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# **Energy Efficiency Interventions: Learning from inhabitants**

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## ***Abstract***

Technological solutions to domestic energy reduction are insufficient without the cooperation of householders. It does not matter how much energy hypothetically could be saved by efficient technologies, if no one wants to live in the properties, install or use efficient lighting and heating. Therefore, to improve the uptake and effectiveness of household energy efficiency interventions, it is necessary to understand 'why people react to particular energy efficiency interventions in the ways that they do?' An analysis is presented of in-depth interviews with 50 householders that participated in one of four domestic energy efficiency interventions. The findings indicate that issues such as aesthetic tastes and effects on lifestyle are central to why people reject economically viable simple and well understood domestic energy efficiency interventions.

Keywords: CFL bulbs, energy demand, energy efficiency, householders, lighting, residential buildings, user acceptance, user behaviour

## Introduction

The fact that space heating accounts for roughly 60% of total delivered residential energy demand is testament to the poor quality of the UK housing stock, which is one of the oldest and least efficient in Europe (Boardman, 2005). In England, 39% of the housing stock was built before 1944, 42% was built between 1945 and 1980 and only 19% was constructed after 1980 when thermal standards were raised significantly (Wright 2008). This is problematic for the UK government, which is committed to significantly reducing the CO<sub>2</sub> emissions from domestic housing stock by 2050. Current estimates suggest that 75% of the present UK housing stock will still exist in 2050 and around 33% of the 2050 housing stock has yet to be built (Wright 2008). Therefore, if a significant reduction in domestic energy consumption is to occur in the UK, it will be necessary to improve the fabric of the current and future housing stock as well as the energy consuming services within domestic properties (Beddington 2008, Sustainable Cities Institute 2009).

Energy efficiency interventions designed to improve the fabric of housing stock and/or the energy consuming services within domestic properties fall into three categories: the refurbishment of existing stock, the building of energy efficient domestic properties and government policies related to domestic buildings and their energy consuming systems (Boardman 2005). Assessments of the 'success' of these types of interventions are usually a technical exercise, involving, at best, the measurement and/or modelling of energy use before and after the intervention. This allows insights into particular energy efficiency interventions but, unfortunately, it omits the human dimension (Crosbie 2006). For example, it does not address the following questions:

- Why householders shun energy efficiency interventions that are economically viable simple and well understood?
- Why expensive and difficult energy interventions can be more popular with householders than relatively cheap and simple interventions?

It is vital to understand energy efficiency interventions from the participants' perspective. It does not matter how much energy hypothetically could be saved by 'green' housing developments or energy efficient heating and lighting systems, if the energy efficiency measures are unwanted. Therefore, to improve the uptake and effectiveness of household energy efficiency interventions it is necessary to understand 'why people react to particular energy efficiency interventions in the ways that they do?' This paper contributes to an understanding of this issue by presenting an analysis of in-depth interviews with 50 householders that took part in one of four domestic energy efficiency interventions.

The interventions studied include new energy efficient housing and housing refurbishments, which were not initiated by the Carbon Reduction in Buildings (CaRB) research team. Therefore, CaRB researchers were unable to influence the energy efficiency measures used. Rather, they made advantageous use of the initiatives to undertake both physical monitoring and qualitative social science studies to gain insights from both a technical and social perspective. The qualitative social science investigation is reported here.

Interest in the people that take part in energy efficiency interventions is relatively new and often separated from the measurement of the impact of those interventions in terms of energy reduction (Crosbie 2006). For example, the 'DElight Study', one of the most comprehensive studies conducted looking at the use of compact fluorescent

light-bulbs (CFLs) in the domestic context, found that there was insufficient data to confirm the relative importance of factors such as income, and numbers of people in the home with regard to domestic lighting use (Palmer and Boardman 1998:22).

However, some information is available about the people that take part in energy saving initiatives from a recent UK government survey exploring attitudes to energy and water efficiency in the UK (Defra, 2007). This study found that homeowners, people aged 40 or over, and those with higher household incomes were the most likely groups to have made energy efficiency improvements to their homes in the last five years. The most common energy efficiency improvement people had made was to replace traditional incandescent light bulbs with CFLs (Defra 2007).

