



Citation for published version:

Hayles, CS, Dean, M, Lappin, SA & McCullough, J 2013, 'Climate change adaptation: A decision support framework to encourage environmentally responsible behaviour', *Smart and Sustainable Built Environment*, vol. 2, no. 2. <https://doi.org/10.1108/SASBE-11-2012-0059>

DOI:

[10.1108/SASBE-11-2012-0059](https://doi.org/10.1108/SASBE-11-2012-0059)

Publication date:

2013

Document Version

Peer reviewed version

[Link to publication](#)

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Climate Change Adaptation: A Decision Support Framework to Encourage Environmentally Responsible Behaviour

Abstract:

Purpose

In this paper, the authors present the Awareness Behaviour Intervention Action (ABIA) Framework, a new system developed by them to support Environmentally Responsible Behaviour (ERB).

Design/methodology/approach

Previous ERB programmes have failed to deliver lasting results; they have not appropriately understood and provided systems to address ERB (Costanzo et al., 1986). The ABIA Framework has been developed in line with behavioural studies in other disciplines. A preliminary Pilot Study has been carried out with social housing residents in order to understand the Framework's efficacy.

Findings

The ABIA Framework enables a better understanding of current attitudes to environmental issues and provides support for ERB alongside technological interventions employed to promote carbon reduction.

Research limitations/implications

The ABIA Framework could be tested on individuals and communities in a variety of socio-economic, political and cultural contexts. This will help unpack how it can impact on the behaviours of individuals and communities including stakeholders.

Practical implications

This type of research and the ABIA Framework developed from it are crucial if the EU is to reduce its domestic carbon footprint and if the UK is to meet its pledge to become the first country in the World in which all new homes from 2016 are to be zero carbon.

Social implications

The Framework encourages both individual and community engagement in solving of sustainability issues.

Originality/value

There are few studies that have developed a framework which can be used in practice to support behavioural change for adaptation to sustainable living in low or zero carbon homes.

Introduction

In this paper the authors present the Awareness Behaviour Intervention Action (ABIA) Framework, a new system developed by them to support Environmentally Responsible Behaviour (ERB). Here ERB is defined as actions that reflect caring about and for the natural environment, often involving resource conservation or low carbon emissions. The ABIA Framework is used as a vehicle to better understand current attitudes to environmental issues and to support the promotion of ERB. In addition to setting out the ABIA Framework in detail, a Pilot Study, which was used as a preliminary means of confirming the general approach of the Framework, is presented. This Pilot Study involved working with tenants of social housing to establish their understanding of Climate Change and awareness of environmental issues before assessing their current behaviours in the home, highlighting their ERBs and working with them to further develop ERB in the future.

If significant carbon reductions are to be achieved in the home, behavioural change is key. Previous research suggests that new buildings, including housing, designed to mitigate Climate Change can introduce the end user to unfamiliar types of interactions and experiences due to new styles of design and technological solutions (Cole et al., 2008). Indeed Janda (2009) states that a designer's intentions for a building, for example low carbon by design, can be far from what is achieved in practice. What actually happens is driven by the end user's cultural norms and existent energy habits.

Whilst these issues have been discussed in the literature, there are few in-depth studies that have investigated individuals' perceptions, awareness and behaviours towards ERB, particularly in relation to low carbon housing. Furthermore, current practice is lacking in systems which can be used to support behavioural change for the adaptation required to successfully reduce carbon consumption. It was in light of these issues that the ABIA Framework was developed in an effort to encourage specific additive changes in behaviour, in particular highlighting actions that support a low carbon future.

This research is well timed, with ever-increasing demand for global energy reduction. New national and international policy goals emphasise the use of low carbon design in buildings, particularly in housing. This type of research and the ABIA Framework developed from it are crucial if there is to be a 26% reduction in energy consumption from housing (EC, 2012) and if the UK Government's pledge to become the first country in the world to require zero carbon homes from 2016 is to be achieved.

The Research Context

Perceptions of Climate Change and responsibility for action

Recent research suggests that a majority of people in the US and Europe are concerned about Climate Change, believing that the world's climate is changing and that they, both as individuals and as a society, have a responsibility to act to tackle the problem (Curry et al., 2008; Department of Transport, 2011; Feldman et al., 2010; Lorenzoni and Pidgeon, 2006; Spence et al., 2010; Upham et al., 2009; Whitmarsh, 2008).

