

CaRB

Carbon Reduction in Buildings

Deliverable 7:
Domestic energy
efficiency
interventions – from
the householder's
perspective

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Exploring energy efficiency interventions from the householders' perspective?

The focus of the research

“In the domestic setting consumers are confronted with a certain number of socket outlets, a boiler of a particular size and type and a building fabric which is relatively difficult to alter and therefore users live in a world in which much of their consumption is already given” (Shove *et al.* 1998: 313).

The fact that space heating accounts for roughly 60 percent 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). Therefore, if we are to significantly reduce domestic energy consumption in the UK, it will be necessary to improve the fabric of the housing stock and the energy consuming services within domestic properties.

Domestic 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 the development of new regulations related to domestic buildings and their energy consuming systems. Assessments of the 'success' of these interventions are usually a technical exercise, involving, at best, the measurement and /or modelling of energy use before and after the intervention. This type of information is essential if we are to understand the possibilities to reduce domestic energy consumption provided by particular energy efficiency interventions. However, it does not help us to understand questions such as:

- Why economically viable simple and well understood energy efficiency interventions are shunned by householders?
- Why expensive and difficult energy interventions can be more popular with householders than relatively cheap and simple interventions?
- Why energy efficiency interventions are less successful in terms of energy reduction than expected?

To address these questions we need to understand energy efficiency interventions from the participants' perspective. This issue is important, as it does not matter how much energy could be saved by 'green' housing developments or energy efficient heating systems, if no one wants to live in the properties or install the new heating technologies. From this perspective, if we are to improve the uptake and effectiveness of household energy efficiency interventions it is necessary to understand 'why householders react to particular energy efficiency interventions in the ways that they do?'

In order to contribute to an understanding of this issue this report presents case study analysis of four energy efficiency interventions, addressing the following questions:

- Who took part in interventions?
- Why did they take part?
- Was taking part in the intervention a positive experience?
- Would/ do participants advise others to take part in similar schemes?
- Can the interventions be reshaped to improve the experience for participants?

The case studies

Accent Homes

Case study one concerns a pilot energy efficient social housing project currently being carried out by the Accent Housing Group. This project involves the building and subsequent renting of a terrace of properties which are designed in accordance with the healthy home principals of Avi Friedman (see Friedman, 2001 and 2002).

EST Hot Water Study

Case study two concerns a study of domestic hot water use currently being carried out by the Energy Saving Trust and the Building Services Research and Information Association (BISRA). The information from this study will be used to inform the BRE Domestic Energy Model (BREDEM). This model is a major component of the Building Research Establishment Housing Model for Energy (BREHOMES), which has a wide range of applications including informing UK building regulations (Natarajan and Levermore, 2007; Shorrocks and Dunster, 1997).

Chess Grant Scheme (SRB6)

Case study three concerns a government funded household energy efficiency intervention run by Leicester City Council, (LCC) which offers financial incentives to householders to improve the energy efficiency of the insulation and /or the heating systems in their homes. This intervention is funded by the single regeneration budget (SRB) round 6¹. LCC is monitoring this project as part of the Econ' homes scheme funded by the EU which has nine European partners.

Milton Keynes Energy Park

Case study four concerns homes in the Milton Keynes Energy Park, where low energy houses were built in the late 1980s, with condensing boilers and higher levels of insulation than were standard at the time (Edwards, 1990). Between 1989 and 1990 one hundred and sixty of these low energy homes had hourly energy data collected. People currently living in eighteen of the twenty nine houses that were part of the Edwards study were recruited for follow up research by the CaRB team in 2005.

¹ SRB provides resources to support regeneration initiatives in England carried out by local regeneration partnerships Its priority is to enhance the quality of life of local people in areas of need by reducing the gap between deprived and other areas, and between different groups. It supports initiatives that build on best practice and represent good value for money. The types of bid supported differ from place to place, according to local circumstances. to obtain funding, organisations have to demonstrate that their bid meets one or more of the eligible objectives

Research methods

In-depth interviews

The main method of data collection employed in the research presented in this report is face to face in-depth interviews with intervention participants. Where it was possible interviews were also conducted with those involved in running the intervention under examination and in the case of Leicester City Councils' energy efficiency scheme householders that had decided not to take part in the scheme were also interviewed. All the interviews were guided by a list of topics and/or open ended questions. Most of the interviews lasted between forty minutes and an hour and a half.