The remainder of the paper is divided into four sections. The first section introduces the domestic energy efficiency interventions that form the focus of the case studies and presents a short discussion of the methods used to collect and analyse the data. The second section presents the research findings. The third section presents some insights from the research findings, to show how it might be possible to improve the uptake and effectiveness of household energy efficiency interventions. The final section draws some conclusions as to why people react to particular energy efficiency interventions in the ways that they do and the implications of the research findings for the development of methodologies appropriate to household energy studies.

## **The interventions**

### **Case study one: Accent Homes**

Case study one concerns a pilot energy efficient social housing project conducted by the Accent Housing Group. This project involved the building and subsequent renting of a terrace of four properties, which are designed in accordance with the healthy

home principals of Avi Friedman (Friedman 2002). The main goal of the project was to inform the development of flexible affordable energy efficient domestic properties. Within this terrace, the two middle properties are family homes and the two end properties are divided into two flats. All the adults, from each of the four occupied properties<sup>1</sup>, were interviewed in March 2007 by the CaRB researchers.

### **Case study two: Eco n' Home**

Case study two concerns a UK government funded efficiency intervention run by Leicester City Council, (LCC) which offered financial incentives to householders to improve the energy efficiency of the insulation and /or the heating systems in their homes. The financial incentives provided under the scheme cover 75% of the total cost of the efficiency improvements made and are not conditional upon age or income. The allocation of this financial aid was location based around postcode boundaries selected by the council administration. The package of technical interventions used in each home, includes: loft and cavity wall insulation, a condensing boiler, radiators, thermostatic controls, and CFLs. The combination of technical interventions used in each home was dependent on the condition of the current boiler, insulation, and thermostatic controls etc. The CaRB team conducted interviews with fifteen householders that had taken part in the scheme in May/June 2007.

### **Case study three: Milton Keynes Energy Park**

In order to provide a longitudinal element to the research conducted by the CaRB team, prior studies with accessible temperature, energy, and socio-technical data were

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<sup>1</sup> In total seven persons were interviewed from four households. At the time the interviews were conducted one of the properties was being used as a 'show home' and the other non-occupied property was being used as a control for the energy and systems monitoring conducted as part of the case study.

sought out. One such study was conducted in the Milton Keynes Energy Park, where 160 low energy homes had hourly energy data collected between 1989 and 1991 (Summerfield et. al. 2006). A sample of twenty-nine dwellings also supplied hourly monitored temperatures in three rooms, and a social and behavioural survey of the occupants was conducted (Edwards, 1990). People currently living in 18 of the 29 houses that were part of the Edwards study were recruited for follow up research by the CaRB team in 2005. Ten inhabitants from the 2005 sample were interviewed in May/June 2007 to provide a qualitative element to the study.

### **Case study four: Energy Efficient Domestic Lighting**

CFLs represent a proven, readily available technology that could deliver substantial energy savings in the residential sector. As a result, lighting is often a preferred target for household energy-saving policies (Mills 2002, Crosbie and Guy 2008). However, in the face of an early policy focus<sup>2</sup> on CFLs as a means to reduce household energy consumption (see Mills, 1993), the amount of energy used to light homes continues to rise (Palmer and Boardman, 1999; Mills, 2002, DTI 2006). In order to explore the reasons behind this increase CaRB researchers explored changing household lighting practices in the UK. As part of this work, eighteen inhabitants were interviewed in the spring of 2006.

### **Research Methods**

In the Accent Homes case study, all of the adults in each of the four households were interviewed<sup>3</sup>. All of those taking part in the Eco n' Home and in the Milton Keynes

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<sup>2</sup> There have been numerous policy interventions encouraging the development of the CFL market in most countries (Martinot and Borg, 1998). For example, the UK government's subsidisation of CFLs led to the distribution of almost 17 million of these energy efficient light bulbs between 1994-2000 (Ofgem/EST, 2003) and compulsory energy labelling was introduced for light bulbs in the 1990s (HMSO, 1999).

<sup>3</sup> In three cases both adult members of the household were interviewed together.

study groups, were contacted and those that agreed were interviewed. In all cases the adult member of the household primarily responsible for choosing the home or deciding to accept refurbishment was interviewed, occasionally this demanded a second visit to the household. In the case of the lighting study snowball, sampling was used to recruit the eleven women and seven men that took part in the research<sup>4</sup>.

