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STRATEGIES AND TOOLS TO RAISE ENERGY AWARENESS COLLECTIVELY

Lara S. G. Piccolo*, Harith Alani

Knowledge Media Institute, The Open University
Walton Hall, Milton Keynes, MK7 6AA
e-mail: {lara.piccolo, h.alani}@open.ac.uk, web: http://kmi.open.ac.uk

Abstract

Providing smart meters and technology for feedback on energy consumption have been considered strategic in current energy policies as part of the battle against climate change. However, feedback alone does not always lead to energy savings. Beyond information on their own consumption and generic advices, people usually still need more specific guidance on how to change their behaviour in an effective and sustainable way. This research considers electricity consumption feedback as a learning element for collective knowledge building, and relies mainly on dialogue and collaboration to engage people with energy conservation as a social issue. To this end, a set of artefacts for triggering and mediating discussions on energy consumption within social groups was developed and evaluated with community leaders in the UK. In a series of 3 workshops, participants discussed how this approach and tools could help them in their mission of disseminating the energy conservation message to the community. Our results show that developing knowledge within a social group is an effective approach in raising awareness, and suggest that tangible artefacts can have an important role in engaging people. Also, initiatives aiming at engaging a wide range of the public must consider different degrees of familiarity with technology, as well as the different perceptions people may have relating energy consumption and environmental protection.

1. INTRODUCTION

Promoting change in behaviour towards energy conservation has proven to be a challenge often spiced by paradoxes. Although energy is central and ubiquitous in everyday life, people in general still do not have a clear understanding on how this invisible force is being used. Much has been invested in feedback technology to bring energy to a more "tangible" and measurable dimension for the end user, but feedback does not always lead to energy savings [1]. Accumulated consumption information does not usually lead to insights into possible changes in behaviour. Furthermore, small energy usage rate, or low cost, revealed by the consumption of individuals, may increase their feeling that their own behaviour has a negligible impact when tackling energy conservation as a societal challenge.

Beyond feedback and generic advice, people need energy conserving guidance that is tailored to their specific capabilities and interests. Deciding whether switching on or off an appliance embraces a multitude of variables beyond the number of kilowatts/hour or the cost involved. Culture, personal values, social norms, regulations, and appliances design, are a few examples of forces that influence how people perceive and use energy. Given this complex scenario, this study considers electricity consumption feedback as a learning element and relies on triggering discussions and collaboration to raise energy awareness collectively.

We developed two tools for mediating discussions on energy consumption within social groups that are based on values and social norms; the Utility Toolkit [2][3], a paper-based tool for engaging families in energy discovery tasks around the house, and EnergyUse (www.energyuse.eu*)*, an online collective awareness platform. To establish how these tools and approaches are perceived in local communities, we evaluated them with a group of 8 community leaders in the city of Liverpool, UK, where energy saving campaigns are already in place engaging a diversity of groups, including families from deprived areas, immigrants, and elderly people.

In a series of 3 workshops, the participants discussed values, motivations and barriers related to energy savings, mapped energy-hungry spots, discussed energy usage in their daily routines, and tips for energy saving. They also evaluated how the strategies and tools can support their current mission to spread energy conservation messages across their neighbourhoods. We hope this work will inspire other initiatives to look beyond the sole provision of energy meters, and into the wider socio-technical challenges and opportunities associated with motivating behaviour change towards energy conservation. Promoting dialogue and experience exchange among communities are key strategies to expand the impact of energy conservation also to people not familiar with technical concepts.

In the next section, work related to the impact of feedback technology is summarised, followed by the tools, methodology and experimental setting applied to perform this study. Results are reported in the sequence, followed by discussions, recommendations and conclusion.

