What is energy know-how, and how can it be shared and acquired?

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Abstract
Our aim in this short paper is to contribute to conceptual, practical and policy discussions about the role of householder knowledge in the context of policy ambitions to reduce domestic energy consumption. More specifically, we are interested in the characteristics of this knowledge, the ways in which householders acquire such knowledge, and the kinds of activities and policies that might support this. Within this context, *literacy approaches* emphasise factual knowledge, cognitive reasoning, and ideal attitudes and behaviours; within this mainstream approach, education and communications are key policy recommendations. In contrast, *know-how approaches* are critical of *literacy approaches* and emphasise practical skills, experience and guidance. Key policy recommendations focus on tailored guidance delivered through activities such as demonstration homes and home audits. Smart Communities was a community action and action research project on energy demand reduction. The activities in the project drew on both *literacy* and *know-how approaches*, and the research methods focussed on in-depth interviews, a survey and informal interactions with project participants and partners. The project strongly supports the ideas that are expressed in the *know-how* literature, but also highlights the practical challenge of scaling-up activities such as home visits. Meanwhile, approaches that drew on *literacy approaches* produced less change, but were easier to implement at scale. In our discussion, we raise the need for *know-how approaches* to be more adequately supported in policy, and the need to investigate and experiment with novel approaches that would allow these activities to be scaled-up. In support of these objectives, we present a concise expression of the concept of energy know-how. In addition, we suggest that the *know-how literature* is perhaps overly critical of the *literacy approach*, and we discuss some ways in which *literacy approaches* can be more effective.

Introduction

> I hear and I forget
> I see and I remember
> I do and I understand
>
> Confucius

While an international literature on reducing domestic energy demand reduction can be traced back to the late 1970s (see Abrahamse *et al*, 2005), this is now also an important element of government policies around the world (in the UK, see HM Government, 2003; 2006; 2009; 2011; DECC, 2012a). Prompted by a number of policy objectives – climate change, carbon reduction, peak load management, fuel poverty and energy security – behaviour change and energy efficiency now have a central role in government policy. These policy developments have prompted renewed debate surrounding the potential and challenges of such an approach (Dietz *et al*., 2009; Shove, 2010; 2011; Strengers, 2013; Whitmarsh *et al*., 2011), as well as a range of UK government energy efficiency and behaviour change publications (DECC, 2011; 2012b/c).

Our aim in this short paper is to contribute to conceptual, practical and policy discussions about the role of householder knowledge in the context of ambitions to reduce domestic energy consumption. More specifically, we are interested in the

characteristics of this knowledge, especially the characteristics of the knowledge that is valuable and actionable for householders, and the approaches through which householders acquire such knowledge. Further, we are concerned with the kinds of specific activities and policies that might support the acquisition of this knowledge by householders. In particular, our objective is to encapsulate these characteristics and approaches within a practical and enabling concept that we call energy know-how. We define energy know-how simply as the things that it is helpful for a householder to know if she or he wants to reduce their energy consumption. For instance, using draught exclusion as an example, this might include: the idea of draught exclusion, knowing how to identify where draught exclusion is required, knowing which specific materials are required, knowing where to obtain these materials, and knowing how to install them. While the existing literature in this domain is either wholly conceptual or draws on traditional empirical approaches, this paper draws on action research. This is helpful because it allows concepts to be examined in the context of practical project action.

In recent years, two approaches have emerged in response to our questions. In brief, on one hand, *literacy approaches* focus on factual knowledge about energy, energy systems, carbon, climate change and personal energy consumption, cognitive reasoning, ideal attitudes to energy and climate change, and ideal behaviours (DeWaters *et al*., 2007; Seyfang *et al*., 2007; DeWaters and Powers, 2008; 2011; Whitmarsh *et al*., 2009; 2011).The policy recommendations in this literature, such as information campaigns and smart meter roll-outs, have informed mainstream government responses. On the other hand, *know-how approaches* tend to be critical of the limitations and dominance of *literacy approaches*. These tend to focus on the practical skills that are required to actually implement change in the household, and emphasise the importance of experience and practice in the acquisition of know-how (Pink, 2011; Catney *et al*., 2013; Royston, 2014; Simcock *et al*., 2014; Wallenborn and Wilhite, 2014). In addition, work in this tradition emphasises the tacit and household-specific nature of this kind of knowledge, as well as the importance to householders of the trustworthiness of the guidance that they are offered and the person offering it. Policy recommendations – such as demonstration projects and home energy audits – tend to focus on demonstration within local social networks.

The paper proceeds as follows. In the next section, we describe the *literacy* and *know-how approaches* in more detail. Then we describe the Smart Communities project; briefly, this was a community action project on energy consumption that featured a range of activities that reflect both the *literacy* and *know-how approaches*. We then discuss the key relevant findings. In Smart Communities, while the activities that drew most heavily on *know-how approaches* produced the most conspicuous change, these were also the most resource-intensive and most difficult to scale-up. Meanwhile, approaches that drew more on *literacy approaches* produced less change, but were easier to implement at scale. In our discussion, we raise the need for *know-how approaches* to be more adequately supported in policy, and the need to investigate and experiment with novel approaches that would allow these activities to be scaled-up. In support of these objectives, we present a concise expression of the concept of energy know-how. In addition, we suggest that the *know-how literature* is perhaps overly critical of the *literacy approach*, and we discuss some ways in which *literacy approaches* can be more effective.