The interviews were guided by a list of topics and/or open ended questions which were tailored to each case study, and designed to elicit the interviewee's perspective on the energy efficiency intervention in which they had taken part. For example, respondents in the Milton Keynes and the Accent Homes case studies were asked why they had chosen their current homes, those taking part in the Eco n' Home case study were asked why they had applied for a home improvement grant and those taking part in the lighting study were asked why they had chosen to use CFLs. In most cases, the initial face-to-face interviews were also supplemented with a subsequent telephone conversation to clarify some of the responses given during the interview. Where it was possible, interviews were also conducted with those involved in running the energy efficiency intervention under examination.

In-depth interviews were used in this work because the open ended approach to questioning respondents, enabled by this approach, offers a greater opportunity to ask probing questions than any other data collection method. Therefore, the comprehensiveness or depth of data is significantly higher than that provided by other methods (Wilk and Wilhite, 1986; Bryman, 1992) This depth of data allows household energy studies to *“place consumer choices within a wider context of other life decisions and link consumption to other processes and activities in society in*

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<sup>4</sup> See Crosbie and Guy (2008) for an in-depth description of the research methods used in this study,

*general*” (Wilk and Wilhite, 1986). In doing so, it enables issues to be examined in a contextually sensitive way, and permits the researcher to probe responses to gain a full understanding of their meaning and implications<sup>5</sup>.

## ***Key questions***

The following questions were addressed during the analysis phase of the research<sup>6</sup>.

- Demographics: Who took part in the intervention?
- Motivations: Why did people take part in the intervention?
- Perceptions: Was taking part in the intervention a positive experience?
- Reflections: Would/do participants advise others to take part in similar interventions?
- Lessons for the future: Can the energy efficiency interventions be reshaped to improve the experience for participants?
- Recommendations: What are the implications of the answers to the above questions for public policy and energy related research?

## **Research Findings**

### ***Data collection***

In the case of the lighting study, some information is available about the backgrounds of the types of people that use CFLs from the DEFRA (2007) study mentioned earlier. This research indicated that homeowners, people aged 40 or over, and those with higher household incomes were the most likely groups to have replaced normal light bulbs with CFLs in the last five years (Defra, 2007). In the case of the other three energy saving initiatives examined, apart from those that took part in the interview

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<sup>5</sup> See Crosbie (2006) for a full discussion of the advantages and disadvantages of the different data collection methods used in domestic energy research.

<sup>6</sup> Nudist software was used to support the analysis of the interview material

research, it is difficult to assess exactly who participated in them. However, it is not unusual that the important role occupants play in household energy demand is overlooked (Crosbie 2006).

Extensive data were collected by CaRB researchers conducting each of the case studies underpinning this paper. However, in most cases more emphasis was given to the collection of technical data, about buildings, than to the collection of data about the people who live in those buildings. In the case of the Milton Keynes study technical details such as, floor area, number of bedrooms, number of floors, and structural changes to the properties etc. were collected along with some economic and socio-demographic information about the people living in the properties, but important factors such as level of education were overlooked in the 2005 study.

In the Eco n' Home refurbishments, attempts were made to collect comprehensive economic and socio-demographic information about the people taking part in the scheme. The approach adopted by the CaRB team relied on postal questionnaires and the 50% response rate obtained means socio-demographic information is lacking for half of the interventions' participants. This is not, however, a poor response rate for a postal questionnaire; rather it is about the best that can be expected from this data collection method (Bryman 1992). Technical data about house geometry and heating systems etc. was collected by professionals undertaking the surveys in person.

The research conducted into the Accent Homes intervention is different on two counts: First, in the small number of participants and second because qualitative in-depth interviews were an integral part of the project. The face-to-face interview approach adopted enabled the participant's socio-demographic details to be collected by the researchers conducting the interviews. These details included, number of

people in the household, their age and gender, the annual household income, the highest level of educational achievement obtained by members of the household and the employment status and occupation of adult members of the household. It must also be pointed out that much more comprehensive household data were collected during the face to face semi structured interviews than it would be possible to collect using either a postal or researcher administered questionnaire. In the case of the Accent Homes case study this information has proved essential to the interpretation of the temperature and humidity data collected as part of the research (see Crosbie, Hasim and Ward, 2007).

The inconsistent information gathered concerning the socio-demographic background of those taking part in the domestic energy efficiency interventions is indicative of the problem that energy studies tend to focus on properties and neglect the role of the residents in creating energy demand (Crosbie 2006). This in turn is symptomatic of the techno-economic paradigm, which dominates the methods and agendas of energy research (Guy and Shove 2003: 54). This focus on the technical aspects of buildings has created a situation in which research tends to be descriptive, rather than explanatory (Lutzenhiser 1993). However, it must be pointed out that the continued dominance of technically driven approaches within energy studies and interventions is perpetuated by an absence of accepted methodologies for socio-technical research in these areas (Lutzenhiser 1993, Crosbie 2006).

