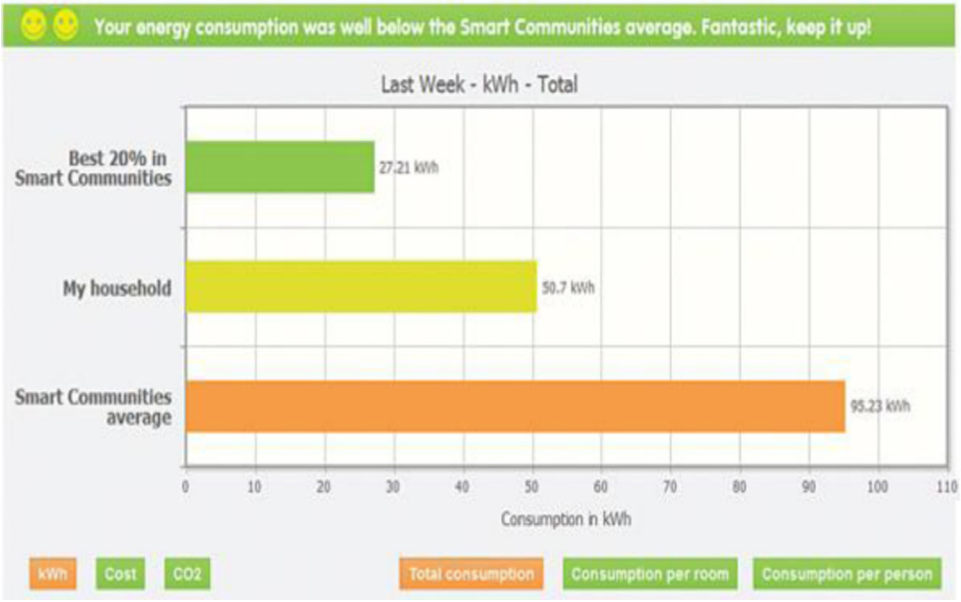

Fig. 1. An example of the Smart Communities energy consumption feedback.

London, UK, and the intervention lasted from May 2011 to May 2013. Recruitment was undertaken via a combination of door-to-door leaflet drops, and emails that were distributed through a variety of local institutions (a primary school, the library and residents' associations). Around 400 households joined the project (16% of the total in the project area).

In the context of this paper, and reflecting Stromback et al.'s (2011) observations, the most important element of the community action was the weekly email communications that were sent to all of the project participants. As mentioned earlier, these were used to prompt the submission of consumption readings to the project website. The emails were also used to provide seasonal energy saving advice, and relevant information about local/national events and programmes on energy. In addition, with permission, the name of the previous week's prize draw winner was featured in the emails. Given the scepticism surrounding communications in some of the literature, it would be helpful to describe what was *distinctive* about the Smart Communities emails:

1. Regularity. Emails were weekly and were sent at the same time each week (Monday afternoons, typically).
2. Action-based. Emails emphasised specific actions that project members could undertake with the real-time feedback on their Owl energy monitor and the web-based feedback.
3. Advice. Emails contained seasonal energy saving advice that was written in ways that acknowledged the variety of conditions in people's homes.
4. Locale. In a variety of ways, the emails emphasised the locale in which the project took place For instance, this was done by featuring information about local events and the names of the weekly prize draw winners.
5. Community. In addition, the emails emphasised the community aspects of the project (for instance, through use of strap lines such as *Working together to save energy* and *Don't forget to tell your neighbours*, invitations and references to the community events, and references to things that other project participants were doing).
6. Style. The emails were written in a style that was accessible, friendly and supportive.

In addition, all of the households that joined the project had access to: regular community workshops on topics such as lighting, thermal comfort and hot water (and, at the end of the project, planning the long-term future of the project); free energy-saving materials; an eco-gadget library at the local library; and a web forum and advice line (in addition, a limited number of experimental home energy visits were undertaken). Importantly for the discussion that follows, a programme of energy-related activities was implemented in a local primary school. This consisted of three main activities: a monitoring and feedback system was installed, and the feedback used in the curriculum (for example, in maths and science) and discussed in assemblies; energy management was explicitly incorporated into the management of the school buildings, this included an environmental audit of the school; implementation of a drama programme through which all the children took part in workshops and performed before the school; and, additional curricula work on energy and water efficiency. Finally, two summer celebration events were held at the school, one to launch the project and another after one year of the project. Invitees to these events were the whole school community, all of the project members, local energy and sustainability groups and the local Members of Parliament. Importantly, this package of activities was presented and implemented in a style that conveyed the local, friendly, supportive, non-commercial and professional nature of the project. For further details on these activities, see Burchell et al. (2014a,b; 2015).