2. RELATED WORK

For achieving sustainable consumption reduction, the European Environment Agency (EEA)

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considers crucial to connect policymaking with engaging the society with energy conservation. In their report [4], different types of interventions that lead to energy savings are compared and analysed. Direct feedback, including energy monitors, can lead from 5 to 15% of savings according to the studies analysed. Community-based initiatives, though, can get to 20% and lead to long-term behaviour change, considering that social norms are more easily shared and established. The report [4] also recognises the limitation of the feedback as an intervention, mainly because people usually need frames of references to understand and evaluate their own consumption. Furthermore, although monitoring consumption can empower users to discuss energy consumption and change their behaviour, it can also raise a feeling of frustration or guilt by the few monetary or environmental achievements [5].

Perception and adoption of energy monitors differ from person to person. For example, a survey with Internet users [6] showed that more environmentally concerned people tend to declare more interest in using energy monitors to learn about their individual consumption, while less concerned participants are more interested in using energy monitors to be able to compare consumption with other people. A qualitative study with 21 families in [7] categorised the households according to the impact of the energy monitors in three types: 1) Monitor Enthusiasts: those that used the monitor to track behaviour change over time and identify energy-hungry practices. 2) Aspiring Energy Savers: householders concerned about energy consumption but revealing uncertainty on how changing behaviour. 3) Energy non-engaged people: who may have a certain environmental concern, but clearly demonstrate a lack of impetus to act. Beyond energy monitors, this study addresses other tools to promote discussions around energy consumption and to build collective knowledge related to energy savings, described as follows.

3. TOOLS FOR RAISING AWARENESS

In the following we described the main tools used in this study.

3.1. Value Tree and House Mapping

Value Tree and House Mapping are two activities part of the Utility Toolkit (Figure 1), which is designed to mediate activities in the domestic context towards energy conservation [2]. The kit and instructions are freely available for download and printing [3]. Value Tree, aims at linking personal values with environmental commitment and energy usage, thus creating a shared understanding within a group of users, usually a family. Group members list at least 5 personal values regarding the environment and energy usage, such as *nature*, *health*, comfort,
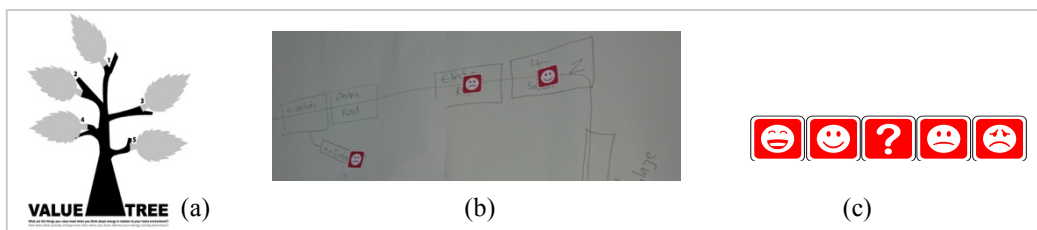

Figure 1 – Utility toolkit items: (a) The downloadable Value Tree
(b) House Mapping (c) Mood Tokens

etc. Participants negogiate and agree on a final list of the 5 main values to be represented in their tree.

For the House mapping, participants are invited to draw the layout of their house, starting from the room each person feels most comfortable in. During this exercise they try to consider all their appliances, energy points and their energy usage. Once the mapping is complete, participants are asked to represent their feelings about their energy usage in the house on top of their drawn map/floor plan (Figure 1b) by using the Mood Tokens (Figure 1c). The tokens represent the feelings ranging from very good (happy) to very bad (unhappy). A question mark is provided in case they cannot reach consensus.