A 2008 study commissioned by the European Parliament and European Commission (EPEC, 2009) examined Europeans' attitudes towards Climate Change. Sixty-one per cent of those taking part in the survey stated that they had already personally taken action to mitigate Climate Change. However an EPEC (2009) study found that 67% of participants believe individuals are not doing enough to tackle Climate Change, indicating that the majority of those taking part in the study felt a moral responsibility to engage in ERB. Seventy-one per cent of those in a US survey (Leiserowitz et al., 2010) accept it is their responsibility to help to do something about Climate Change, 63% believing that this can be achieved by changing individual behaviour.

In a UK study, 65% stated that they were willing to take measures to greatly reduce their energy consumption, yet only 44% were prepared to pay more for energy efficient products (Spence et al., 2010).

Some studies have considered energy procurement in the home and findings indicate that 44% per cent of Europeans surveyed stated that they would be willing to pay between 1% and 30% more for energy from 'green' energy (EPEC, 2009). Of those surveyed in the UK, only 36% were willing to pay an extra amount, whilst 41% stated that they were not ready to pay more (Leiserowitz et al., 2010). Indeed, Spence et al. (2010) found that 52% prepared to pay 10% a month more for energy generated from renewable sources. A few studies have looked at attitudes to purchasing specific items. Studies by Defra (2009) and Defra and Opinion Leader (2007) found that the public displayed widespread (70%) support for buying locally sourced and in season fresh food. Fifty-nine per cent were also willing to consider diet changes to reduce their environmental impact. However, when drivers for food selection were considered environmental considerations were rarely reflected. A study by Defra (2007b) indicated that some information campaigns have had effect as the introduction of energy label for appliances has influenced the public to consider efficiency during purchase. Seventy per cent of participants stated they actively looked for the sticker during most purchases.

Overall public inclination to significantly improve energy consumption habits does not seem to be increasing. However, it is clear that in some citizens a slow transition is taking place. A study by EST (2010) found only 10% of participants perceived they could not improve whilst 32% were already taking small steps. Furthermore, a small increase was seen from previous years from 19% to 38% of those who perceived they were taking larger steps. Nevertheless, there is public confusion as to the best actions to take to address Climate Change alleviation (Defra, 2002).

Environmentally responsible behaviour

In addition to the apparent confusion over how to reduce domestic energy use, attitudes toward Climate Change amongst multiple publics vary greatly. Empowering individuals and communities to change patterns of behaviour, especially in energy use, is therefore a significant challenge. Programmes which focus on participants taking ownership of and reducing impacts on Climate Change must consider both how technology can be used to reduce carbon emissions and the extent to which user behaviour responds to technology to create durable change. These schemes face a twofold challenge of technical and human factors (Costanzo et al., 1986).

Social factors and technology cannot be considered in isolation. Several studies argue that any system aiming to address ERB must acknowledge that end users are active stakeholders who understand both what they need and want; individuals should not be viewed as passive (Vatsa, 2001; Freeman, 2004; and Schildermann, 2004). Any attempts to address ERB must also address arguments that the actions of one person can achieve little in the face of global challenges and even helplessness, a particular problem when information is conveyed without clarity (Harrison et al., 1996; Donn, 1999).

A central argument in the Climate Change debate is the understanding that transition requires changes to human action and behaviours (Moloney et al., 2010) and so behavioural change is seen as the only goal of consequence (Costanzo et al., 1986). Programmes attempting to create ERB must address theories of persuasion, attitude change, decision-making processes and understanding of the correspondence between attitudes and behaviours (Costanzo et al., 1986). Studies have indicated that decisions regarding ERB are largely influenced by familiarity and habit rather than deliberate informed choices. Consequently interventions based on information transfer and media have not meaningfully influenced consumption lifestyles (Whitmarsh et al., 2011). Similarly a UK

study indicates that public concern often does not interpret into action or lifestyle changes. Factors of influence were found to be knowledge, standards, experience and cultural norms (Lorenzoni et al. (2007). Programmes must therefore address issues of durability and behavioural scope of interventions (Harland et al., 2004). Although a number of programmes which focus on the end user taking responsibility for changing their impact on Climate Change have been suggested, few agree on which are the most effective strategies for influencing ERB (Moloney et al., 2010).