Within the action research context described above, our analysis relies upon data from four sources:

1. Informal interactions with project members. These took place at project workshops and other events, as well as via the telephone and emails.
2. Thirty interviews were undertaken with project participants. Ten interviews were conducted in early 2012, fifteen in early 2013 and five in October 2013. Interviewees were drawn from households across the range of levels of engagement with the project. Depending on circumstances, some interviews were with individuals and some with couples. The interviews were conducted in participants' homes, lasted around one hour and included discussions of energy consumption feedback, other

project activities and ways in which change did and did not happen within the household. The interviews were analysed drawing on the principles of thematic analysis, in which transcriptions are read, re-read and coded (in this case, in Atlas.ti), and in which themes are derived from codes and then refined for presentation in written form (e.g. Boyatzis, 1998).

3. Towards the end of the project action in April 2013, a population survey of both project participants and non-participants in the project area was conducted. The survey was distributed door-to-door throughout the project area and digitally through local institutions. The survey focussed on similar issues to the interviews, but had the additional objective of providing comparable information from households that were not part of the project. 462 survey responses were received (around 18% of local households); 130 from project participants and 332 from other local households. The survey was not intended to be representative.
4. The web-based database of participant information (name, address, email address and contact details) was another helpful source.

3. Results

Smart Communities was a complex project, featuring multiple interventions which played out in interactive ways over two years. With this in mind, this paper draws firm boundaries around the scope of the analysis presented here, concentrating specifically on the relationships between the community action and the email communications, and engagement with energy consumption feedback and monitoring (as well as the relationship between energy consumption monitoring and behaviour change). Other important issues have been addressed in more detail elsewhere (Burchell et al., 2014a,b; 2015). In the context of energy consumption feedback, a number of the Smart Communities findings support the results from previous studies. The quantitative and qualitative data reveal a very wide range of extents of engagement with energy consumption monitoring and feedback. Although numbers will have varied over the course of the project, we estimate that the Owl monitor was installed in approximately 300 households. Of these, around 50 were highly engaged with real-time monitoring and the on-line historical feedback (submitting weekly consumption readings over an extended period) and a further 50 households were engaged with monitoring (i.e. the real time feedback) but did not submit readings or view the on-line feedback. Recalling Murtagh et al.'s (2014) crude 20%/60%/20% distribution, this might suggest a similar 33%/66% split between more and less engaged project participants. From the interviews, we are aware that, in some cases, the energy monitor was quickly put away in a drawer, while in others it took on a significant and long-term role within the household.

The findings provide support for the notion of engagement with real-time and historical energy consumption feedback as a route to behaviour change and knowledge about household energy consumption. Data from the end-of-study survey suggests statistically significant differences in behaviour change between households in which high levels of engagement with energy monitoring and feedback took place and those people in the local area who had not joined the project (Gamma value: .362[2]; significance: .000) (see Burchell et al., 2014b: p20). The survey data also indicates statistically significant differences in claimed knowledge about household energy consumption between householders who engaged with monitoring and feedback and householders who had not joined the project (Gamma values – Knowledge of 'own energy consumption': .746; Knowledge of 'How this compares to others': .827; Knowledge of 'Own baseline consumption': .827; Significance: .000 in all three cases) (see Burchell et al., 2014b: p29). The qualitative data also illustrates the ways in which the monitoring and feedback supported engagement with energy, re-appraisal of energy-consuming activities, the kinds of investigation around the home that led to the development of the knowledge described above, and experimentation with new ways of doing things (see Burchell et al., 2014b).

The project also reveals a number of the challenges that have been identified in previous research. Many project participants did not engage with the monitoring and feedback to the extents described above. Among those who did, the feedback often did not disrupt a raft of practices that appeared to be understood as immutable or beyond challenge. In addition, some participants disengaged as they became weary of the feedback, and wanted new forms of feedback that would teach them something new.

At the same time, particularly due to the community action and communications elements of the project, a number of findings that add new dimensions to previous commentaries can be identified. This is particularly in the context of the challenges of long-term engagement and the gender issues associated with energy consumption feedback discussed earlier.