3.2. EnergyUse and Electricity monitors

EnergyUse is an online social and collaborative platform for people to discover, share, and discuss tips for conserving energy (Figure 2a). Users can navigate discussions by tags associated to appliances or contexts of energy usage (e.g., *working in the office*, *breakfast*). Discussions are open to everyone, but users of energy-monitoring devices from Green Energy Options (GEO - Figure 2b), can also view the electricity consumption of specific devices and appliances, or of their entire households, and compare with the community's average. Currently, platform users are mainly volunteering participants of an energy trial in UK.
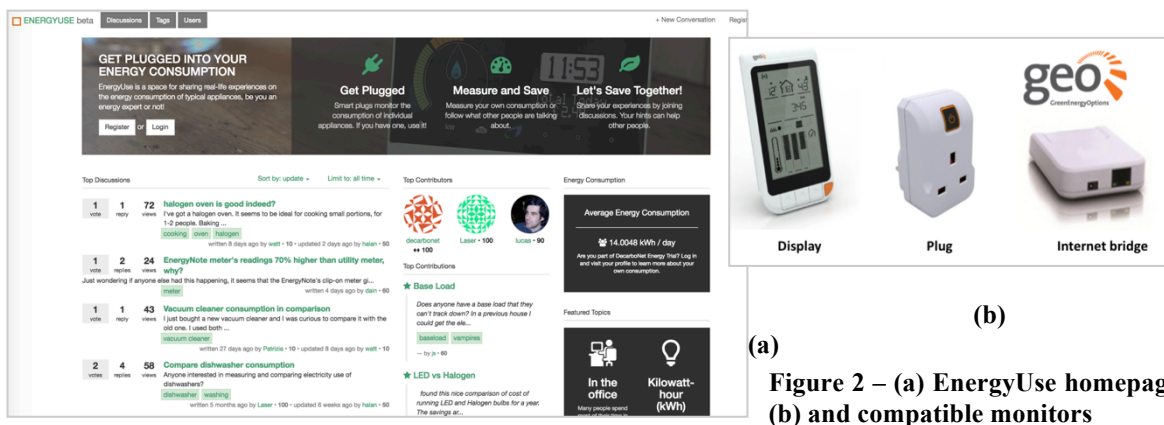

(a)

(b)

Figure 2 – (a) EnergyUse homepage (b) and compatible monitors

4. METHODOLOGY

We follow a 3-steps strategy (Figure 3) mediated by a mixture of tools to trigger discussions and collaboration. Developing **self-perception** is the first step, supported by the Value Tree, to leverage personal and group values to identify the forces that lead or prevent people from saving energy. Second step involve energy meters, and the House Mapping tool, to help people **understand their own consumption** at the appliances level, and to identify opportunities
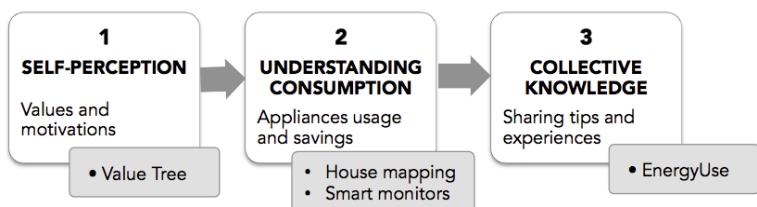

Figure 3 – 3-steps Process to Raise Awareness Collectively

for savings. Once this individual knowledge is developed, EnergyUse is introduced as a space to build **knowledge collectively**.

5. EXPERIMENTAL SETTING

We held a series of 3 workshops in a community centre in Liverpool, UK, with a group of 8 participants. Group age was between 35-72 (average age: 50) and was formed by a representative of the local government, 2 volunteers engaged with pro-environment campaigns, and 5 project officers at the community centre, where energy saving campaigns targeting the neighbourhood already take place. The workshops happened in Jan-Feb 2016, with intervals of 2-3 weeks, lasting no more than 2 hours each. The workshops followed this script:

Workshop 1) Self-perception: Started with participants filling out a form with some information about age, energy consumption, social media usage, and motivations for joining the meetings and for savings energy. The meeting was split into 2 main parts:

- Answering questions: i) Why it is important to save energy? ii) What do you do for saving energy? iii) What prevents you from doing more? Answers were written in post-it notes, creating a panel for further discussion to highlight the most relevant answers.
- Discussing values: the Value Tree was applied to mediate discussions on shared values in the community. They created a final tree representing the community values, and were invited to work on their own tree individually to take home and discuss among the family.