### ***Demographics***

In the absence of consistent socio-demographic data about all the participants in the interventions studied, the focus is on those that took part in the interviews, for which reliable data exists. Only six of the participants in the case studies were under thirty

years of age, while thirty were over fifty and fourteen of those were over sixty and all but seven had incomes at or above the UK average of around thirty thousand pounds per annum<sup>7</sup>. Thus, in common with the UK Government Survey (Defra 2007) the findings from our case studies suggest that older people and those on higher incomes are more likely to look favourably on energy efficiency interventions.

Another interesting finding was that the households of the interviewees were predominantly composed of couples and couples with children. Only three of the interviewees live in single person households and only two of the interviewees are single parents. It would seem that our research, like much of that which has gone before, overlooks the energy use of non-traditional family units (Guerin et al. 2000). This critique of energy research is not new (see Keating, 1989). However, it may not be the selection of the interviewees which is the problem. The lack of interviewees from non-traditional households may indicate that people living in traditional family units are more likely to take part in household energy efficiency interventions, than those living in non-traditional family units.

The speculation involved in the findings outlined above could be reduced, if it was possible to check whether they were replicated throughout all of the participants in the energy efficiency interventions discussed in this paper. However, as detailed earlier, this is not possible because the relevant data regarding the socio-demographic background of those participants is either inconsistent or not available.

### ***Householders' motivations***

In the majority of cases, the benefits the different interventions could bring to participants lifestyles appeared to be a far stronger motivational factor than

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<sup>7</sup> See Office of National Statistics 2008

environmental issues. In the case of Accent Homes and Milton Keynes Energy Park case studies interviewees said they chose to rent or buy their current properties because they perceived that they are in a more desirable area and of a superior design to the alternative properties available to them. For those taking part in the Eco n' Home scheme a desire to refurbish their housing at a reduced cost was the main motivational factor. In the case of those interviewed in connection with their household lighting, most that were using, or had tried CFLs in the past, said they were doing /or had done so for one of two main reasons; either because they thought they would save money on their energy bills or because they had been sent free bulbs by their utility company. Although only one of these participants said environmental issues had played no part in their decision to use CFLs.

However, it must be pointed out, that even in the case of interviewees that said they used CFLs purely for environmental reasons they did not use them throughout their home and two of the respondents said that they had used CFLs in the past but did not do so currently. These findings correspond with the findings of UK Government research (Defra 2007), which found that people did not use CFLs though out their home<sup>8</sup> and that almost half of the people that did not use CFLs had tried them in the past.

The survey-based approach used in the UK Governments' research (Defra 2007) does not permit researchers to investigate why people do not use CFLs throughout their home. As pointed out by Wilhite et al "*an analysis and interpretation of complex culture based household behaviours... is very difficult to achieve in a closed format*

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<sup>8</sup> Of those respondents in the DEFRA (2007) study that used CFLs the average number used per respondent was only 4.2. This figure is not very high if we consider that UK households used an average of 21.6 bulbs in 1996 and it is estimated that this figure will have risen by at least 20% by 2020 (Market Transformation Program 2006).

*interview or from survey questionnaire responses” (1996:796). However the semi-structured interview approach used in the research presented here allows researchers to use open-ended questions, which can be used to explore why people behave in the ways that they do (Bryman 1992). Using this approach it was found that respondents’ main reasons for not using CFLs throughout their homes are related to aesthetics, style and quality of light. This is clearly demonstrated in the following quote from one of the female respondents: “I use energy efficient bulbs in some of my lights, but I don’t like them much because the light they give isn’t strong enough for me to read or sew or anything like that, and they look awful sticking out of the lamp shades.”*

In most cases, design aesthetics and style were also found to be important in the acceptance or otherwise of all of the interventions under examination. In the case of the Milton Keynes Energy Park and the Accent Homes project, the layout of the properties and their aesthetic qualities were major factors influencing residents desire to live in the properties. When asked, respondents often replied with statements such as:

*“Well we just loved the look of the place”*

*“It is so much more liveable, light and spacious than the others we looked at”*

*“It was important that my wife was pleased with the layout;”*

*“On my first visit I just thought it felt right because it looked modern and bright.”*

The findings from Eco n’ Home interviews emphasise the significance of style and aesthetics in motivating people to take part in household energy efficiency

programmes. All of those interviewed were more than happy to have new heating systems and insulation fitted at great inconvenience and some personal expense, but in most cases they were not prepared to use the CFL bulbs they were supplied with, free of charge as part of the project. The reasons given for this by participants, as illustrated by the following quotes, were that CFLs are ugly, they do not fit current light fittings and fixtures and the light they provide is too dim.