Assumptions surrounding ERB

The barriers and motivators surrounding ERB lacks investigation, as historically, transitioning to unfamiliar living environments has required significant adjustment (Speller and Twigger-Ross, 2009). Individual approaches to promoting ERB have been wide-ranging and include:

1. Education combined with a mass media campaign (Abrahamse et al., 2005);
2. Education combined with a public commitment (Pallack and Cummings, 1976);
3. Tailored energy information combined with feedback (Houwelingen et al., 2002); and
4. Energy reduction measures combined with a monetary reward (Winnett et al., 1982).

Fien et al. (2008) identified three common assumptions made in programmes aiming to create ERB. The first assumption is the supposition that being privy to the right information will automatically result in an individual demonstrating ERB. However, as argued by Moloney et al. (2010), information alone is unlikely to result in sustained behavioural change. Although initially there might be some evidence of change, this is not sustained in the long run.

The second assumption is based on the idea that if an individual or community were to understand how their personal and/or collective behaviour potentially contributes to Climate Change they would be more likely to adopt ERB. Moloney et al. (2010) dispute this assumption based on evidence that it is impossible to predict how an individual or community may respond to information. Contrary to empowering the individual or community, such an approach may result in disinterest, disempowerment, scepticism or even fear (Finger, 1993; Australian Psychological Society, 2008). In addition, behaviours may be so entrenched that modification requires more than the provision of information if ERB is to become a habit or a social norm.

The final assumption is that previous programmes demonstrate a preference for changing behaviours at an individual level as opposed to tackling communities. As demonstrated by Moloney et al. (2010) this has proven to be an ineffectual approach if there is no understanding of the social norms and constructs which characterise society. Fundamental political, social and cultural issues need be considered and actively demonstrated if individuals and communities are to embrace change. Indeed the World Wildlife Fund (2008) recommend that future programmes must address intrinsic values such as personal growth and community involvement at all levels.

Evaluation criteria for ERB programmes

Five key themes emerged from Moloney et al.'s 2010 review of behaviour change programmes and socio-technical approaches to understanding energy use and consumption, namely:

1. Recording and framing behaviour and social practices;
2. Looking beyond barriers and constraints;
3. Approaches to agency and empowerment;
4. The need for systematic changes; and
5. Paths through learning and integration.

Based on these criteria, Moloney et al. (2010) made recommendations regarding future behaviour change intervention programmes, which suggested that programmes must:

1. Map behaviours before achieving behavioural change;
2. Consider technological interventions, the consumer/end user, and their interrelationship;
3. Study of motivations, values and self efficacy;
4. Take into account social norms and practices that underpin the behaviour of individual and communities; and
5. Include top down and bottom up processes, encompassing stakeholders and end users.

Focussed ERB studies

Much of the previous research that addresses ERB concentrates on perception, awareness and behaviour in relation to energy technologies and infrastructure. A review of these studies reveals that they have focused on three main areas:

- Awareness and perception of Climate Change issues (RCUK, 2011; Whitmarsh et al., 2011; Defra, 2009; Lorenzonia et al., 2007);
- Evaluation of specific energy behaviours (Pilkington et al., 2011; DCLG, 2010; Gram-Hanssen, 2010; Shipworth et al. 2010; Gill et al., 2010); and
- Perceptions and energy behaviours in regards to comfort (Shove, 2008; Cole, 2008).

An analysis of these studies thus shows that previous efforts have tended to focus on very specific aspects of ERB rather than an holistic view of use and impact of strategies for carbon reduction (RCUK, 2011). The focus of these studies contradicts Janda's (2009) argument that the diversity in building energy consumption cannot be addressed using such a fragmented approach.