Workshop 2) Understanding consumption: In pairs, participants of this workshop sketched the plan of some community centre rooms mapping the outlets, light bulbs, heaters, devices, and appliances. They identified energy-hungry spots and, together, calculated the consumption to keep a room with around 10 computers operating. Smart plugs were made available for them to measure and compare appliances consumption. They were invited to repeat the exercise for their own house and discuss findings with a colleague in the room.

Workshop 3) Collective knowledge: Based on their daily routines, participants were requested to list the devices they believe could be used more efficiently, and the ones they have tips for operating them with less energy. After that, they were invited to create a collective account on EnergyUse to share their tips online. Feedback was then collected about all the tools above, through a pictographic Likert scale 1-5 question (Figure 4) to reflect their experience with the tools, questions about their strengthen and weakness, and how helpful the activities were to guide behaviour towards energy conservation.
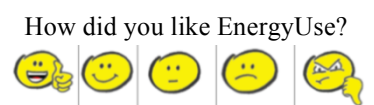
How did you like EnergyUse?

Figure 4 - Pictographic Likert scale

6. RESULTS

6.1. Participants' profile and motivation

As a rough measure of familiarity with social technologies, all participants declared using Facebook regularly (50% were everyday users). None of them used Twitter.

Their energy bill exceeds £100 per month, except for one participant who proudly declared spending less than £50 per month. The average number of house occupants was 2.

To understand their motivations, we asked them to select the statements that represent their position towards energy conservation among: 1) "I am really concerned about savings"; 2) "I do not have a clear view on how I consume energy"; 3) "I need to learn what to do to start saving"; 4) "I already save the energy I can"; 5) "I am keen to help other people to do the same". Figure 5 shows that the majority of participants (6) were interested in disseminating knowledge about energy conservation, although 2 of them, despite their interest and commitment to helping others, were not personally concerned in saving energy. Helping others to save money was their primary motivation. One participant said "*I am interested from the point of view of the project, beyond personal, on what is that most concerns people about energy, how they can save money, and to find a language that people can understand, - its more than kilowatt/hour, which I think nobody understands*". Another participant confirmed saying: "*I want to give people ideas and tips to help them to save some money*".
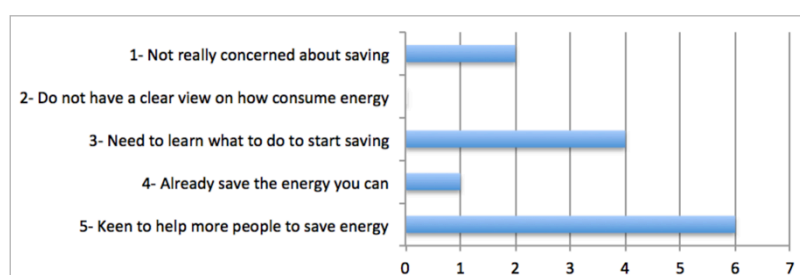

Figure 5 - Participants' position towards energy conservation

6.2. Self-perception (Workshop 1)

The first activity started with participants building a panel of post-it notes with reasons to save energy, what they are already doing for saving, and why they are not doing more.