To properly introduce these findings it is important to make two comments on the patterns of participation in the Smart Communities community action that were observed – for instance, in the workshops, social events and the web forum (Burchell et al. 2014a,b). First, the overall pattern of participation in Smart Communities conformed to a 'pyramid of participation' (Stigsdotter and Grahn 2002; Chanon, 2009), with an inverse relationship between numbers of participants and extent of participation. For instance, more project members participated in energy monitoring at home (we estimate around 300, or 75% of the total) than in community activities (such as evening workshops or social events) (we estimate around 80, or 20% of the total).

Second, however, there is evidence in the interviews with project members who *did not* engage with the community activities that it was important to them that these activities were taking place, even though they were not participating in them themselves. For instance, Faith (a pseudonym) – in common with many parents of young children in the project – told us that she was too busy and tired to attend community workshops and other social events. However, Faith was highly active within her own home and also explained,

> **Faith:** People as individuals often feel they can't make much of a difference and them putting the lights on or running the drier, well what difference does that make? But obviously as a part of Kingston, you feel you're all doing something.

Another project member, Tom, was also very active within his own home. At one point in his interview, Tom explained that he was attracted to Smart Communities because, 'It was quite nice as a sort of community thing'. On the other hand, Tom also revealed his aversion to group activities in his explanation, 'I'm not very clubbable', for why he had not attended any of our community workshops. In a sense, these participants felt that they were *working together, but apart*. As these quotes illustrate, both Faith and Tom were somehow engaged and motivated by the fact that Smart Communities was a community action project, even though they were not participating in the more interactive elements of the

[2] The Gamma test is a non-parametric test that is recommended when both variables are ordinal or when one variable is ordinal and one is nominal but has only two categories (as here) (e.g. De Vaus, 2014). The Gamma value indicates the strength of the effect, in this case the difference between the two categories. Gamma values range between 0, indicating a weak effect, and 1 (or −1), indicating a strong effect.

community action. This is an important point to bear mind because it suggests that the weekly emails – which were sent to all of the project participants, whether they participated in the community action activities or not – played an important role in creating a motivating sense of community action that was far broader than the householders who participated in it.

3.1. Long-term engagement and change

Existing research suggests the importance of long-term householder engagement with energy consumption feedback and of the longevity of the behavioural changes that householders make. However, as previously discussed, while some studies are sceptical about this, Stromback et al.'s (2011) meta-analysis of quantitative studies suggests that, not only is long-term engagement possible, but it also produces greater behavioural changes and reductions in energy use over time. Smart Communities provides support for Stromback et al.'s observations in two key ways.

Although there has been much discussion of the social reasons that particular ways of doing things persist (e.g. Shove et al., 2012), the Smart Communities research highlights the importance of understanding householders deliberate efforts towards behaviour change as a time-consuming process that unfolds gradually over time. This is important since policy documents often present behaviour change as straightforward once it is decided upon (e.g. DECC, 2015a), and because it might explain Stromback et al.'s (2011) claim that reductions in consumption increase over time. Reducing energy consumption has implications for many facets of domestic life, and involves numerous complex changes in behaviour and practice. While some simple changes may be possible almost immediately, typically change is planned, negotiated, researched, piloted and undertaken over extended periods. For example, Adam described how his 'room-by-room approach' was unfolding over time. Similarly, Audrey told us:

> **Audrey:** We've been talking about longer term projects to increase the insulation and if we were going to do any building works how we could actually make those the most efficient that we could that would save us money in the future, rather than just choosing something basic.

Some changes only take place 'when the time is right': for example, when work is done on the house (as in Audrey's case), when something needs replacing, when the cost becomes affordable or when other priorities allow. With reference to his gradual replacement of halogen lights with LEDs (due to the high purchase cost of the LEDs), Tony referred to this as 'opportunistic greening'. Project participants, especially those with young children, also often described the – sometimes almost overwhelming – busyness and competing priorities that pervade their everyday lives (Wilson et al., 2013). Given our finding that engagement with energy monitoring and behavioural change is a time-consuming activity, it is perhaps not surprising that householders often told us how these activities are easily squeezed out by more pressing priorities.

Table 1
Self-reported frequency of use of the IHD energy monitors (at the end of the project action).

	%
More than once a day	26
About once a day	15
2–3 times a week	11
About once a week	19
About once a month	8
Not at all	21

$n=108$.

Table 2
Self-reported changes in use of the Owl IHD over time.