It becomes apparent in examining this literature that public concern about issues of Climate Change appears to have stalled. Furthermore, the public is confused about the means by which to approach such a global problem at a local level, and attitudes about the issue vary significantly across social, political and economic climates. Maloney et al's (2010) research points to the need for specific understanding and a careful consideration of appropriate technological solutions to be put in place in order to help develop ERB in a lasting way. One can also see that previous ERB research has been focussed on specific aspects of ERB rather than necessarily grasping it in the wider sense. The approach engendered by the ABIA Framework, which will be presented in the next section of the paper, takes into consideration these significant points, and it considers perceptions, awareness and behaviours inclusively. The ABIA Framework, unlike the aforementioned studies, provides a grounded understanding on which to develop strategies to encourage ERB and fill a significant gap in the research literature. It also offers a model for practice that might be deployed in a number of specific contexts with varying public understandings and interest in Climate Change.

ABIA Decision Support Framework

Framework design

The development of the ABIA Framework draws on previous experience of working with teams to engender change. This includes structured facilitation using recognised relationship, value, risk and knowledge management tools and techniques. In particular, the ABIA Framework was developed in light of experience of working with housing design teams and engaging with end users. The idea for the framework evolved from research with students and building professionals looking at ERB, evaluating perceptions and behaviours and embedding sustainability in educational and vocational training programmes.

The ABIA Framework was developed in a similar fashion to behavioural studies in other disciplines; incorporating evaluation (feedback loops) before, during and after the framework is applied (Abraham and Michie, 2008; Michie and Abraham, 2004; Michie et al., 2008). In common with approaches to change management, it allows the facilitator to investigate current understandings before recommending specific solutions to support ERB. Most importantly, it gives the participants ownership of their understanding and behaviour, engaging with them positively to engender change.

The Framework's Structure

The ABIA Framework, based around four main themes discussed below, aims to encourage and facilitate participants to create new sustained environmentally responsible habits based on their own informed decisions. It intends to increase a sense of individual and collective value whilst helping participants develop their own solutions to ERB. Significantly, the ABIA Framework acts as a tool to gather data on current attitudes about Climate Change while simultaneously supporting individuals and communities as they move towards low carbon living.

Stages of the ABIA Framework

The ABIA Framework has been designed to work in four independent but sequential stages, carefully integrated to best help support ERB (Hayles and Dean, 2010):

1. Awareness;
2. Behaviour;
3. Intervention; and
4. Action.

Awareness and Behaviour

Stages 1 and 2 of the process acquire a 'snap shot' of the participants' current awareness, perceptions and understanding of sustainability at a global, community and individual level. This involves asking questions, which gather information without leading the participant to give what they might consider to be an expected response. These stages also measure behaviour. This allows the researchers to not only build an understanding of current perceptions and awareness of sustainability, but also to calculate, on an individual and community level, the ecological footprint of the participants as a baseline measure. The structured approach is broken down into two steps, awareness and behaviour.

Stage One - Awareness

Participants are asked questions designed to gather information on understanding of global issues. These are captured by asking participants to rank key issues facing society in order to establish how highly they prioritise sustainability issues such as Climate Change, the energy crisis and overpopulation, in relation to other current affairs such as obesity and current economic climates. Then participants are presented with a list of topics, which all negatively impact on the environment, and they are again asked to rank these according to how important they are perceived to be. The final part of this stage of the process asks participants about their present understanding of words and phrases such as biodiversity, one planet living, zero carbon and food miles.¹

Stage Two - Behaviour

This stage ascertains actual behaviour and frequencies thereof through in-depth interviews with participants. This approach allows the researchers to develop an understanding of relevant aspects

¹ Please contact the corresponding author for a copy of the questionnaire used.

of participants' behaviour including consumption habits, transport patterns, recycling practices, and home energy and water use. Researchers are then in a position to calculate the following ecological footprint domains: carbon footprint; food footprint; housing footprint; and goods and services footprint of each of the participants using a carbon footprint calculator, such as the Redefining Progress calculator provided online (Redefining Progress, 2011).

Intervention and Action

It has been well documented that programmes that incorporate devices to feedback about performance to the participant increase the sense of both individual and collective value (Bandura, 1977). Feedback alongside social support is more likely to accomplish ERB and more importantly durable pro-environmental change (Harland, 2004). Kaplan and Kaplan (1989) rationalise this as what they term as 'human nature', an inherent desire to be a part of something rather than being incompetent or helpless. Thus Stages 3 and 4 of the process engage participants in effective and participatory problem solving which gives an opportunity for individuals to develop their own solutions to ERB in a reflection-in-action mode of learning (Schön, 1983.)