However, first, we briefly review some of the objections that might be raised to an emphasis on knowledge *per se*. For instance, Wynne (1992) has famously proposed the information deficit-model to challenge the assumption that people with more knowledge will adopt the particular attitudes and behaviours that institutions might expect or desire. Similarly, Shove (2010; 2011), in her attitudes-behaviour-choice or ABC critique, has pointed out the simplistic nature of the notion of straightforward links between knowledge, attitudes and behaviour (in the context of energy, see discussions of these associated critiques in Hargreaves *et al*., 2010; 2013; Whitmarsh *et al* 2011; Catney *et al* 2013; Strengers, 2013; Royston, 2014; Simcock *et al* 2014; Wallenborn and Wilhite, 2014). Critics might also point to the reductionist nature of a focus on knowledge alone, variously asking what of: systems of provision, infrastructures, materials, 'sayings and doings', attitudes, values, financial incentives, 'choice architectures', defaults, social norms and even the inadequacy of an emphasis on behaviour when the challenge of climate change demands wholesale social change? While we endorse these critiques, we also agree with Simcock *et al*'s (2014) pragmatic observation that, while increased householder knowledge alone cannot be relied upon to deliver sizeable reductions in domestic energy consumption, it nonetheless constitutes an important element of this challenge. Finally, some might criticise the emphasis on energy in the name energy know-how, arguing that it is not so much energy itself that is the issue, but rather energy-consuming services, practice, everyday life or society. Again, conceptually at least, we endorse this criticism. However, we feel that the concept of energy know-how has important messages for policy and practice; with this in mind, we argue that it is essential that the name of the concept is self-explanatory, and is meaningful to people working in these domains.

Approaches to knowledge about energy consumption reduction

While we are aware of the possible dangers of proposing a simple dualism, two conceptual approaches to householder knowledge and energy consumption reduction can be detected in the literature: what we refer to here as *literacy approaches* and *know-how approaches*.

LITERACY APPROACHES

There are two key *literacy approaches* to this issue in the literature: energy literacy (which specifically focuses on secondary-aged children) (DeWaters *et al*., 2007; DeWaters and Powers, 2008; 2011) and carbon capability (Seyfang *et al*., 2007; Whitmarsh *et al*., 2009; 2011). For the originators of carbon capability, this represents a significant development of the energy literacy approach. However, our analysis suggests that that they have much in common. For instance, both concepts draw on the behavioural models of educational and social psychology (for instance, see Triandis, 1977; Azjen, 1985; 1991). As such, these approaches largely focus on relationships between factual knowledge, cognitive decision-making, ideal attitudes to energy and climate change, and ideal energy saving behaviours (see Table 1).

Further, both of these approaches are designed with quantitative measurement in mind. For this reason, they tend towards the assertion of a highly codified, top-down canon of knowledge, attitudes and behaviours against which people can be measured. Dismay at apparently low levels of literacy and capability is a feature of both approaches. Finally, and perhaps most significantly, practical and skills-based knowledge is relatively neglected in these concepts. Skills are mentioned in the context of carbon capability, but this element is not well developed. In the case of energy literacy, while DeWaters (pers. comm., 2012) originally planned to include skills in energy literacy, she omitted this due to a perceived difficulty of measurement. That said, differences between the two concepts can be discerned. For instance, carbon capability draws on social representations theory, and highlights the challenges identified by the information deficit-model. In addition, carbon capability emphasises the importance of wider social and infrastructural systems and the resulting limits of individual action; as a result, political engagement for change is included as a component of carbon capability.

In terms of policy recommendations, work on energy literacy unsurprisingly focuses on the need for education, while research on carbon capability primarily emphasises improved communications and social marketing (using insights from social representations theory). In addition, work on carbon capability emphasises a range of policy tools – personal carbon budgets, energy consumption feedback on smart meters and carbon-labelling on products – designed to provide individuals and householders with information about their own energy consumption and its related carbon emissions.

The *literacy approach* could reasonably be called the mainstream approach. For instance, in the UK, a recent House of Commons Energy and Climate Change Committee (2012) report asks, 'How "energy literate" are consumers in the UK? For example, are most consumers aware of how much their bills vary according to usage? Are terms such as "kWh" understood by most consumers?'. In addition, UK government policies that have drawn on *literacy approaches* include the 'Are you doing your bit' public information campaigns of the late 1990s (DETR, 2000), the 'Act on CO_2' campaign in 2009 (see Gillespie, 2010), the Energy Savings Trust website (2015; also see Centre for Sustainable Energy, 2015a) and the provision of in-home displays to all UK households as part of a nationwide smart meter roll out (DECC, 2015a). *Literacy approaches* are also popular in the commercial consultancy sector. For instance, in the UK, CarbonSense (2015) states, 'most people, while aware of climate change, do not fully understand what the concept means or grasp the implications: they are "carbon illiterate". The key is to help the people responsible for most of the emissions...to become "carbon literate'; also see More Associates (2015).