Why is it important to save energy? In the answers to this question, money was mentioned 8 times across the 13 notes. Environment-related factors, such as carbon emissions and footprint were cited 4 times. Being aware of waste was mentioned once. As one participant stated: "*Money appears as the most important aspect of saving energy. For almost everyone*".
What do you do to saving energy? Switching off lights or appliances appeared 4 times Unplugging charges, not overfilling kettles, turning down heating, washing machine in lower spin, and "I don't do anything" were all mentioned once. These results generate discussions around the value of small actions and uncertainty around consequences, such as switching off lights "*We need to know the impact of tuning off the lights*". "*Hard to find what is more important cause people don't know the consequences. We have to identify the vampires, not the small things.*" The heating, a typical "energy vampire" was then discussed: "*How much you are going to save if you turn the central heating down by 1-2 degrees?*", which triggered health concerns: "*There are bounces between practical usage, safety… We need to consider that when passing information to people.*", referring to their previous experience when elderly people provided with consumption feedback got obsessed with saving money that started switching the heating off, putting their health at risk.
What does prevent you to do more? Third question revealed lack of information and

communication problems with the energy companies as barriers. Not understanding bills or tariffs was mentioned 6 times; Not understanding the source of energy and how to set or operate appliances were highlighted 4 times; Don't know which energy company to trust was mentioned once. Participant stated: "*Energy companies target profit, they are not partners in savings*". And about the source of energy "*energy companies are still relying on coal, fossil. We will never resolve our energy problems while they are still relying on those resources*". Also, "*We don't understand where the energy come from. If we were told what is going on around we could make informed decisions*."

Another barrier discussed was the compromise between energy saving and lifestyle, referring, for instance, to the noise in doing the laundry during the night, when energy is more available, or arguing for using a tumble dryer: "*I need to have things done in the same day*".

The Value tree

For being tangible and visually attractive, the paper-based artefact Value Tree (Section 3.1) was considered of great potential to engage families in the community, especially for families with children. "*It makes you understand things*", "*it gives meaning*", stated two participants. For another participant, financial problems and eventual conflicts between family members, issues commonly present in community campaigns, are examples of discussions that could be facilitated by the Value Tree activity. Participants built the community tree (Figure 6), debating the most important values that should be taken into account when disseminating the energy conservation message.
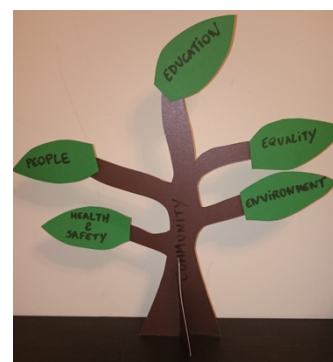

Figure 6 – The community tree

Discussions around the personal trees revealed the connection between habits and values, and the complexity in changing these habits. For instance, leaving some lights on around the house was mentioned by a participant as a way to strengthen her feeling of safety, a priority value for her. Her household members need to find alternative ways for saving energy.

6.3. Understanding consumption (Workshop 2)

The House Mapping activity [1] invited participants to map the community centre building (Figure 7). Groups of 2-3 people mapped different rooms and discussed the findings with the whole group later on. A smart plug was offered to participants to measure some mapped equipment or appliances.

Rather than identifying and questioning current practices and behaviours, the discussions were mostly about infrastructure and building restrictions, e.g. type of brick, windows glazing, number of light bulbs connected to the same switch, etc. The only actual behaviour discussed was keeping doors and windows open while the radiator is on. Printers, scanners, kettles, hobs, were mapped but how they were used was not discussed. Similarly, in the context of households, discussions focused on general aspects, such as the need for a new boiler, or double glazed windows, house position and sunlight, etc.

One participant suggested that the group should identify the vampires (appliances that use much energy), and the best way to operate them: "*computer and lights which is more important [to switch off]. We don't know whether switching off a computer is*

Figure 7 - The House Mapping activity

good or not." Although the energy monitoring kits and smart plugs were made available, there was no interest in using them. The group was invited to install them at the community centre or at home. Only two participants accepted to take it home, and one returned it after facing difficulties in installing the kit. A participant argued, and the group agreed "*I still don't really understand what a kilowatt is* (everybody agreed). *I understand what a pound is, 25p, whatever*."