Stage Three - Intervention

The feedback aspect of the process takes many forms dependent on circumstance and learning styles of participants (Schmeck, 1988). Feedback is provided in the form of one or more 'interventions' to promote ERB. These range from time, giving the participants time to respond to what they're learning during the process, to technological interventions such as smart metering. Other examples of interventions might include focus groups, literature, media, online tools and support, which may be made available to support behavioural change. It is important to emphasise here that these intervention types are selected after the awareness and behaviour stages have been completed in the process – the types, timings and sequencing of the interventions are thus tailored to the specific participants involved in that particular context.

It is necessary to consider how the results of the awareness and behaviour stages are presented back to the participants during the intervention stage of the framework. Previous research undertaken in the health care sector using focus groups as feedback mechanisms has demonstrated that graphic discrete frequency formats using highlighted human figures had greater salience than continuous probability formats using bar graphs (Schapira et al., 2001). Other research established that participants often preferred design features such as visual simplicity and familiarity that were not associated with quantitative judgments (Ancker et al., 2006). This research also found that facilitators should not assume that all graphics are more intuitive than text; many of the studies found that participants' interpretations of the graphics were dependent upon expertise or instruction and so in these situations, simple text was more valuable for feeding back results (Ancker et al., 2006). These issues need to be taken into account when designing interventions.

Interventions may take place in parallel or in series, again dependent on the nature of the participants. When interventions take place in parallel, participants are given a choice of behavioural support mechanisms from which they can select. Their selection may reflect their preferred learning style, or they may choose to take advantage of all the support provided. When interventions are provided in series, the order in which they are offered depends on the project and the decision framework adopted by the researchers that can either demonstrate an increase in complexity, reflect the financial cost of each intervention, or manage the time constraints of the project.

Stage Four - Action

The Action stage of the ABIA Framework will most certainly involve a time lag for the participants. It is envisioned that this stage includes changes in behaviour at varying scales and depths for individuals, families and communities. These might include increased recycling, installation of low-flow white goods or increased use of public transportation. It is anticipated that there will be varying levels of positive behaviour change towards ERB as a direct result of the participants exposed to one or more of the interventions described. This type of behaviour change is seen as empowering as it is self-driven, and thus more likely to create self-efficacy, resulting in further ERB. In the case of community driven projects, once the number of people demonstrating ERB crosses a threshold of critical mass, ERB may be considered the social norm, influencing those less motivated as they feel obliged to conform to social pressure (Bearden et al., 1989). Key to this final stage is the opportunity for participants to reflect and evaluate how their actions change post-intervention. This might be done at various intervals and could occur at the convenience of those involved through online surveys.

Stakeholders

It is important to emphasise that the ABIA Framework can also be deployed with other stakeholder groups involved in the processes of ERB, such as housing providers, designers and policy makers. Feedback on their own perceptions and awareness of ERB, end user behaviours and how to make connections between the two can only help to improve the quality of design and technological interventions.

Within the ABIA Framework, it is also recognised that both convenience and cost influence likeliness and willingness to act; cost and ease of use must therefore be considered alongside the altruistic position of the participant. The ABIA Framework allows a project to establish an equilibrium and find the balance between a reliance solely on moral responsibility and the desire for economic gain, which can result from more energy efficient living (Kaplan, 2000; Winefield, 2005).

Having developed in the ABIA Framework as a response to gaps in current practice (Hayles and Dean, 2010; Hayles et al., 2010), the researchers set out to pilot the Framework on end users as a preliminary means of examining its efficacy. This step in the Framework's development acted a means for the researchers to validate the Framework as well as to discover potential problems which may need further development.

The Pilot Study

Policy context

The principal participants of the Pilot Study were social housing residents on the waiting list for new homes, designed to meet levels 4 and 5 of the Code for Sustainable Homes.² The intention was to establish these tenants' perceptions and awareness of Climate Change and environmental issues, their current behaviours in the home, and their willingness to engage with the sustainability agenda, through ERB, when moving to housing specifically designed for low carbon living.