KNOW-HOW APPROACHES

While practical skills are not emphasised in *literacy approaches*, these are a key element in *know-how approaches* (see Table 1) (Pink, 2011; Catney *et al*., 2013; Royston, 2014; Simcock *et al*., 2014; Wallenborn and Wilhite, 2014). Although they vary somewhat in their detail and emphasis, *know-how approaches* employ sociological, ethnographic and anthropological theory and concepts, and the empirical papers among them (Royston, 2014; Simcock *et al*., 2014) employ qualitative methods. As *know-how approaches*, they explicitly or implicitly draw on a putative distinction between know-what and know-how that can be traced back to Ryle (1949; 1954; also see Brown and Duguid 1998). In classical Greek philosophy, contemporary ideas about know-how are further elaborated in discussions of techne, phronesis and metis (see Royston, 2014 on energy; also Baumard, 1994; Flyvbjerg, 2001; Scott, 1998) (also see Harris, 2007 on the inter-relationships and inter-dependence between these knowledge types, as well as the difficulty in distinguishing between them in many cases). At the heart of the know-what/know-how dichotomy is a distinction between the cognitive, informational and factual nature of know-what, and the active, practical and skills-based nature of know-how (Catney *et al*., 2014; Royston, 2014). For followers of the *know-how approach*, the knowledge that householders use and require to reduce their energy consumption is primarily know-how. For instance, Royston (2014) describes the myriad ways in which householders employ practical – rather than cognitive – skills to monitor and manage efficient heat flows within the home (from detecting draughts and operating heating controls to making bed warmers). Thus, although they do not directly engage with the *literacy approach* literature, a key characteristic of most *know-how approaches* to energy is that they identify the mainstream *literacy approaches* described earlier with a narrow and inadequate focus on know-what (and communications) and a neglect of know-how. Wallenborn and Wilhite (2014) make the point in a slightly different way when they argue that mainstream approaches collapse body into mind and overlook the importance of what they call embodied knowledge in the management of household consumption.

Some *know-how approaches* also emphasise the highly contextualised nature of knowledge about energy consumption reduction. To put this in more practical terms, these approaches assert the extent to which valuable and actionable know-how

Table 1. Key elements of literacy and know-how approaches.

	Facts* and cognition	Household consumption	Practical skills	Political engagement	Social engagement
Literacy approaches	X	X		X	
Know-how approaches			X		X

** About energy, energy systems, climate change and carbon.*

must be household specific. Simcock *et al*. (2014) elaborate on this more fully, suggesting that valuable and actionable know-how needs to be tailored in three specific ways: the material infrastructure of the building and appliances, existing ways of doing things within the household and the level of existing know-how in the household. As illustrated by Royston (2014), *know-how approaches* tend to assume that there is know-how present in households but also that more is needed. Turning, then, to the ways in which knowledge about energy consumption reduction might be best shared and acquired, Catney *et al*. (2013) draw on Polanyi (1962; 1966), arguing that this practical (and context-dependent) knowledge is highly tacit; which is to say that it is complex, implied or intuited and therefore not amenable to straightforward articulation, communication, codification or formalisation. This renders such knowledge 'sticky' and makes it difficult to share and acquire (von Hippel, 1994). Across *know-how approaches* to energy consumption reduction, the 'stickiness' of practical knowledge underpins the criticism that the policy tools of education and mass communication that are recommended in *literacy approaches* represent a manifestation of Wynne's deficit-model or Shove's ABC thinking, and are therefore limited.

Instead, *know-how approaches* emphasise two key points. First, *know-how approaches* focus on the extent to which know-how is acquired through everyday experience and practice (Wenger, 1998; Orlikowski, 2002; Harris, 2007). In the context of energy, Royston (2014) draws on a range of broader work (for instance, Knorr-Cetina, 1981; Frohmann, 2004) as well as her own data to suggest that this takes the form of ongoing idiosyncratic, opportunistic and highly-situated negotiation, improvisation, tinkering and making-do. In a similar vein, Wallenborn and Wilhite (2014) emphasise the value of experimentation. For her part, Pink (2011; also see Royston, 2014) highlights the importance of sensory experience in the acquisition of know-how about energy (in the context of Greek philosophy, these kinds of activities are features of phronesis and metis; see Baumard, 1994; Flyvbjerg, 2001; Scott, 1998). The ongoing and iterative nature of these activities leads most advocates of *know-how approaches* to the conclusion that know-how should be understood as always emergent, a process of knowing-how or coming to know (Duguid 2005). Second, *know-how approaches* focus on the ways in which these processes of coming to know rely upon – and can therefore be enhanced by – a variety of forms of peer-to-peer and expert-to-lay (or non-expert) demonstration and guidance within so-called communities of practice (Lave and Wenger 1991; Wenger 1998; Harris 2007). In this regard, Simcock *et al*. (2014) emphasise the importance of householder trust in both the source and the authority of knowledge about energy consumption reduction. In particular, on the basis of interviews and focus groups with householders, they note that profit-making sources of knowledge, such as energy companies, are particularly mistrusted by householders.

Drawing on these insights, policy recommendations associated with the *know-how* approach tend to emphasise local and social approaches that promote peer-to-peer and expert-to-lay (or non-expert) demonstration and guidance. The two approaches that are most commonly discussed are demonstration projects, in which householders visit a local energy efficient home, and home energy audits, in which local experts visit householders in their own homes (Royston, 2014; Simcock *et al*. 2014; Wallenborn and Wilhite, 2014). Such approaches have a history that stretches back to the 1980s (Abrahamse *et al*., 2005), and are being implemented in a variety of formats by third sector groups in the UK; for example, see the SuperHomes (2015) and Green Open Homes (2015) demonstration homes projects and a number of home visits approaches (Burchell *et al*., 2014; Groundwork, 2015; Centre for Sustainable Energy, 2015b). Within the context of its Community Energy Strategy, UK government policy is starting to support these approaches through pilot projects in social housing and housing associations (DECC, 2014, pp 78–80).