Why use in-depth interviews

The open ended approach to questioning respondents, used in in-depth interviews, 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 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 implications².

The structure of the report

Each of the following four chapters presents the analysis of one of the case studies.

The final chapter of this report summarises findings from all of the case studies and illustrates how they can be used to inform both the development and implementation of household energy efficient interventions.

² See Crosbie (2006) for a full discussion of the advantages and disadvantages of the different data collection methods used in domestic energy research.

Accent Homes: An Energy Efficient Social Housing Project

Accent Homes: Description of Intervention

The Accent Homes intervention is a social housing pilot project currently being carried out by the Accent Housing Group. The main goal of the project is to inform the development of flexible affordable energy efficient domestic properties. It consists of a terrace of four domestic buildings which have been designed for, and built by, the Accent Housing Group following the healthy home principals of Avi Friedman (Friedman, 2001 and 2002). Within this terrace the two middle properties are family homes and the two end properties are divided into two flats. The houses have four bedrooms, the ground floor flats have one bedroom and the first floor flats have two bedrooms. A mix of different heating and hot water systems are used in the properties, including solar, gas central heating and electric under floor heating. This enables the assessment of each heating system in terms of energy consumption and thermal comfort³. The timber frames, wall panels and floor units used in the construction of the properties were manufactured off-site and have blown cellulose insulation. The wall panels give exceptional insulation and airtightness values. Due to their airtight and well insulated and timber framed construction, these properties have exemplar standards in energy efficiency⁴.

It is hoped that the findings from the research conducted into the Accent properties can be used to improve energy efficient housing schemes being undertaken by the Accent Housing Group.

Description of Research Undertaken

Householders, from each of the four occupied properties⁵, were interviewed in March 2007. In all cases the initial face to face interviews were supplemented with a follow up telephone call to clarify some of the responses given during the interview. To address the goals of the Accent Group in developing energy efficient properties, the Company Director responsible for instigating the project and members of the Bradford Accent Housing Association, that manage the properties, were also interviewed. Finally members of Bradford City Council involved in the planning process for the project were interviewed to explore how the application of local and national planning regulations shapes energy efficient housing projects. This work has been conducted as part of an ongoing socio-technical investigation of the Accent Housing pilot project. Other scheduled research includes:

- Remote monitoring of energy and water consumption over two years.
- The monitoring of internal temperatures and humidity over two years.
- Further interviews to explore occupant behaviour informed by the energy and temperature monitoring data.

³ This allows the performance of the solar heating system to be compared with the more conventional heating systems.

⁴ See Ward (2007) for a detailed analysis of lighting, air-flow, sap energy rating, heat loads, domestic water and embodied/life-cycle energy of the accent properties.

⁵ One of the unoccupied properties is currently the 'show home' and the other is being used as a control for the energy and systems monitoring being conducted by Sheffield University.

Interviewees

Project participants'

Interview 1: A single mother living in house A

Interview 2: A married mother living in house B

Interview 3: The couple living in flat A

Interview 4: The female member of the couple living in flat B

(See household details in the next section)

Accent Housing Group

Interview 5: The Director Accent Housing Group

Interview 6: The Accent Bradford Housing Manager

Interview 7: The Accent Bradford Housing Project Manager

Bradford City council

Interview 8: A Senior Planning Officer in Bradford City Council

Findings

Who took part in the intervention?

Interview one – House A

One of the two houses is occupied by a single mother and her four children. The mother is between forty one and fifty years of age and not in employment outside of the home. The household income is less than ten thousand per annum and the highest level of education obtained by any member of the household is O' level/GCSE.

Interview two – House B

The second house is occupied by two married adults and their three children. The adult members of the household are between thirty one and forty years of age. The father is in fulltime employment and the mother is on dependency leave looking after her youngest daughter with serious health problems. The household income is between sixteen and twenty thousand pounds per annum. The highest level of education obtained by adult members of the household is O' level/GCSE.