The energy cuts proposed for buildings are ambitious (see table 1). They require an adaptation to design and construction that may be unpalatable to traditional thinkers and environmentalist alike

² The Code for Sustainable Homes (CSH) was established in 2007 (Department for Communities and Local Government, 2008a) in an effort to reduce carbon emissions and create more sustainable homes; all new homes in the UK are to be zero carbon from 2016. CSH is currently the UK voluntary national standard for the sustainable design and construction of new homes. CSH measures the sustainability of a new home against nine categories of sustainable design, rating the 'whole home' as a complete package (Department for Communities and Local Government, 2008).

due to the demolition of existing housing to make way for more energy efficient homes (Centre for Alternative Technology, 2007). Users will also need further training and understanding of how their homes operate, as design aiming to achieve significant carbon reduction tends to incorporate an increased level of technology in the home.

Insert Table 1: Energy reduction requirements

Participant sampling

The ABIA Framework was piloted over a period of one year with a cohort of future residents of low and zero carbon homes in Northern Ireland. The homes are to be provided by the Northern Ireland Housing Executive (NIHE) and are classified by the Code for Sustainable Housing levels 4 and 5.

The operational criteria for selection of these individuals were two-fold: a desire to include a variety of family sizes and their then current residence location. The family groups were taken from the household classification accommodation requirements waiting list, namely:

1. Single person household and small adult households. This included households of one or two persons aged 16 to 59;
2. Small families, large families and large adult households. This included households of one to three persons aged 16 or above which may also have one to three persons aged between infancy and 15; and
3. Older small households. This included households with one or two persons aged 16 or above, where one or both of whom are aged 60 or over.

Furthermore, the participants were chosen to represent three different contexts of living conditions, including one site each from a rural, suburban and urban location.

Recruitment of sample

A letter was sent by post to 217 households informing them of the research and asking them to take part; the letter was co-signed by the researchers' university and the NIHE. Participants were given the opportunity to opt out by phoning a free phone number. Two researchers also visited each home and asked the occupants to participate.

Of the 217 people who were approached to take part in the three different sites, 27 actively declined while 137 residents did not respond to the recruitment efforts. Thus the pilot study had a return rate of 24%. Of the participants, 40% resided in suburban areas, 32% in urban neighbourhoods and 28% in rural regions.

Framework participation

Semi-structured interviews with the 53 participating households took place over a 6-month period. Each interview took approximately 60 minutes to complete.

A qualitative approach was used, with the researchers interviewing the tenants using both structured and open-ended questions. The interview was divided into 'awareness' questions first (Climate Change and environmental impact awareness) followed by 'behaviours' questions (behavioural measures and frequencies namely: transport, home energy, food, water, and household consumption - goods and services), tackling themes that would be revisited during the intervention stage.

In addition the researchers noted observations on the house the participants currently live in (design and construction) and determined the household demographics.

Awareness

The interviewer began by asking the participants to rank key issues facing society today. This was done in order to see how highly they prioritise Climate Change, the energy crisis and overpopulation.

Following on from this, they were given a list of topics, which all negatively impact on the environment including flooding, deforestation and population growth. Participants were again asked to rank these in order of perceived importance. In both these instances, flash cards with images were used in this process, both to help the participants feel at ease as well as to engage with the whole family including small children and those with limited literacy.

Finally in this section, the participants were asked to list what sprung to mind when different terms used in the media to refer to environmental impacts were stated. These terms included 'biodiversity', 'one planet living' and 'food miles' (Slovic et al., 1991).

Interactive tools including flash cards were used to trigger thoughts and awareness of issues, and ranking was used to illicit importance attached to issues. The key issues that emerged are outlined in Table 2.

Insert Table 2: Summary of Key Perceptions

A number of the results can be directly compared with previously published evidence. For example, the responses to Climate Change recorded above are in line with Spence et al's (2010) survey of public perceptions of Climate Change and energy futures in the Britain, which found that 71% accept it is their responsibility to help to do something about Climate Change, with 63% believing that this can be achieved by changing their own behaviour. However, with regard to piloting the framework, what is important is to establish what results should be fed back to the participants in during the intervention stages of the framework. As the NIHE focus was on energy and water saving, these results were fed back to tenant participants during the intervention stage.