Surveying the literature, it is also possible to identify emerging practical approaches that combine elements of *literacy* and *know-how approaches*. For instance, a number of websites are in operation and development that provide tailored tips and advice on the basis of householder-provided information (Ford et al., 2014; British Gas, 2015; Energy Saving Trust, 2015).

Smart Communities

Smart Communities was a community action and action research project on domestic energy consumption reduction (further information is available in Burchell et al., 2014a/b). The project took place in Kingston upon Thames, a middle-class suburb of London, UK, and the project action lasted from May 2011 to May 2013. The project featured: energy consumption monitoring, community-based consumption feedback; weekly email communication; a web forum; community workshops; home visits; working with a primary school and library, and collaborating with local groups and experts. More information about the project is provided below; within the context of this paper, Smart Communities is a helpful case in three key respects:

1. The *literacy* and *know-how* literatures do not examine these concepts in the context of *practical efforts* to help householders to reduce their energy consumption. In contrast, since Smart Communities drew on action research (Reason and Bradbury, 2008), this allowed the concepts to be examined in the context of practical action.

2. Central to the project was a programme of weekly email communications and an energy consumption monitoring and feedback system. While these activities are associated with *literacy approaches* in the literature, this programme was implemented in ways that also drew on *know-how approaches*. In particular, the emails encouraged and supported project members to experiment with their energy monitoring as well as to enter weekly consumption readings on the project website. In this spirit of action and experimentation project members were encouraged to enhance their knowledge of the energy consumption of their appliances. Email communications were also designed to emphasise community action on energy.

3. The project also featured activities that are associated with the *know-how* literature. Key among these was a novel home audit format that we called Home Energy Action Visits. While approaches to home audits inevitably vary, they tend to emphasise comprehensive auditing and reporting. In Smart Communities, our objective was to bring to bear

further insights from the *know-how approach* in the ways in which we implemented the activity. Thus, the Home Energy Action Visits emphasised: action, hands-on demonstration, thermal imaging and the provision of materials such as draught excluding materials. In early piloting of the format in which the homes of the researchers themselves were audited, the audit reports were experienced as being too comprehensive, dry, and overly technical. They were unexpectedly overwhelming and did little to encourage action. For this reason, in Smart Communities, householders were sent a *very short* report, illustrated with thermal images, containing ten bespoke, relatively straightforward and impactful actions for implementation. In recognition of our emerging observation that domestic energy consumption reduction is best understood as a long term and incremental process (see Burchell *et al*., 2014, p. 22), this was followed by offers of further visits, guidance and support. Also see the discussion of Thermal Imaging Parties and community workshops in Burchell *et al*., 2014.

Our analysis relies upon data from four sources. During the course of the project action, informal interactions with project members took place at project workshops, celebration events, home visits, and on the telephone and in emails. Thirty interviews were undertaken with project participants; ten in early 2012, fifteen in early 2013 and five in October 2013. An end-of-project survey of both project participants and non-participants in the project area was conducted in April 2013. 462 survey responses were received; 130 from project members and 332 from non-members. In addition, the project member database contributes to our analysis.

Prior to discussing the specific findings of the project, we are pleased to provide broader information about the project and its outcomes. Smart Communities was designed by the researchers, in collaboration with a number of local partners (Burchell et al., 2014: 10). The project took place in a suburban area, in Kingston upon Thames in south west London, centred on the Tudor ward; one of the 15 % least deprived wards in England (UK Census of Population, 2011). The area mainly contains 3-bedroom houses (often-extended) with some flats, and includes the 1930s Tudor Estate, as well as older and more modern housing (Mervyn Smith, 2015). This area of Kingston was selected because it is home to Fern Hill Primary School (Fern Hill), which already had a good track record on sustainability, it offered an area that was reasonably easy to demarcate and contained an appropriate number of dwellings (1,600). In the spring of 2012, to attract further participants, the project area was extended to encompass some 2,500 households. The area also had the advantage of being within reach of the university campus, facilitating community engagement. The choice of an affluent suburb reflected the links between energy consumption and affluence; in addition, although some 80 % of the UK population lives in suburban areas, these are often over looked in research and action (DECC 2013; Bioregional 2006; Local Futures Group, no date).

To broaden its appeal, Smart Communities was framed in terms of energy consumption reduction; climate change was not discussed in Smart Communities materials (see Heiskanen *et al*., 2010; Rettie *et al*., 2012; 2014). The key proposition of the Smart Communities project was encapsulated in the strap-line: Working together to save energy, and a free energy monitor was offered to all members. The name Smart Communities was intended as a response to the notions of smart grids, meters and homes, which emphasise technology but sometimes overlook people (Strengers, 2013). At the heart of Smart Communities was the notion that people and communities are smart, and have valuable knowledge, know-how, ideas and capacity to share (though the word 'smart' was sometimes interpreted as an endorsement of the technological 'smart' vision). Further key notions in determining the 'look', 'feel' and 'style' of the project were: local, informal and friendly; homes, people and children; non-commercial and university-based; and collaboration with local partners.