Interview three – Flat A

One of the two flats is occupied by a married couple, the husband is fifty nine years of age and the wife is forty seven years old. Both members of the household are in fulltime employment. The household income is between twenty five and thirty thousand pounds per annum and highest level of education obtained by the members of the household is O' level/GCSE.

Interview Four – Flat B

The second flat is also occupied by a married couple they are between sixty and sixty five years of age and are retired. The household income is between ten and fifteen thousand pounds per annum, neither member of the household has formal educational qualifications.

Why did they take part?

The interviews revealed that a desire to be energy efficient, in its self, was not a motivating factor in residents' decision to move into the properties. The occupants were influenced by the idea that their energy bills could be reduced but, this was not a primary factor in their choice of residence. The area in which the properties are built, the design of the properties and the necessity of finding suitable accommodation were the main factors influencing the residents' decisions to rent homes in the development. This is clearly evident in the following quotes from residents' replies to the question why did you choose to live in this property?

"Well, what I was told about it. Because of the heaters and how it all works..... that was one of the reasons. But I just like the set up. I prefer that you get radiators and gas fires. I just prefer it how it's designed, but there were some personal reasons as well" [interview 1].

"I was told because it was energy efficient it filtered all the dust mites out [and] it keeps the heat in. I do have a child that's actually got a serious illness, as well as bad hay fever at times so that's one major reason.....That was one part and the other part of it was that being energy efficient then I would be saving a lot on heating [interview 2].

"A the area and B we liked it. The idea that bills could be a lot less certainly did influence us. Obviously, we don't want to be paying over the odds. But, it's fair to say that it was accessible for my wife's work and for me as well. But the energy part of it was secondary" [Interview 3].

"Well, simply because we lived in an area where we were robbed and we just wanted to get out and plus with my husband's ailment we wanted to move into a flat or something. We did have a house. It had nothing to do with energy efficiency. It was just we needed to get away from the area. [And] we just fell in love with it [the flat]. Virtually fell in love..... I [thought] this is gorgeous and ideal for us. You know? Especially for us pensioners you know? And we're not going to get any younger and I thought it was ideal for us both" [Interview 4].

Was taking part a positive experience?

The residents are pleased with many aspects of the design of the properties. In particular residents are pleased with following:

- *The overall style and layout of the properties*- residents described the layout of the properties as "homely" [interview 1], "really nice" [interview 2] "brilliant" [interview 3] and "cosy" [interview 4]. Those living in the houses are particularly impressed by the size of the bedrooms and the provision of two bathrooms. The utility space provided in the bathrooms of the properties is also popular with respondents.
- *The high levels of thermal insulation*- residents are very pleased with the heat retention and sound proofing provided by the thermal insulation built into the properties. For example, the residents of flat B said that the thermal insulation in their property is "absolutely superb" and they were both "delighted and surprised" that they hear very little noise from their neighbour's children [interview 4].
- *The window design* – residents made the following comments about the high levels of natural light provided by the innovative window design, "I like the light in here it is much less dark than my last place" [interview 1] "its bright and light" [interview 2] "its lovely in the day time with so much light coming in" [interview 3] "the big windows are a good thing for letting the light in" [interview 4].

However there were some negative feelings associated with the design of the properties. Residents experienced problems with the following issues:

- *Kitchen layout and design* - All of the residents comment that they can not fit a fridge freezer in their kitchen areas and that in their opinion a fridge freezer is necessary to modern living. This sentiment was most clearly indicated by the female resident of flat b when talking about her kitchen she complained “there’s no space for a fridge freezer.... But to me 90% of people have a fridge freezer” [Interview 4].
- *Condensation* – The utility spaces provided for washing and drying clothes in the flats and houses are designed for use with condensing tumble dryers⁶. None of the residents uses a condensing tumble dryer quoting cost as their reason for not doing so. This has led to problems with condensation from vented tumble dryers⁷ as there is nowhere to vent the steam they produce.
- *Using heating and hot water systems*- all of the residents are confused by the energy efficient services installed in their home and stated that they have no idea how to use their heating and hot water systems because they have not been supplied with instructions on how to do so. Two residents also complained that their central heating malfunctioned which led to them using electric standalone heaters in their homes on numerous occasions.
- *Electric lighting and energy efficient sockets*- The residents are also confused about the types of lighting in their home, what kinds of replacement bulbs to use and where to find appliances with energy efficient plugs to fit the energy efficient sockets installed in their homes. Also residents reported that both internal and external light bulbs had to be replaced frequently; this indicates a technical fault, as on the whole, energy efficient light bulbs have a much longer life span than traditional incandescent light bulbs.
- *Noise from washing machines [flats]* -The residents of the flats have problems with both noise and vibration from their washing machines when in use.

Residents also made some negative comments made about the management of the properties.

- *Delays in fixing faults with the properties* – Most of the negative comments regarding the management of the properties concerned the length of time it took to fix faults with the properties. These faults included security system displays in Spanish, faults with internal and external lighting systems, external doors which did not function properly, TV aerials which could not be connected, badly fitted kitchens and in two cases faulty heating systems. While the technical problems with heating systems were rectified in a matter of weeks other problems were not resolved for months.

The delays in fixing faults with the properties were caused by problems with the building contractors which were exacerbated by the internal politics of the Accent Housing Group. The regional management of the Accent Group failed to engage the local management [Bradford Accent housing Association] in the development of the project at the outset. One local manager commented “[t]hey were well on with the

6 A condenser tumble dryer is different from a vented tumble dryer (see footnote 5) the steam from the machine is condensed into water and transferred to a container which then can be removed and emptied.

7 Vented tumble dryers work by expelling the hot, damp air from the wash through a hose that can be fixed to a permanent vent in an outside wall or hung out of a window during operation.

construction before we were involved and we didn't get any input into the layout, or the mix of the units." As the local management were not engaged with the goals of the project, when problems arose with the properties, after completion, local management did not want to deal with these issues, feeling that it was the role of regional management to do so. However, the regional management also failed to take responsibility. This impasse led one manager to comment "[w]e've also had some internal communications problems between the local team and the regional level. Neither side has been that great at accepting responsibility."

Would/ do participants advise others to take part in similar schemes?

The residents of the flats are not sure if they would be able to advise others to rent similar homes, when questioned on this issue they gave the following replies:

"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" [Interview 4]

"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" [interview 3].

However, the residents of the houses are much happier with their properties, when asked if they would advise others to rent similar homes they stated the following:

"Yes..... the way they are designed really and the space and all that. If I had a chance I would buy. The houses I've lived in the past have not been up to this standard. The space and it's in Bradford" [Interview 1].

"Yes, I would, the way they are designed, how it's eco-friendly. It's a nice house and its eco-friendly, Yes, I would. If it was down to me I'd recommend purchasing. I don't know any houses in Bradford that are up to this standard" [Interview 2].

Can the intervention be reshaped to improve the experience for participants?

Many of the problems encountered by the residents could be avoided. This information is very relevant to the next round of energy efficient building to be undertaken by the Accent Group.

Solutions to problems

Kitchen layout and design – The main problem with kitchen layout and design is that residents can not fit a fridge freezer into their kitchens. The simple solution is to remove part of the counter top in the kitchen design leaving room for a fridge freezer.

Condensation – The problems encountered with condensation are the result of residents not being able to afford a condensing tumble dryer. There are three possible solutions:

- provide residents with condensing tumble dryers,
- integrate a venting tumble dryer into the heat exchange system,
- re-design the kitchen space to make room for a venting tumble dryer which can be vented through the window,
- re- design the utility space providing a permanent vent to an outside wall to which a venting tumble dryer can be fixed.

Using heating and hot water systems- The provision of instructions, in an easily digestible form, for heating and hot water systems may avoid many of the problems encountered by residents with thermal comfort and the use of heating systems. However, it is also important to consider that the technologies used in homes must conform to prevailing social practices if they are to satisfy the needs of users. Automated systems such as those installed in the Accent properties, if used as they are designed, take control of the temperature in homes away from the user, who can no longer switch the heating system on to achieve a short term boosts in temperature, as is common practice in the UK (Baker and Crosbie 2007).