*“They gave me some [CFL bulbs] my love but, I can’t use them on dimmer switches, so it is just table lamps I use them in.”*

*“I have only got them [CFL bulbs] upstairs on the landing light, oh I have got them in the children’s bedrooms, but they are a bit dim..... I think it takes a while for them to warm up.”*

*“I have not used them [CFL bulbs] because they are ugly. They are really really ugly.”*

Of the few participants expressing environmental concerns as a major motivational factor in their decision to participate in the refurbishment scheme, most had young children or grandchildren. Overall, they tended to discuss their environmental concerns in terms of their children or grandchildren. This suggests that these interviewees are prepared to forgo their self interest, to some degree, to protect the interests of their children and/or grandchildren. However, this altruism was mediated by the perceived costs of the intervention to the participants’ current lifestyle. For example, in the case of the Eco n’ Home study, one of the grandparents interviewed that expressed very strong concerns about the effects of pollution on her grandchildren’s future did not use the CFLs she was supplied with. When asked why

this was the case she replied *“Well they just look awful don’t they sticking out of the lampshades and anyway they are very dim, we put one in the cupboard under the stairs but I took it out because it took ages to come on”*.

### ***Householders’ perceptions***

In three case studies (Milton Keynes Energy Park, Eco n’ Home and Accent Homes), most of those interviewed found their experience of their new or refurbished energy efficient homes positive. This is because, overall, interviewees’ expectations were met. In the case of Accent Homes and Milton Keynes Energy Park, many of the interviewed residents found that living in their home reinforced their belief that the properties in these developments are of a superior design to the alternatives available to them. In short, many believed that they had more aesthetically pleasing homes, better levels of thermal comfort and lower heating costs, than would have been the case had they chosen to live in one of the other types of property available to them. This is clearly summed up in the following quotes:

*“They [the houses in Milton Keynes] are cheaper to run, but what people don’t realise as well, is that during the summer they are a lot cooler than less energy efficient houses, so we don’t get the same oppressive heat as we did in our previous house.”*

*“If I had a chance I would buy. The houses I’ve lived in the past have not been up to this standard, all this space and it’s in Bradford” [Accent Homes’ resident].*

In the case of the Eco n’ Home scheme, most participants had fulfilled their original expectation that taking part in the scheme would allow them to improve their properties at a reduced cost. One respondent stated *“I would not have been able to*

*have this new heating system without the scheme so I am really pleased” while another stated that “well my boiler was condemned and it would have cost me all of my savings if this hadn’t come along.”*

However, in the case of the lighting case study all but one of those interviewed were disappointed with some aspect of CFLs. In many cases, research participants disappointment with CFLs was related to the fact that participants felt that CFLs did not produce the same quality of light as traditional incandescent bulbs and that their equivalent brightness vis-à-vis traditional incandescent bulbs are not realistically labelled. The following quotes are typical of the replies to the question about why the respondents in the lighting study did not use CFLs throughout their home.

*“I don’t care what it says on the packets you cannot buy a one of those bulbs [CFLs] as bright as a 60 watt old fashioned bulb never mind a 100 watt”*

*“I think they exaggerate how bright the light is from CFLs no matter which watt bulb they say they are equivalent to they never are they are just not bright enough”*

In the cases where participants’ initial expectations of the energy efficiency intervention were not met, or were only partially met, their experience was marred. This was not only an issue in the case of the lighting study but also, in a more limited capacity, in all of the energy efficiency interventions examined in this paper. For example, technical problems in the Eco n’ Home scheme and the Accent Homes properties led some participants to develop negative impressions of the experience of taking part in the intervention. In the case of the Accent Homes, internal disputes within the Accent Group prevented the resolution of problems with contractors, which meant that for some participants their expectations of the intervention were not met,

and their perceptions of the intervention were marred. It must also be pointed out that, in the case of the Accent Homes, these problems were not totally restricted to problems with workmanship but were directly related to the energy low energy features in the Accent properties.