Recruitment to Smart Communities largely relied upon communications materials. A recruitment leaflet and later, a newsletter were hand-delivered to all households in the project area. Project communications were also distributed by our project partners (Fern Hill Primary School, the local library and the residents' association), complemented by face-to-face recruitment at Fern Hill events. All project members were offered a free Owl energy monitor. Householders joined the project on the Smart Communities website, submitting basic contact details and an indication of how they heard about the project (and project interviews suggest that this process may have discouraged some). Although a membership of 750 had been aimed for, around 400 households from a possible 2,500 joined the project; an overall recruitment rate of around 16 %. By contrast, the nearby Ham and Petersham Low Carbon Zone recruited around 26 % of households in its area. This success can perhaps be attributed to intensive door-to-door recruitment by local Street Champions in this project (London Borough of Richmond, 2013). The end-of-project survey suggests that local awareness of the project was around 40 %. Importantly, recruitment through the materials that were distributed via local partners was more effective than the door-to-door leaflet drop; some ten times, in the case of Fern Hill. Recruitment was supported by the free energy monitor, but may have been constrained by the on-line registration system.

The end-of-study survey suggests that people joined Smart Communities for a range of – and often multiple – reasons. Dominant among these was interest in reducing energy consumption (86 %), saving money (54 %) and reducing carbon emissions (45 %) (90 % of members cited one or more of these reasons). These figures suggest that omitting climate change from the framing of Smart Communities did not deter people whose motivations lay in that domain, and attracted people who might not have joined a 'climate change' project.

The overall pattern of participation in Smart Communities reflected a 'pyramid of participation', with an inverse relationship between numbers of participants and intensity or extent of participation (Stigsdotter and Grahn, 2002; Chanon, 2009; also see Walker and Cass, 2007 and Rogers *et al*., 2008 on modes of participation in community energy projects; also see the Pareto Principle, 2015). The overall pattern of change in Smart Communities also reflected this 'pyramid of participation'; while change was extensive in a relatively small number of households, a range of much smaller and very basic changes were observed in far greater numbers of households. The Smart Communities research also highlights the importance of understanding behaviour change as a process rather than as

a one-off event. The interviews suggest that change in energy consumption behaviours should be understood as a gradual process that often unfolds over quite lengthy periods of time. While some simple changes may be possible almost immediately and with minimal financial and opportunity cost, change is often planned, negotiated, researched and discussed, and takes place over extended periods. Change often makes considerable demands in terms of time and effort. Thus, the busyness and competing priorities of householders' everyday lives can constrain behaviour change. Project participants also often mentioned cost as a constraint on change. Some changes can only take place when the time is right: for example, when work is done on the house, when something needs replacing, when the cost becomes or affordable or when other priorities allow; Tony called this 'opportunistic greening'. Other changes are undertaken gradually to spread the costs (such as, replacing halogens with LEDs). As the broader conditions of people's lives change, processes of change can be terminated or interrupted, and previous changes can be reversed. Please see Burchell *et al*. (2014) for further information on these issues.

Findings

Reflecting the action research emphasis on simultaneous or iterative conceptual and practical development, our findings weave between the conceptual and practical. To summarise, the findings from the Smart Communities project strongly indicate that the ideas that are featured in *know-how approaches* are valuable in practice. The project activities that drew most heavily on *know-how approaches* were also those that produced the most conspicuous action and change among householders. Further, thinking about these issues in very practical ways also enabled us to further develop the existing *know-how approach* literature. However, at the same time, the project also illustrates the time-consuming and costly nature of these activities, as well as the challenges of scaling-up and reaching large numbers of households. In addition, the findings suggest that activities that are associated with *literacy approaches* in the literature can be imbued with insights from *know-how approaches*, and that these can also produce change (though in general not to such a great extent). Significantly, in practical terms, the project suggests that these latter activities can more easily and economically reach many more householders than those that draw on the *know-how approach*.

Home Energy Action Visits, the Smart Communities version of home audits was the activity that was most impactful among householders; this was also the activity that most strongly reflected *know-how approaches* (also see the discussion of the Thermal Imaging Parties in Burchell *et al*., 2014). As illustrated in the following quotes from interviews with householders who received Home Energy Action Visits, our findings support the practical and conceptual emphasis in the literature on: experience and practice, social interaction, tailored knowledge, and trusted and authoritative sources:

> Sophie (all names are pseudonyms): I thought it was brilliant because it really personalises what your issues are … It was great! They [the local experts] were very personable and very informative … and there's nothing pushing it apart from a real desire to help the planet, it's not profit related.

> June: It was really helpful for me to just sort of walk round the house and go over a few things with them [the lay experts] … They've got experience and knowledge, and they'll come to your home and give advice but it's not hard sell … They were lovely, very friendly, approachable, polite and interesting. I felt really comfortable with them.

In addition to these issues, the Home Energy Action Visits highlighted two further points. First, in a reflection of Pink's (2011) emphasis on the importance of sensory experience and of the expression *seeing is believing*, the thermal images proved to be a very powerful and motivating visual representation of heat loss. For Martin, the visual nature of the thermal images proved more powerful than his previous non-visual sensory experience of a draughty window. For Kate, in the context of her on-going endeavours to convince the managers of her building that new gas heaters were causing draughts, thermal images provided visual 'evidence' that could be used to convince others.

> Martin: The thermal images were quite a surprise for the windows, since then we've put draught excluder in. These large blue areas [in the thermal images], you could feel it, but when you can actually see it, crikey!

> Kate: I could feel it was draughtier since they fitted those heaters, now I have the evidence.

The second novel insight that emerged from the Smart Communities home visits was the potential value of providing householders with a relatively short list of straightforward and impactful actions (as opposed to a more comprehensive report). In concert with other features of the Home Energy Action Visits, the provision of a bespoke checklist of just ten key actions seemed to render the task of implementing the actions manageable. In interview, for instance, both Martin and Saleem ticked off the actions as they were discussed.