Electric lighting and energy efficient plug sockets- The solution to the problems encountered with electric lighting and the use of energy efficient sockets may be as simple as providing the necessary information in an easily digestible form. However, the problems encountered with the electric lighting in the properties may also point to a technical fault in the system.

Noise from washing machines - The residents of the flats have problems with both noise and vibration from their washing machines when in use. This problem could be reduced, or even solved, by the provision of sound proof matting to be placed beneath the washing machine.

Delays in fixing faults with the properties – Had the local management of the Accent Housing Group been engaged with the Accent Housing project from the outset many of the problems encountered with the building contractors, and the resulting delays in fixing the faults with the properties, may have been avoided. To avoid these types of difficulties, it is essential that all levels of management are engaged in a development at the earliest stage possible and that each layer of management has clear goals and responsibilities.

EST Hot Water Study: Informing domestic energy models and building regulations

EST: Description of Intervention

This intervention is a study of domestic hot water use currently being carried out by the Building Services Research and Information Association (BISRA) on the behalf of the Energy Saving Trust. It involves monitoring the hot water supplied from the storage tank to determine the total usage of hot water and the way this varies in time in 120 homes over one year. The quarterly electricity and gas usage are being recorded by the BISRA project team, with monthly readings provided by the householder. In a sub-set of 24 homes, the end use of the water (bath, hand basin, washing machine, etc) is being monitored.

The information from the EST study will be used to inform the BRE Domestic Energy Model (BREDEM). This model is a major component of the Building Research Establishment Housing Model for Energy (BREHOMES), which has a wide range of applications including advising the Department of the Environment's building regulations division (Natarajan and Levermore 2007, Shorrock and Dunster 1997)

Participation in these types of studies is one of the few ways in which the general public participate in the development of new regulations related to buildings and household services. It is hoped that the findings of the research presented here can be used to improve the reliability of data collection and levels of participation in studies of this kind.

Description of Research Undertaken

Face to face in-depth interviews were conducted with people living in eleven of the households taking part in the EST hot water study during March and April of this year. In two cases two adult members of the household were interviewed together and in all other cases one adult member of the household took part in the interview. None the interviewees' houses are being used in the in-depth monitoring stage of the research. All of the interviews lasted between forty minutes and an hour.

Findings

Who took part?

The intervention

There is no data available concerning the income, educational achievement or age of those living in the households taking part in the EST study. However, the number of adults and children living in the households taking part in the study, the type of housing they occupy and the employment status of adult household members was recorded by BISRA.

In total, one-hundred and twenty households are taking part in the EST study. Each household has between one and six members. Thirteen of the households are single person households, forty eight consist of two adults and in twenty two there are three or more adults. There are children living in forty two of the households none of which have more than three child members. One household consists of an adult and one child, but in all other cases the households with children have two adult members. In ninety-nine households there is at least one adult in employment, in twenty households the members of the household are retired and in one case the householders are unemployed. In all of the households with children at least one adult member is employed.

In the interviews

Nine men and four women took part in the interviews, in two cases couples were interviewed together therefore a total of eleven interviews were conducted. Only three of those interviewed are under fifty years of age, these relatively youthful interviewees are in their thirties. Over half of those interviewed are over the age of sixty. None of the interviewees lives alone. Four of the interviewees have children under the age of ten living in their household, and in two cases interviewees have adult children living with them.

The household income of the interviewees varies widely; three interviewees have a household income of less than £15,000 per annum and three have a household income of over £61,000 per annum. Of the other five interviewees three have an annual household income between £21,000 and £30,000 and two have an annual household income between £41,000 and £50, 000.

The educational background of interviewees also varies widely. In over half of the households that took part in the interviews at least one household member has a bachelor's degree and in four of these at least one member of the household also has a postgraduate degree or equivalent qualification. However, in the case of three of the interviewees the highest level of education achieved by members of their household is O' level or equivalent and in the case of one interviewee none of the members of their household have any formal educational qualifications.