	%
We use the Owl more often now than when we started	13
We use the Owl less often now than when we started	53
We used to use the Owl but no longer do	7
We use the Owl as much now as when we installed it	26
We have never used the Owl	1

$n=106$.

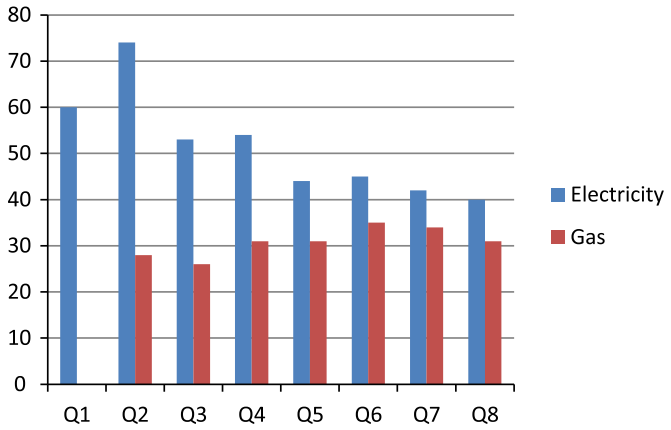

Fig. 2. The number of readings submitted each week by quarter (Q1 = June 2011 to August 2011).

For example, for Lynsey, engagement with energy counts as 'household stuff' that is competing against more essential 'household stuff' and spending time as a family:

> **Lynsey:** Looking after the house, the kids, the washing, the tumble drying, you try and get as much done so that the weekend you've got some time to just enjoy being together, to go out on walks, take the kids out, just to potter around and not be bogged down in household stuff.

These findings provide a possible explanation for Stromback et al.'s observations of increased reductions over time, and illustrate the importance of long-term engagement with energy consumption feedback.

In support of Stromback et al.'s (2011) claim that long-term engagement with consumption feedback is possible, our findings also suggest that there were elements in the Smart Communities approach that led to sustained engagement with the Owl monitor and, to a lesser extent, the web-based readings and feedback. Table 1 indicates that, up to two years after the installation of the IHDs, up to 40% of users were still using their monitor at least once a day, a further 30% at least once a week and only 20% not at all. Table 2 indicates that, although more than 50% of respondents stated that their use of the monitor had declined over time, just under 40% suggested that they were using it as much as *or more than* earlier in the project.

Throughout the project, consumption readings were submitted to the project website by only a sub-set of the members who were engaged with the energy monitor. The interviews suggest that this is because this level of engagement was too much trouble for many participants, particularly within the context of the need to use the computer, and to remember user names and passwords. For example, in reflecting on why she had not submitted readings, Chloe told us of her experience:

> **Chloe:** Fiddly, technical, frustrating. And there're always so many things to log in on the computer, and then passwords. It's

Table 3
Self-reported frequency with which members read the Monday emails (at the end of the project action).

	%
Every week	41
Most weeks	21
Some weeks	21
Few weeks	11
Never	6

$n=122$.

just one more thing to do on the computer. I just think, ugh.

Fig. 2 focuses on the number of consumption readings that were submitted to the project website per week through different phases of the project. Electricity shows an almost immediate spike, followed by a gradual decline, while gas shows a gradual increase, followed by a decline. The gas readings pattern may be related to the increased emphasis on gas – and space and water heating – that we implemented in the weekly emails, workshops and other materials as the project progressed. These figures suggest that more than 10% of households in which Owl monitors were installed were demonstrating high levels of engagement by submitting electricity and gas readings up to two years after installation.

Two elements of the Smart Communities approach appear to have together been important in facilitating these longer term changes: the community action context and the prompts to action in the weekly emails. The project findings suggest that community action and communication can play an important role in prompting and prolonging engagement with energy consumption monitoring and feedback, as asserted by Stromback et al. (2011) and Hargreaves et al. (2013). The qualitative research suggests that key to these encouraging outcomes was the relationship that developed between the Smart Communities project (and the individuals running it) and its members. This seems to have created an important sense of commitment and reciprocity (as illustrated in Jacqui's comment, below) and a feeling among many members of 'being part of something'. Project members variously implied that 'being part of': an energy project, a community project, a school community or initiative, a university/research project, or more straightforwardly a local interesting social group – was important to them.

Jacqui: I agreed to do it, so I would feel that I have to fulfil that really. As soon as we came back from holiday, we said oh, we must do our readings! [laughs].