> Martin: Yeah, the report helped because we could just say, right, we'll do that, we'll do that. We've done all these, well, not the microwave.

> Saleem: I put the strips on the kitchen door; that works brilliantly, it has reduced the draughts. I've put in the chimney balloon, and also the reflective panel on the radiator in the front room. The only thing I haven't done is the insulation at the top.

Our experiences in the context of the community workshops that we ran also emphasised the complexity and household-specific nature of this form of knowledge, as well as the value of experience and social interaction in the acquisition of knowledge. During the project we ran six community workshops – two on lighting, two on thermal comfort and two on hot water – each of which featured a section in which a local lay expert conducted a question and answer session (see Burchell *et al*., 2014, p. 35–7). Although it is not possible to straightforwardly illustrate this with direct quotes from the workshops, it was notable that the local lay experts often found it difficult to specify exactly what materials or actions might be appropriate in the specific context of each questioner's home.

One particular exchange in a workshop on thermal comfort also illustrated the complexity that householders might

encounter when trying to follow the oft-stated – and, apparently, straightforward – advice regarding internal temperatures (for instance, in the UK, the Energy Saving Trust website states 'Your room thermostat should be set to the lowest comfortable temperature – typically between 18 °C and 21 °C'). In addition, this passage highlights the value of experience – the tinkering that is described by Royston (2014) – and social interaction in the emergence, sharing and acquisition of knowledge.

> Facilitator: I have a thermostat, and it's set to 18, but I've learnt that the temperature in our living room is around 21. We were dismayed, so we're experimenting now with 17, to see what we end up with.
>
> Pat: I think I experienced the same, my thermostat is set actually for 19, but I have a separate electronic thermometer that tells me the real temperature which is usually over 21.
>
> George: Ours is set for 18 and a half, and like everyone else, I mean, it's in the hallway, so I know the hallway's 18 and a half, but I honestly have no idea what the other rooms are.
>
> Karen: Well, mine's set pretty low, I think it's probably about 17, but I don't think that is the temperature in the room, I think it gets higher than that, because again, it's in the hall.
>
> Facilitator: So this issue of thermostats being in the hall is a confounding factor?

The importance of in-home demonstration and guidance was also illustrated in the comments of the local experts with who we worked. In particular, our colleagues reported to us that the Home Energy Action Visits that they performed were also learning experiences for them in a number of ways. Specifically, they reported that they learned more and more about the challenges that householders were facing in their efforts to reduce their energy consumption and they learned new ways of reducing demand that they themselves had not been aware of before.

Conceptually, in the course of our work on the Visits and know-how more broadly, it became increasingly helpful to us to distinguish between and pay practical attention to three interrelated forms of know-how:

1. We found it helpful to think about know-how in terms of *ideas* or suggestions for alternative ways of doing things, or investigative experiments that householders could try out. This form of energy know-how broadens the scope of future possibilities and builds confidence to experiment. For example:
   - You could try hanging your laundry rather than tumble drying.
   - You could experiment with just heating the room(s) that you are using or that you use the most.
   - You could investigate which of your windows is draughty and have a go at insulating them.
2. As predicted by the *know-how* literature, we also found it useful to think about know-how as the practical skills required to implement these ideas. This form of know-how makes it easier to put these ideas or changes into practice in the future. For example, continuing the previous examples:
   - Clothes dry better when they are hung immediately after washing, when they are re-shaped by hand and when they have space between them etc.
   - Turn off the radiators in the rooms you are not using and close your internal doors.
   - You can investigate which windows are draughty using a joss stick and you insulate the windows like this.
3. It also became increasingly clear to us that it is helpful to think about know-how as knowledge of the material objects involved. This relates to both the infrastructure of the house (for example, *what kind of boiler do I have?* or *what type of windows do I have?*) and the appropriate materials that might be needed to affect an improvement (for example, *what kind of insulation material do I need for my type of windows?*), and of where the materials can be obtained (on- or off-line).

However, although the Visits had substantial positive impact on the householders who experienced them, it is important to sound a note of caution. The findings from the Smart Communities project highlight two associated issues that together make it challenging to implement such activities at scale. First, these approaches are highly time-consuming and, therefore, expensive to implement. In addition, as we have indicated, much of the success of the Home Energy Action Visits in Smart Communities appears to have been due to the nature of the social interactions between the local experts with whom we worked and the householders. To a considerable extent, we attribute this to the distinctive style of the local experts, whose personal attributes were simultaneously: authoritative, informal, respectful, understanding, informative and modest. It is not easy to imagine this being preserved within the context of a large-scale programme. Together with the importance of preserving the locally-provided and non-commercial nature of these activities, these issues represent considerable challenges in terms of scaling-up.

At the same time, the Smart Communities findings illustrate the potential value of communications and energy consumption monitoring and feedback. As we described earlier, weekly email communications with project members played a key role in the project. Communications are a key recommendation of the *literacy approach* and are criticised as inadequate within *know-how approaches*. However, in Smart Communities, we used the email communications to promote forms of action and experimentation that might be more readily associated with *know-how approaches*. For example, we used the emails to prompt and encourage project participants to enter electricity and gas consumption readings into the Smart Communities website and to use the in-home display to learn more about the energy consumption of their appliances. The findings from the survey suggest that both communications and energy consumption monitoring and feedback can be supportive of experimentation, action, the acquisition of knowledge, and change among householders (see Burchell *et al*., 2014, pp 20, 29–30).