All the interviewees live in owner occupied houses, five of which are semi-detached, four are terraced and two are detached.

Full details of the socio-economic background of the individual interviewees are listed in the appendices.

Why did they take part?

Most of the interviewees were at least partially motivated to take part in the EST hot water study by financial concerns. Only three interviewees [3, 7 and 11] explicitly stated that they took part in the study because of a concern for the environment. It is interesting to note that two of the interviewees expressing strong environmental concerns have children under the age of ten and the other has adult children living at home. However, one of the interviewees [1] with small children said that the financial incentive offered to take part in the study was their only reason for doing so. The fourth interviewee with small children [interviewee 8] said that they were motivated to take part in the study by both the financial incentive offered and their concern for environmental issues.

Interviewee 4 said that they would not have taken part in the study if they did not benefit directly and interviewee 6 said that they were motivated to take part in the study by both the financial incentive and a desire to reduce their energy costs. This is unsurprising, as these interviewees have household incomes of less than £15,000 per annum. The other interviewee [9] with an income of less than £15,000 stated that they were motivated to take part in the study by the financial incentive to do so, a desire reduce their energy costs and a desire to reduce their environmental impact.

On the whole, the three interviewees living in households with incomes over £61,000 had different motivations for taking part in the study to those on low incomes. One expressed a professional interest in the research findings [interviewee 5], one said they volunteered for the study as a favour to a friend but, also stated that environmental issues played a part in their decision [interviewee10] and one [Interview 11] said a concern for the environment was their main motivation for taking part in the study. However, it was not only those on very low incomes that were motivated to take part in the study by the possibility of financial gain. Interviewee 2 lives in a two person household with an annual income of between £41,000 and £50,000 and stated that he was motivated to take part in the study because he wants to reduce his energy costs.

Was taking part a positive experience?

Half of those interviewed found their participation in the study to be a wholly positive experience. However, six participants raised issues about the way in which the study is being carried out. Administrative, installation and operational problems were encountered by these participants.

In the case one interviewee [11] the payment for taking part in the study was cancelled. This issue was resolved quickly and the participant did not believe that it reflected poorly on the study. Another Interviewee [2] experienced problems with the administration of the project and the installation of the monitoring equipment. This interviewee felt that the information they were given concerning the study was misleading, it took two months for the hot water monitor to be installed and they had to take a days leave from work to have it fitted. The latter problem arose because, this interviewee and his wife work fulltime, and it was not possible to have the monitor installed during the weekend.

In this case of interviewee five the system did not monitor hot water usage correctly when first installed. This problem was identified because the research participant worked in the field and was able to identify the faults with the system. This interviewee felt that "the engineering that went into the system could have been better because it took it couple of goes to get the system working" [Interview 5].

Interviewee 1 experienced both installation and operational problems. During the installation of the monitoring equipment, their property was damaged. More importantly from a methodological perspective this participant found that the installation of the water monitor reduced water pressure, leading to changes in how they used hot water, as illustrated in the following quote: "I think they shut off a value they [the technicians that installed water monitoring equipment] should not have done.... It reduced the water pressure. We had to start running the kid's bath longer and it took longer to fill the sink" [Interview 1].

Interviewee 2 also found that the monitoring equipment changed the water pressure in their home as illustrated in the following quote: “recently the power of the shower has dropped. I must admit that I didn’t notice it at first but using appliances at hotels and guest houses, or something, and you come back and you think there might have been a bit of a drop off” [Interviewee 2].

Another operational problem encountered by research participants concerned the recording of their monthly meter readings. Interviewees 8, 10, and 11 stated that they found it difficult to remember to record their energy meter readings. In the case of interviewee 8 after 10 months of participation in the study they had only taken two meter readings. In the case of the other interviewees the information collected on energy consumption may also be problematic, as many said did not always remember to take the meter readings on the first day of the month, as requested.