In order to achieve the high standards of fuel efficiency, the Accent Homes were designed to be airtight, with the airflow controlled by automated Mechanical Heat Recovery Ventilation (MHRV) systems. These systems adjust both the internal and external airflow of the building and the heating systems in the properties are activated by a thermostatic control, which switches on the heating when temperatures drop below the required level. However, the systems installed in the Accent properties did not enable short boosts in temperature. Thus the MHRV systems in the Accent properties, if used as they are designed, take control of the heating system away from the user, who can no longer switch the system on to achieve a short term boosts in room temperature, as is common practice in the UK.

The following quotation highlights the frustration caused by the lack of control the Accent Home residents have over their heating systems. *“Friday evening, it was quite chilly and my husband said ‘switch ‘em [the radiators] on.’ Well, they wouldn’t come on so we had no heating. I went in the bedroom but those ones were working.....’ Well, we didn’t know what to do with the damn things”*. This resident had the automated temperature controls removed and the system switched to manual in order to regain control over when and in which rooms her radiators were switched on. Also in common with other residents interviewed, she installed electric heaters so that she could achieve the short-term boosts in room temperature that she and her husband required for their thermal comfort.

In the case of the Eco n' Home refurbishments traditional heating systems were installed over which the residents had full control over. Those interviewed from this scheme also indicated that when problems had arisen with workmanship they were usually resolved quickly and therefore the intervention met their expectations and their perceptions of the intervention remained positive.

### ***Householders' reflections***

Naturally, whether or not participants felt they could advise others to take part in similar interventions was influenced by whether their experience of taking part in the intervention was positive. Therefore, it is unsurprising that only two of the participants taking part in the lighting study said that they could whole-heartedly recommend the use of CFLs. Most of the participants in the Milton Keynes, Eco n' Home and Accent Homes case studies stated that they would recommend this type of home or energy efficiency intervention to others. In the case of the Eco n' Home study four interviewees said that they had all ready done so. Respondents' willingness to recommend the scheme or intervention in which they had taken part was directly connected to whether the participants' initial expectations of the new home or intervention were met.

As discussed in the previous section, some participants in both the Accent Homes and Eco n' Home case studies found that they had technical problems with the energy efficiency interventions in their homes. In the case of the Eco n' Home study, it was found that the speedy resolution of the problems meant that respondents were happy to recommend similar schemes to friends and family. However, respondents living in the Accent Homes scheme were more reticent, with two respondents making the following comment:

*“I don't know. I'm not as pleased with them [as her previous accommodation rented from Accent Housing]. It's just the little things. We've had a lot of problems.”*

*“If you had asked me that a month ago I would have said no..... It has taken them seven months to resolve the problems..... I will reserve judgment rather than say yes until we have been here longer.”*

### **Lessons for the future: improving the participants' experience**

As discussed earlier, there was widespread dissatisfaction amongst those interviewed as part of the lighting study mainly because respondents felt that CFLs are not a direct replacement for traditional incandescent light bulbs. Those that took part in the Accent Homes case study were dissatisfied with their heating systems and found that they had to adapt them by installing supplementary heating and in one case disabling the automated heating controls<sup>9</sup>. These findings suggest that current practices and expectations must be considered when undertaking energy efficient interventions.

Those that took part in Eco n' Home and Milton Keynes case studies were largely content with the technologies, their implementation and administration. Although, some of the problems encountered by a minority of participants in the Eco n' Home and Milton Keynes case studies provide some lessons relevant to future energy efficient interventions.

All of the residents of the Accent Homes properties and some of the participants in the Eco n' Home intervention commented that the level of information that they were provided with was inadequate; in some cases, the information was overly complex and in other cases non-existent.

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<sup>9</sup> This has led to the Accent Homes using more energy for heating than was expected during their design.

Some of the participants in the Eco n' Home, Milton Keynes and Accent Homes case studies experienced problems with contractors. These problems were due to communication difficulties between the contractors and the organisation that commissioned them and/or due to poor workmanship. However, if they were resolved quickly, participants were generally understanding of these difficulties. They only became frustrated when problems with the technologies used in their home were unresolved over a significant period of time.