In some cases, this sense of 'being part of something' was developed through personal interactions, for instance, at project events, on the telephone or via individual email exchanges. However, as we described earlier, this sense of 'being part of something' was even reflected on by participants in the absence of attendance of the more interactive community events. As indicated by Audrey's comment, our data suggests that – for far more project members – the weekly Smart Communities emails in conjunction with the community action context played a vital role in this.

Audrey: I find that the weekly email from yourselves is really useful in prompting me to do those readings weekly.

The research suggests that the weekly emails were valued by many participants. For example, as shown in Table 3, in the end-of-project survey 62% of project members claimed they read the emails 'every week' or 'most weeks', while only 6% claimed they never read them. For those who read them, the interviews suggest that the emphasis on ways of using the Owl monitor supported frequent and sustained engagement with the Owl monitor and energy consumption. As Jess's comment indicates, this was often habitual or routinised:

Jess: It's like you might say Friday night's bath night. Monday, 4 o'clock, take your readings. It's a routine now.

3.2. Gender

Some previous research suggests that engagement with IHDs is often limited to one individual only in a household, and that this individual is often a man (Hargreaves et al. 2010; Strengers, 2013). In Smart Communities, as in Murtagh et al. (2014), the engagement and participation of women was comparable to that of men. The project participant database suggests that around half of the individuals who joined the project on behalf of their households were women and – as some of the earlier interview quotes illustrate – many women participated in energy consumption monitoring.

While it is not easy to provide solid evidence for why this is, our sense is that this is related to aspects of the broader community action context within which the energy consumption monitoring and feedback took place. In particular, we hypothesize that many women joined the project as a result of the project's association with the local primary school and the ways in which elements of the project were incorporated in to the curriculum and their child's education. For households that joined the project through the school, around three quarters of the individuals who signed up on behalf of their households were women. This, we suggest, may be because mothers are typically more engaged with their children's primary school than fathers (the evidence at the school gate certainly supports this) or because the educational framing of energy consumption within the school was appealing to women. In addition, as we have discussed, the Smart Communities project team aimed to be friendly and supportive in all of its actions. Here, we speculate that these elements serve to temper the seemingly adverse effects on women of the emphasis on technology and management that is present in many studies of energy consumption feedback. For instance, these descriptions of the project team were typical of women who engaged with them.

June: They were lovely, very friendly, approachable, polite and interesting. I felt really comfortable with them.
Sophie: It was great! They were very personable and very informative.

3.3. Contextualising feedback

With respect to the comparative element of the feedback, the interviews provide some evidence that this was engaging for project members who looked at it. For instance, Doug suggested that this was the 'real glory' of the feedback and Faith reported that the comparative feedback prompted her to wonder how other households were achieving a lower weekly consumption than her own. This theme of contextualisation was also reflected in the preference of many participants for the monetary units that were provided on the Owl monitor and in the web-based feedback. At the same time, other project members reported that they were put off by the potentially competitive aspect of the comparative feedback; for instance, Chloe complained that this offered people the opportunity for further 'bragging…at the school gates'. In broad terms, though engaging in some cases, our conclusion is that the comparative element of the feedback was not as important as the broader community action and communications contexts within which the feedback was provided.

4. Discussion

On the basis of our findings, we now briefly discuss several issues that have both conceptual and practical implications for future research. In the introduction, the distinction between the *content* of energy consumption feedback and the *context* within which it is provided was made. While content is clearly important, this paper illustrates that the content/context distinction is a helpful one. Context however, has been relatively neglected in research and practice, and this we suggest is a potentially important omission that bears further examination. This observation raises a number of questions, such as: what kinds of broader activities support engagement with energy consumption feedback, what are the sources of energy consumption feedback that would be most trusted by householders (e.g. community project or energy company), and what feedback platforms are most appropriate (e.g. stand-alone devices, apps or websites)?