The research suggests that the weekly emails were valued by many participants. 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 (see Burchell *et al*., 2014, p 31). For those who read them, the inter-

views suggest that the emphasis on ways of using the in-home display supported frequent and sustained – and, as indicated in Audrey's and Jess's comments, habitual or routinised – engagement with the in-home display and energy consumption.

> Audrey: I find that the weekly email from yourselves is really useful in prompting me to do those readings weekly.
>
> Jess: It's like you might say Friday night's bath night. Monday, 4 o'clock, take your readings. It's a routine now.

In the context of a complex and multi-activity project, it is not easy to attribute specific outcomes to specific activities. However, the end-of-study survey also suggests that greater engagement with the in-home display and the web-based feedback were associated with more extensive knowledge about one's own energy consumption and the energy consumption of one's appliances, and with more changes in behaviour (see detail in Burchell *et al*., 2014 pp 20, 29–30). Finally, it is important to note that the Smart Communities communications were implemented within the broader context of a community action project that the project interviews suggest created a strong sense of *being part of something* among members. With this in mind, therefore, there are clearly important differences between these hybrid interventions that blend know-how with literacy and the mass communications that are envisaged within *literacy approaches*.

Discussion

This paper is concerned with the conceptual, practical and policy challenges associated with householders' acquisition of energy saving know-how. We are interested in the characteristics of this knowledge, and in the implications of this for the ways in which it can be acquired and shared. We have described *literacy approaches* and their tendency to focus on facts and cognition, and policy responses such as marketing and communications. We have also described *know-how approaches*, which we suggest are often critical of *literacy approaches*, and typically emphasise practical skills, and policy actions that focus on social interactions in which practice, experience, guidance and demonstration are prominent. As an action research project, Smart Communities was novel because it examined *literacy* and *know-how approaches* together and within the context of purposive efforts to support the acquisition of such knowledge. In this discussion, we wish to make a number of points relating to the interrelated conceptual, policy and research challenges.

Conceptually, we make two points. First, the opportunity to examine these issues within an action research context has proven highly fruitful. The project confirms that the insights in the *know-how* literature (such as: the importance of practical skills, sensory experience, guidance, tailoring, trust) are, indeed, important within the context of activities designed to support the acquisition of knowledge about energy demand reduction. In addition, alongside practical skills, the research has emphasised the value of understanding novel *ideas* about experimentation and ways to do things, and practical knowledge about *building infrastructures* and *material objects* as important aspects of this form of knowledge. Further, not surprisingly perhaps, the thermal imaging elements of the project suggest that visual experience might be more powerful that other sensory experience in this context. At the same time, the project illustrates the value of approaches – such as communications and smart meters – that are associated with *literacy approaches*, especially as ways of reaching many people and when implemented in ways that also draw on *know-how* thinking. Thus, while the observation that *literacy approaches* are limited is supported by Smart Communities, the project suggests that this way of thinking might be written off a little too easily within some critiques.

Second, building on the ways in which ostensibly *literacy* and *know-how approaches* were combined in Smart Communities, this clearly illustrates Harris' (2007) cautionary note that know-what and know-how are inextricably linked and that it is often difficult to distinguish between them. While we have found it conceptually helpful to distinguish between know-what and know-how, and *literacy* and *know-how approaches*, the project action itself illustrates the importance of Harris' (2007) observation. This is particularly the case with respect to energy consumption feedback which has been associated with *literacy approaches*, but emerged within Smart Communities as a hybrid approach that was often highly supportive of action on energy demand.

From a policy perspective, an ideal approach to the sharing and acquisition of knowledge about energy consumption reduction would easily reach many people and would be highly impactful (see Figure 1). The Smart Communities findings illustrate the challenges associated with this objective. The project suggests that activities that are derived from *know-how approaches* are often highly effective in supporting householder acquisition of energy know-how, but have limited reach because they are relatively time- and cost-intensive to implement, and challenging to reproduce at larger scales. In addition, as predicted by the *know-how* literature, the findings also suggest that activities that are associated with the *literacy approach* are likely to have a much lesser impact. At the same time, the findings suggest that these activities can more easily reach more people, and that insights from the *know-how approach* can be helpfully put into action through *literacy approaches*. These relationships are also illustrated in Figure 1. These findings have a number of implications for policy and research.

First, and most importantly, the findings from Smart Communities clearly demonstrate the value of greater policy support for *know-how approaches*. Further, as indicated in Figure 1, the findings emphasise the policy and research challenge of developing novel institutional structures and approaches that might facilitate the ease with which intensive activities, such as home visits, might reach increasing numbers of households. Central, here, is the challenge of doing this without compromising the highly sociable and trustworthy approach that proved so successful in Smart Communities and is being reproduced in other small scale projects by third sector organisations, such as Centre for Sustainable Energy (2015b) and Groundwork (2015). In the UK, these suggestions have the most obvious implications for DECC's Community Energy Strategy because this is the policy area in which the important principles of practice, experience, demonstration and trust are most likely to be realised. At the same time, these findings also have implications for DECC's smart meter roll out (DECC, 2015a) and its Green Deal home improvement scheme (DECC, 2015b). Both of these policies are important because they already involve home visits that could be enhanced to include more explicit energy consump-

tion reduction *know-how* elements (always remembering that these should be conducted very carefully by individuals who are likely to be trusted by householders; in this context, the governments preference for private delivery is clearly problematic). In addition, both of the activities offer the potential for action-based follow-up communications. In particular, these imperatives suggest the need for policy action and research to: further investigate the dynamics of successful approaches to activities such as home visits, open homes, thermal imaging events and the rest; support new models for the funding of the third sector (and possibly public sector) groups and institutions that are best placed to deliver such activities; and support training and knowledge-exchange in the context of energy know-how, and the practical activities that support its acquisition (in the way that it is starting to in the context of supply-side community energy). In this context, it is essential that research and evaluation also acknowledges the value of experimentation, and looks beyond simple questions of kWh saved (Seyfang *et al.*, 2013). Instead, research might ask how and why know-how is – or is not – shared and acquired in the context of a range of: activities, models of delivery, socio-economic contexts and so on.