## **Recommendations**

### ***Motivation***

The research suggests that people's general attitude towards environmental issues plays a rather minor role in their decision making with regard to choosing a new energy efficient home or engaging in energy efficient refurbishment. It would seem that the decision to take part in domestic energy efficiency interventions is driven by self interest. This is calculated not only by the cost of the energy efficiency intervention in monetary terms, but also by assessing its aesthetic qualities and calculating how well the technologies used fit with current lifestyles expectations and tastes. This suggests that:

- Promoting energy efficiency interventions in terms of abstract environmental issues is likely to be ineffective.
- Promoting energy efficiency intervention in terms of the direct benefits they can bring to participants lifestyles is likely to increase participation.
- Energy efficiency interventions must be aesthetically pleasing, stylish and fit with current lifestyles and practices if a significant level of participation is to be achieved.

## ***Maintaining positive perceptions***

To maintain positive perceptions of particular energy efficiency interventions participants' expectations of the intervention must be met during the realisation of the intervention. These expectations are often related to lifestyle improvements, (i.e. increased thermal comfort), rather than monetary gain or pollution reduction. It was found that if participants have clear expectations of an intervention and reliable technologies are used in conjunction with good workmanship inhabitants are more than happy to recommend the intervention to others. It was also found that if technical problems are addressed quickly and efficiently there is little negative impact on participants' perceptions. These findings suggest that

- Information regarding energy efficiency interventions should contain realistic expectations and be clear, concise and easily available.
- Professional administration and implementation of energy efficiency interventions is essential.
- Technologies and contractors used in an energy efficiency intervention must be reliable and capable of meeting participants' expectations.

## ***Inclusiveness in interventions and research***

Disparate, and in some cases very little, information was gathered concerning the background of the people that took part in the energy efficiency interventions explored in this paper. This makes it difficult to assess whether particular groups of people are included or excluded from these interventions. However, it is possible to make some tentative recommendations concerning how to increase the inclusiveness of energy efficiency interventions. Of the fifty people that took part in the interviews it was found that most were made up of older people and only two were single parent

households. Given the importance of style and aesthetics in motivating people to take part in energy interventions revealed by the interviews, these findings suggest that:

- Greater efforts need to be made to design domestic energy efficiency interventions and technologies to fit the lifestyles and tastes of young adults and non-traditional family units.
- More research is needed focusing on the household energy consuming practices of young people and non-traditional family units to enable the design of energy efficiency interventions, which fit the lifestyles of these groups within society.

## **Conclusions**

Many of the recommendations outlined in this paper may seem obvious, however these issues are often overlooked even in large policy based household energy efficiency interventions, such as government attempts to increase the market penetration of CFLs. Due to this policy push, replacing traditional light bulbs with CFLs is an economically viable simple and well understood energy efficiency intervention, nonetheless it is largely rejected by householders. The findings, from the research presented in this paper, indicate that this is because CFL manufacturers' and government claims about CFLs are misleading; in that CFLs are not an exact replacement for incandescent light bulbs, in terms of quality of light or design. This is clearly indicated by the comments of the interviewees presented throughout this paper and the findings of other studies, which show that even when inhabitants use CFLs they do so in a limited capacity (MTP 2006, Defra 2007, Crosbie and Guy 2008, Wall and Crosbie 2009). These findings support the position taken by BSRIA (2008) "*that*

*ignoring the differences [between CFLs and traditional incandescent light bulbs] and claiming universal compatibility will lead to consumer rejection.”*

The findings from the Eco n’ Home case study offer the best indication of why difficult and expensive energy efficiency interventions can be more popular with inhabitants than relatively cheap and simple energy efficiency interventions. The participants in the study were content to have new heating systems and insulation fitted at great inconvenience and some financial cost, but in most cases they were not prepared to use the CFL bulbs they were supplied with, free of charge, as part of the project. The reason for this is that CFLs did not fit with participants current lifestyles, whereas lower energy costs and improved heating control were perceived as lifestyle enhancing.

The reported research also highlights the urgent need for the development and diffusion of integrated methodologies, which can be used to address both the social and the technical aspects of household energy consumption. A good starting point would be to place a greater emphasis within energy studies on collecting data about the people who live and work in buildings under examination. However, to understand the complex social and cultural factors driving household energy demand, a simple post- energy efficiency intervention quantitative survey is insufficient; rather, in addition, qualitative research, involving in-depth interviews and/or focus groups, must play a central role. However, it is not merely a case of researchers within household energy studies accepting the validity of qualitative methods and learning how to apply them. Those involved in the funding of energy research must also embrace the validity and findings of such methods (Shove et al 1998; Crosbie 2006).

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