When invited to calculate the cost of running a room with 10 desktops, they preferred to search for the typical consumption online instead of using the smart plug to get actual readings. Finding out that running 10 desktops (without the monitors) would cost £0.3 (£0.03 each) a day created a feeling of surprise and certain frustration: "*If you look individually is tiny money!!!*".

The visual and interactive aspect of the House Mapping were pointed out as the strength of the artefact and the activity as "*an excellent way to learn to save energy*", specially because "*we could realise we don't know what is around the building. We don't pay attention to that*".

6.4. Collective knowledge (Workshop 3)

To identify daily-used appliances, the group listed their routine activities. The discussion raised different choices to perform the activities to conserve energy. Examples are: 1) For preparing breakfast, making coffee using the kettle or coffee machine? Toaster or grill for the bread? 2) For clothes: which is more efficient, iron or steamer? Does washing with 30 or 40ºC make any difference? Does eco-mode save energy and water? 3) For cooking: what is uses less energy, the microwave or slow cooker? Do steamed vegetables need more energy to be prepared than boiled vegetables? Is it worthy unplugging the microwave when not in use to switch off the clock? Answers to most of these questions were unknown, and hence the need to measuring their actual consumption was acknowledged. Nevertheless, there was still no interest in installing and exploring the smart plugs in the community centre or in their homes.

Discussion then moved towards the trade-off between energy saving and time, as explained by a participant: "*lots of gadgets we have in our house are for saving our time or related to you lifestyles*", and was complemented by another participant "*in the 60s when few women worked, these things were largely done by women, now much higher proportion of women are working, cause they have to share the bills…*". They also highlighted appliances that the time of usage depends on the power, like hairdryer and vacuum cleaner. As one participant summarised, "*It's not about time or energy, it is what we need to keep our lifestyle*".

The group was then invited to explore EnergyUse.eu, checking whether the questions raised in the previous activity have already been posted there, and if the group could contribute to existing discussions. While navigating trough EnergyUse, they expressed their lack of understanding of energy consumption from a technical perspective. As illustrated by participants' quotes, the feedback provided revealed that the format and content were not adequate for this group:

- **Meaning of kWh**: "*There's an assumption that people know about kWh. Everything that comes out information-wise* (based on campaigns that the participant had been involved) *is in that level! This is too technical!"*. Posts explaining the meaning of a kWh were then considered as "*the sort of information everyone needs to understand* [the discussion content]", such as "22 min of ironing consumes 1 kW", or the average price of 1 kWh in the UK. Another participant complemented, "*If you say in kWh and carbon usage, people say, what does it mean to me? Its my hygiene standards, my time…*".

- **Focus on money instead**: "*People don't bother about kWh! If you have a picture of a microwave or a washing machine saying - do you know using that costs you £5 a day?*". Another participant suggested equating the tips to average savings (i.e. £, ££ £££), and then how this is related to carbon outputs.

- **Energy monitors:** "*I think these monitors are focused on people who know how to use [Information Technology]. I don't think anybody in our community would get involved*".

- **Forum-based format:** "*open-ended question is more confusing in the end of the day. People need options or choices. People need to see the possibilities, the choices they have*". As an example, "*use silly pictures of someone cooking, if you click on there, you have the option, gas oven, electric oven, microwave. If you click on gas you have the settings, gas mark, etc. Then whatever you choose you can have the cost per hour*".

- **Personal and emotional approach:** "*There are many things going around global warming and carbon emissions. And it scares people for discussing energy. Politicians and scientists arguing, people can have this perception. But if you do in a light way, small [energy saving] actions, and in the end you say - you saved 3 penguins*", then it is ok".

- **Addressing myths**: "*We all have this mythology to say this or that is more expensive. It is not always true*", for example "*some people believe that leaving the heating on overnight is more expensive*". They suggested highlighting myth-related tips on EnergyUse.