Behaviours

Behaviour was measured by asking participants about their day to day lives including their home energy and water use, recycling practices, transport usage and shopping (consumption) habits such as food and white goods (see Table 3). Again, the energy and water data was used during the focus groups of the intervention stage to support the development of ERB in these areas.

Insert Table 3: Summary of Key Behaviours

Intervention

Intervention can be achieved through a number of different approaches as outlined above. This Pilot Study demonstrates one approach in which end users were given access to focus group sessions. In these sessions, participants were given the opportunity to further discuss their awareness of the need to mitigate Climate Change and how they might approach this.

The aim of this session was to encourage ERB amongst the tenants whilst establishing what could be done by the NIHE to engender and support further ERB amongst their tenants. The format for the tenant feedback session is outlined in Table 4.

Following an ice breaker, where the participants were asked to identify environmental campaigns from TV, radio and print media in order to debate their effectiveness, they discussed perceptions of sustainable housing and housing preferences.

Insert Table 4: Summary of Focus Group

The focus of the session was on changing behaviours. The researchers calculated the following ecological footprint domains: carbon footprint; food footprint; housing footprint; and goods and services footprint of each of the participants using the calculator provided online by Redefining Progress (2011). In order to motivate participants this information was shared amongst the group to demonstrate how their ecological footprint compares with the sample and country averages. For example in Figure 1, Participant A's results are compared with the UK average, sample mean, sample high and sample low of the current case study.

Insert Figure 1: Example footprint results

In order for the tenants to further explore ERB, feedback on both energy and water perceptions and behaviours was provided.

Perceptions of Energy and Water consumption were discussed (Figure 2-3) in order to explore possibilities for further reducing consumption by changing behaviour in the home whilst feedback on Energy and Water behaviours (Figures 4-5) was presented to establish what was already being done by tenants to conserve both energy and water. Figures 6-7 show the proportion of participants who stated that they would welcome energy and/or water reducing technologies. These and other technologies were discussed to gauge the responsiveness of participants to accepting new technologies as standard, to further support ERB.

Insert Figure 2: Perceived willingness to turn down the thermostat to reduce energy use/cost

Insert Figure 3: Perceived ability to reduce water consumption

Insert Figure 4: Current energy saving behaviours in the home

Insert Figure 5: Current water saving behaviours in the home

Insert Figure 6: Percentage of participant households who would consider energy saving strategies

Insert Figure 7: Percentage of participant households who would consider water saving strategies

Action

Stage Four of the framework ensures that awareness has been translated into 'action'. As stated above, this stage involves a time lag in order to determine lasting behaviour change; this may mean revisiting participants over different time periods.

Discussions that took place following the intervention workshop demonstrated that those taking part were keen to make further changes to reduce consumption. With respect to energy and water use, many ERBs are already in place and tenants demonstrated an interest in having energy meters and motion sensors installed in their homes to further promote energy saving alongside devices to reduce water usage.

Ultimately the Pilot Study centred around the development of ERB awareness to provide support to tenants moving to new housing designed to be more sustainable, and in particular, low carbon. Therefore it will be necessary to revisit the participants again once they are established in their new homes. Once they are in situ both the transition to their new homes and their current ERB will be assessed.

Discussion

Strengths of the ABIA Framework

The review of current literature has identified several significant challenges to ERB: how information should best be disseminated, understanding current knowledge and attitudes towards Climate Change and addressing the seemingly overwhelming problem that Climate Change can present in relation to individuals. The Pilot Study outlined above begins to illustrate the number of ways the ABIA Framework can be used to address these considerable challenges to ERB.

Firstly, with its collective approach during the intervention stage and feedback mechanisms, the Framework helps participants see that by making small changes to their behaviours, they can have a significant collective impact. Furthermore, the ABIA Framework supports Climate Change adaptation by identifying motivators and barriers to ERB as well as exploring how and why individuals respond differently to the same information.

The ABIA Framework approach also gives the opportunity for the participants to explore their awareness and understanding of issues, challenge their assumptions and build on knowledge constructively in a way that is not confrontational, but rather controlled by them. This approach does not need to be facilitated by an outsider but has the potential to be developed as a self-lead tool.