Drawing on research into research-policy interfaces (Burchell and Holden, 2008; Burchell, 2009), this emphasis on energy know-how and policy, stresses the importance of presenting these conceptual and practical insights in a practice-oriented, concise and non-technical way that will be of value in policy and practice contexts. With this in mind, we describe the energy know-how concept below:

> Energy know-how refers to the things that it is helpful for householders to know if they want to reduce their energy consumption. In practical terms, it is helpful to think about energy know-how as: ideas or suggestions for alternative ways of doing things that would consume less energy; the confidence to experiment and tinker around the home; the practical skills that are required to implement these ideas; and, practical understanding of the infrastructure of the home, of the materials that are required and of where to obtain the materials. Energy know-how is typically practical or skills-based knowledge. To maximise its value, it is important that energy know-how is tailored and takes into account the specifics of: the building, the appliances, the existing level of know-how of the household members and the current ways of doing things within the home. These skills-based and highly-specific characteristics mean that it is difficult to effectively share energy know-how using traditional communications, such as leaflets and websites. Instead, approaches that emphasise in-home practical demonstration and guidance by experts are far more likely to support the acquisition of energy know-how by householders. Since householders are typically sceptical of commercial sources of energy know-how, it is important that this guidance is provided by people from non-commercial sources, such as local authorities or local community groups. Short reports, featuring a limited number of recommended actions and thermal images, are also helpful in supporting action by householders.

Third, Figure 1 also suggests that a further way of boosting the acquisition of energy know-how by householders is by investigating and supporting ways in which *literacy approaches*, such as communications and energy consumption feedback can become more effective. Smart Communities suggests that approaches to this should include maximising the extent to

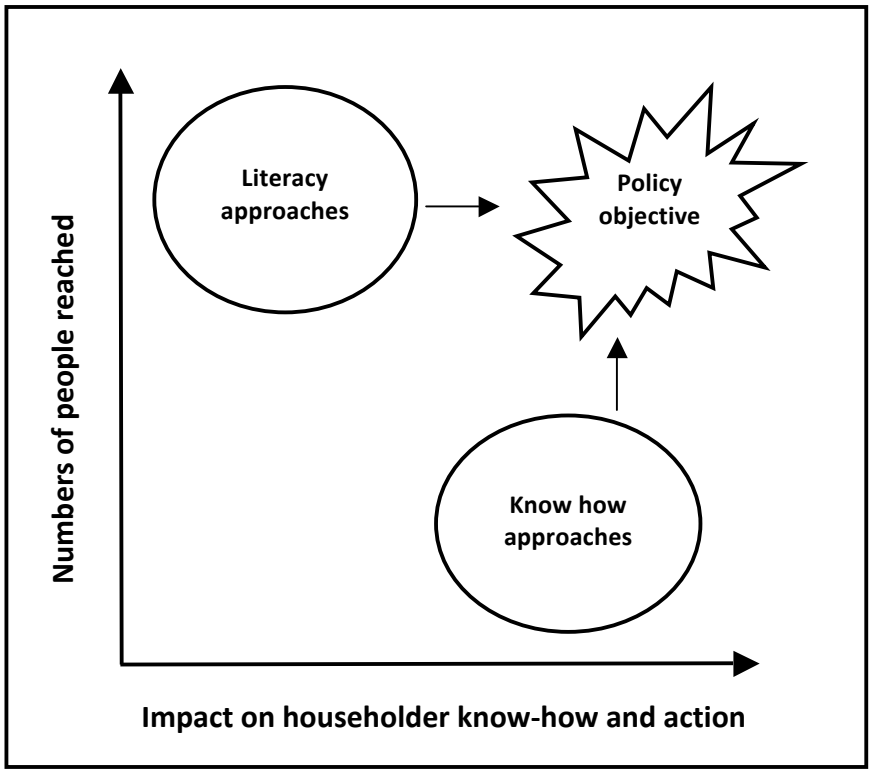

Figure 1. Relationships between numbers of people reached and impact.

which these activities are action-oriented, personalised and implemented within a local group or community context. As we have suggested, there are policy options here in the UK context of the smart meter roll-out (DECC, 2015a) and Green Deal (DECC, 2015b), but this also remains a live research question.

It is clear that the challenges of climate change and other energy related issues are transforming the physical, infrastructures, institutional arrangements and economic systems of energy supply. What we are suggesting here is that our acquisition of the knowledge and know-how that is necessary for successful demand-side action is not just a matter of checking some energy saving tips on our energy supplier's website. Our work, and the work on know-how that has accompanied it and preceded it, suggests that the demand-side challenge also transforms: the ways in which we know and come to know our homes; our willingness and ability to spend time experimenting, and investigating in new and unfamiliar ways; our openness to new approaches to thinking about our homes and our everyday lives within them; and, our willingness to allow people to visit our homes to help us with these tasks.

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