- **Engagement:** they said that most people would not use EnergyUse spontaneously: "*some people have a natural desire to learn more, but* [for some people] *vouchers might help*",

In the participants' opinion, although the tool is helpful and the collective aspect promising to community-oriented activities, it has to evolve towards making the interaction simpler for people who only require energy saving tips, and not to engage in discussions.

6.5. Experience with the tools

Figure 8 represents the feedback overview from the 8 participants on the Values Tree, House Mapping, Energy monitor and EnergyUse tools. Their opinion was expressed in a pictographic Likert scale (1-5) (Figure 4). Some participants did not rate the monitors and EnergyUse, since they did not use these tools themselves. The Values Tree had the best score

with an average of 4.5 out of 5; the House Mapping's rating average was 4.1, while EnergyUse received 1.6 (median was 3), followed by the monitors with 1.3 out of 5.

7. DISCUSSION

Although limited in the number of participants, this study is built on the experience of community leaders; people who have the responsibility,

Figure 8 – Participants' experience with the reported in a Likert scale

voluntary or not, to engage others with energy conservation. Often, their comments and responses do not purely represent their personal perception, but rather embody how people in their community would deal with a tool or situation. The audience of their current energy campaigns includes families from deprived areas and elderly people frequently living on their own. Though it is a restricted sample in terms of diversity of the society, this group introduces a new perspective to feedback technology studies, which are usually focused on upper-middle class population [5].

Raising self-perception – lifestyle: Saving energy requires self-perception and negotiation. The participant's statement "*It's not about time or energy, is what we need to keep our lifestyle*" illustrates the need to for saving energy actions that respect these values.

Mainly for the tangible and interactive nature of the Value Tree and the House Mapping activity, the participants found them to be effective in engaging groups in discussions and negotiations. However, raising and sharing health and safety concerns with regards to certain actions (e.g., turning lights off) may deter others from adopting those actions.

Understanding consumption – beyond providing consumption feedback: Discussions around choices, for example, cooking with microwave or slow cook, and efficient settings for appliances made evident the need to measure energy consumption. Even though, the participants did not feel the monitors were suitable for them. As explained by a project officer at the community centre, other projects or utilities have also offered smart monitors to be distributed across the community. Since the leaders themselves cannot make sense of the feedback provided, they do not perceive the value in supplying people with these monitors.

Reflecting that, electricity consumption in kilowatt/hour rarely emerged as a topic. When it did, they preferred to go online to check typical consumption instead of measuring it. Money is still the main target for making energy tangible and measurable, even though the little money associated with individual appliance consumption was too low to raise interest.

External factors, such as tariff options, deals with energy suppliers, characteristics of buildings, appliances settings, etc. frequently dominated the conversation.

Collective knowledge – dialogue and collaboration: Sharing experiences with other people is a common approach. For instance, participants mentioned asking neighbours' advise on operating typical devices, such as boilers or thermostat, since they are likely to have similar equipment. Empowering technically skilled people who are keen to learn from feedback
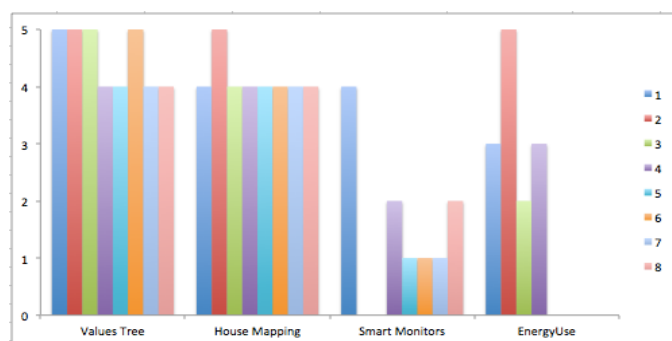
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devices and disseminating this experience across the community could be a powerful strategy in raising collective awareness. This is in line with [4], which revealed that relying on existing acquaintances and influential people to promote and establish social norms is an important factor for the success of a community intervention.