Additionally, the Pilot Study demonstrates how the Framework can be used with both the tenants (end users) and stakeholders (decision makers) to ensure a better outcome. It allows for those without first-hand experience of living in social housing to realise the potential problems tenants may face and can thus be instrumental their making significant management decisions with the end user in mind. The ABIA framework could be applied to multiple points in the design and build process and could open areas of self-reflection, for example: approaches to embodied energy in building materials, energy use during construction, energy management by end users and CO₂ emission reduction throughout the building's design and life as examples.

Furthermore, the ABIA Framework allows for the potential for both participants and decision makers to adopt a myriad of intervention options to suit their particular economic, physical, political or social circumstances. Because the ABIA Framework offers a staged approach, which can respond over time to these complicated contexts, flexibility is one of its key strengths.

Finally, the ABIA framework can be used in multiple contexts, well beyond the realm of social housing tenants and providers. The Framework can also support the outputs of the built environment sector indirectly, using it for example to develop corporate social responsibility strategies or to engender student engagement in environmental issues.

Areas for further development

Clearly a period of time is required before it is possible to establish whether or not individuals' desires to demonstrate ERB translates into action and whether or not there is lasting change. For example, it will be necessary to revisit the participants of the Pilot Study once they are established in their new homes, to determine whether an increased awareness of ERB has supported their transition to a low carbon home, and importantly, whether this has encouraged further ERB.

The next stage will be to apply the ABIA Framework within a variety of socio-economic, political and cultural contexts, working with individuals, project teams and community groups. The Framework can be then analysed in greater depth to understand, in both short and long term, how this process, and in particular raising awareness of ERB, impacts upon the long term behaviour of individuals, communities and stakeholders. The construction industry is notoriously bad at undertaking post-design or occupancy evaluation; further research into and reflection on the final 'Action' stage is thus possibly one of the largest challenges. However, it is also indubitably the work which will lead to the most insight about how the system may impact on these significant concerns.

Implications for the research, practice and society

A review of the literature reveals that current practice is lacking in systems which can be used in a variety of contexts to support behavioural change for the adaptation required to live in low or zero carbon homes. It is widely recognised that Climate Change cannot be successfully addressed solely with technology. It requires adaptation by all areas of culture, particularly the decision making around energy lifestyles (Lorenzoni et al., 2007). Due to the significant role of the end user, understanding of user perceptions, awareness and behaviours is key to encourage and enable support of individual behavioural change. While some might argue that individual householders can have little impact on Climate Change and that it is mainly policy makers and designers who should be targeted, the authors of this paper strongly maintain that individuals are not powerless. Those using low-carbon housing must understand and feel confident in their daily use of these potentially technologically sophisticated homes.

More than this, however, it is the pressure individuals who understand the importance of ERB can apply in democratic systems. The ABIA Framework seeks to empower individuals to push their elected policy makers and implementers to focus on issues of Climate Change. The aforementioned EPEC Study of 2009 makes clear that many individuals feel governments are not doing enough to tackle issues of Climate Change and the studies by Leiserowitz et al. (2010), Feldman (2010) and the Department of Transport (2011) all indicate that individuals' interest in these issues is waning. The ABIA Framework has been designed to keep these issues on the agenda for both individuals in their daily use of low-carbon homes as well as maintain political pressure on their leaders.

Conclusions

When designing and building new housing, and in particular when focusing on current carbon reduction targets, business as usual is not an option. It is not only a case of reducing existing consumption, it is also necessary to address the increasing energy demands that comes from a larger population and more households with higher expectations. It is important to identify why the design of buildings hasn't acted as a catalyst for change. Fundamental changes to the way houses are designed and built are required to meet the challenges set by the government for zero carbon homes in 2016.

Appropriate design and technology alongside occupant engagement are necessary if zero carbon targets are to be reached. Also required is on-going research to learn from existing and new homes to both ensure they meet their design performance in use and to assist occupants to live in them with optimum energy efficiency. Whatever approach is taken it is necessary to ensure that it does not worsen fuel poverty, reduce built quality or lessen user engagement; of equal importance is the need for immediate action on a global scale. The four-stage ABIA Framework presented in this paper can undoubtedly add value and provide a human element to programmes designed to address carbon reduction targets and Climate Change amelioration.

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