Both Hargreaves et al. (2013) and the current authors have started their narratives with energy consumption feedback and then introduced community or local action as an adjunct to that. Of course, these are reasonable approaches. However, from Strengers' (2013) perspective, it is possible to understand these narratives as problematic because they start from the technology as opposed to the householder, and are therefore perhaps themselves symptomatic of the misapprehensions that are associated with the technological vision of the smart utopia. On the basis of our own experiences, it seems more productive to begin the narrative with community or local action. Our findings suggest a number of reasons for this: local action may be more meaningful to householders than national programmes, 'joining' something and community action can engender an important sense of 'being part of something' (even when not actually participating in community events), local recruitment via trusted organisations appears to offer the potential to broaden the breadth of types of people who might engage with energy consumption feedback, and the 'softer' style of good community action – friendly, supportive, informal – may have the potential to ameliorate the potentially off-putting 'hard' nature of the technology, data and management that is inherent in the energy consumption feedback programmes typically studied. The questions then become, what are the most appropriate actions within the context of local or community action, what are the best ways for community action on energy to be supported through policy, how might national energy consumption feedback programmes be incorporated into and reframed *within* a strategy that starts from locale and community?

Of course, not all energy consumption feedback projects can be implemented within a fully developed community action context of the kind created in Smart Communities. Perhaps this is particularly true of large scale or national smart meter roll-outs. But our findings suggest that there is potential in explicitly reframing energy consumption feedback as *feedback plus communications*. As discussed earlier, the limitations of mass communications, and standardised tips and advice are well-known. Evidence from Smart Communities suggest that communications can be important if they are implemented appropriately: regular communication from trusted sources can help to render engagement with energy consumption feedback habitual, often over lengthy periods; communications that emphasise action can prompt engagement and learning (in this context, it is helpful to consider action using both the real-time feedback and the historical feedback); general tips and advice can be offered in ways that are meaningful within the specificities of householders' lives and homes; a sense of 'being part of something' can also be created through communications that emphasise the local (and the locale) and are informal, friendly and supportive in tone.

However, a number of caveats must be placed on these findings. While these features of Smart Communities were helpful in prompting engagement with feedback and behaviour change, as previously said, the extent to which this took place varied widely across the participants. In addition, change typically takes place over extended periods, even when householders are engaged with feedback and actively working on reducing their energy consumption. It is also worth recalling the observations that IHDs may actually reinforce existing ways of doing things. Clearly, the approaches that discussed here are not panaceas. Rather, these insights have the potential to support *deeper* engagement and *further* behaviour change by *more* householders and households. Further, it is important to note that these findings emerged from a case study that was conducted in the very specific circumstances of a relatively affluent suburban area. Within this context, the findings possibly tell us less about inner city, rural, less affluent and other country environments. These observations point to the need for further long-term research and comparative work across a variety of social, demographic and geographical contexts.

5. Conclusions and policy implications

Our objective in this closing section is to offer a number of succinct conclusions and policy recommendations. Our conclusions are as follows. Energy consumption feedback can support learning and behaviour change. However, engagement with energy consumption feedback, behaviour change and energy consumption reduction varies widely within and between households and – even when householders are engaged and committed – changing energy-consuming behaviours is typically a time-consuming and lengthy process. That said, this study suggests that the challenges that have been identified in previous research – with respect to long-term engagement with IHDs and increased engagement with IHDs by women – can be acted upon. In Smart Communities, these findings appear to be most prominently related to the community action acting in concert with supportive accompanying email communications on energy consumption feedback.

Our first policy recommendation is relevant within the context of current IHD roll-outs. On the basis of the findings in Smart Communities, it would be of value to consider energy consumption feedback as part of a package of activities that might include elements of community action, and could more readily include ongoing regular communications that focus upon action and advice, and are written in an appropriate style. Our second policy recommendation relates to the longer term. Here our observations of recent developments suggest that it is important to think of current IHD roll-outs as energy consumption feedback v1.0. Looking to the future, and within a broader context of action and communication, the technological developments – in particular, apps – that are informing future formats of energy consumption feedback – v2.0 and v3.0 – are likely to enable the provision of energy consumption feedback in ways that are increasingly bespoke to each household allowing householders to better contextualise their energy consumption data. For example, social comparisons, disaggregation around particular appliances or practices, tailored advice based upon disaggregation and householder-provided information and so on are likely to become standard features that have increased appeal and potential for engagement. Apps also have the potential to send alerts, notifications and other communications, and to develop a social environment within and between households. The pervasiveness and increased sophistication of apps suggests that, if designed carefully, these may offer the potential for bringing these social and technical aspects together in a flexible and updatable way that transcends the limitations of v1.0 stand-alone IHDs. Nonetheless, whatever future platform is used to bring energy consumption

data to householders in evermore engaging ways, it will be important for future designers and practitioners to recognise the sociality of energy consumption and pay careful attention to the style of the message and community context in which it is given.

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[3] All web links were verified in January 2015.