The group is now launching a campaign based on this strategy, lead by a local energy champions; "*Rather than giving out leaflets or sheets of information, it is better to have a local face to give simple messages*". Their experience reinforced the perception that "*it's better to ask people instead of assuming what they need to know.*".

EnergyUse was regarded as too technical by the participants. To expand the target user group to those who are not that familiar or keen on technology, the platform should evolve to support people interested only in consuming tips, and should target also money and tariffs.

8. RECOMMENDATIONS - BEYOND CONSUMPTION FEEDBACK

Our experience with community leaders in the UK evidenced that many people are still struggling to understand essential concepts related to energy, such as tariffs, consumption measurements, and the impact of individual consumption. In this study, leaders active in engaging society with energy conservation did not feel comfortable with installing energy monitors and did not understand the feedback they provide.

Main concern of the group was helping people to afford their energy bills. Literature showed that money and rational choices are weak motivations and lead to unsustainable behaviour change [9][10][1]. However, this study revealed that most people, even environmentally motivated ones, still use cost as the primary method to quantify energy consumption.

Even though our energy monitors can provide consumption feedback in term of cost, participants created a barrier by considering that the technical gadget was too complicated.

Figure 9 illustrates the contrast between technology and the characteristics of our research study. Familiarity with technical devices is a continuous variable. Energy monitors and EnergyUse require a high level of technical skill. People need to understand the value of the effort in overcoming these technical barriers. Adopting these tools, then, requires a higher degree of environmental motivation. The dimensions in Figure 9 aim at guiding the development of future energy-awareness tools, to more properly map adequate features to the right target-audience.

It is important to understand real life scenarios to ground technology design. The energy industry and policies invested in energy monitors designed for users who understand resources units, interested in data and able to make decisions upon it [8]. Challenge posed by [8] is to move from this perspective of
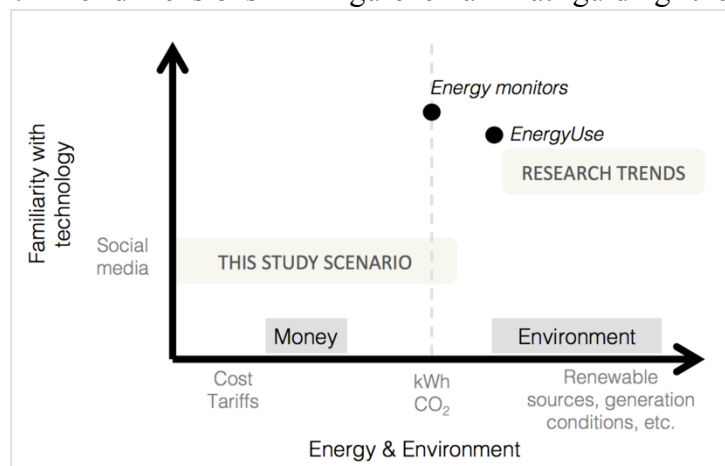

Figure 9 - Energy awareness technology dimensions

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energy as a commodity and engage with everyday topics such as laundry, cooking, heating, etc. This approach forms the basis of EnergyUse as a tool to promote dialogue and collaboration. However, as the study pointed out, additional development is necessary to make it accessible to people with lower familiarity or interest in technology-based solutions.

9. CONCLUSIONS

This paper introduced and analysed a process to raise collective energy awareness based on dialogue and collaboration. Tools and strategies to mediate and support knowledge building were applied and discussed with current energy campaigners and leaders in a community centre. The paper-based tools were found engaging and effective to raise awareness and to guide energy saving. However, when moving towards technological approaches, digital literacy was a major issue. Even our strongly motivated participants refused to use energy monitors and smart plugs, due to the complexity of installing and understanding their output. Similarly, they regarded the online discussion platform to be too "techy", and were reluctant to use it. This study evidenced the status of group of society not always considered in energy awareness technology research.

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