The administrative problems encountered by participants in the study did not reflect badly on the study, because they were resolved efficiently. The problems experienced with installation of hot water monitors are more serious and negatively impacted upon participants perceptions of the study. This is because these problems give the impression that unprofessional contractors and poor quality equipment are used in the study. However, the most serious problems are those of an operational nature, as they have the potential to invalidate the findings of the study. If the monitoring equipment used and/or the way it is installed is changing the water pressure in some of the households under examination this will lead to changes in hot water use behaviour. Therefore the findings of the study will not reflect normal hot water consumption habits.

The second operational problem, identified by this research, also has consequences for the findings of the study. If the energy meter readings are not correctly recorded, then it will not be possible to assess the contribution of the energy used by participants’ hot water consumption to their overall energy consumption. This problem may be mitigated by the quarterly meter readings also being recorded by BISRA as part of the study.

Would/ do participants advise others to take part in similar schemes?

All but one of the participants’, in this study, feels it is a worthwhile exercise and would recommend taking part in similar studies to others. These participants feel that this type of study is worthwhile because findings can be used to reduce consumption, which will have a positive effect on the environment and/ or reduce consumers’ energy bills. The following quotes are typical of the responses given to the question of whether respondents felt that the study was worthwhile:

“Yes reducing carbon footprints are the main thing at the moment” [Interview 3].

“Yeah, cheaper energy, if houses are constructed properly, because all of that will come into it” [Interview 6].

Two participants said they would recommend the study to others because the purpose of the study could be better served by expanding the participation. Interviewee 3 suggests that increasing the level of participation in the study may generate new ideas concerning how to save energy, while Interviewee 6 believes that increasing the number of people involved would help to make people more aware of energy use.

As mentioned earlier only one participant said they would not recommend the scheme. This participant, when asked if they would recommend the scheme, said: “No. The meter has not been working properly has it? And they have not been getting the results they wanted... we’ve had problems with our heating, hot water as well which we didn’t have before the meter was put in [and] we had to resolve them ourselves” [Interview 1]. However the other participant that encountered problems with water pressure in their home, as a result of the hot water monitoring equipment, did not agree with interviewee 1. When asked if he would recommend similar studies to others he said “yes. I’ve found it no great work. Not obtrusive [Interview 2].

Can the intervention be reshaped to improve the experience for participants?

Many of the problems encountered by the participants in the EST hot water study could be avoided. This information is very relevant to researchers undertaking energy and water monitoring studies.

Solutions to problems

Administrative issues – While most of those interviewed felt that the EST hot water study is well run in terms of its administration the problems encountered by some research participants indicate that improvements could be made. These include:

- Providing all research participants with clear and concise written information outlining the goals and requirements of the study.
- Setting a reasonable timeframe within which those volunteering to take part in the study are contacted to arrange the installation of monitoring equipment.
- Collecting the information necessary to the fitting of monitoring equipment in each particular household when the appointment is made to fit the monitoring equipment.

Installation issues - Most those interviewed did not encounter problems with the installation of the monitoring equipment, however there are lessons that can be learnt from those that did, these include:

- Installing monitoring equipment at a time convenient to participants [including weekends].
- Ensuring that technicians are fully trained and have the information necessary for each particular property in which they are fitting monitoring equipment.

Operational issues – There were two problems encountered with the operation of the data collection phase of the EST study both of which could have serious consequences for the validity of the data collected.

Two interviewees found that the hot water monitoring equipment changed the water pressure in their homes, which may lead to changes in the way they use hot water.

- Problems with water pressure could be resolved in the case of future studies if contractors determine the water pressure prior to fitting the monitors and test it after installation. This would allow any changes to be addressed.
- To validate the findings of the current study it will be necessary to ask research participants if the water pressure in their household was changed by the monitoring equipment and exclude the data from any households that did have a change in water pressure from the analysis phase of the study.

Reliance upon the participants to take gas and electricity meter readings unprompted has introduced errors regarding accuracy of measurement. Several alternative solutions to this problem present themselves:

- Participants could be reminded via phone or email to take readings.
- Local contractors could be used to take the readings.
- The use of 'smart meters' that automatically communicate the meter readings.

Chess Grant Scheme (SRB6): Funding to improve insulation and heating

Chess Grant Scheme: Description of Intervention

The case study presented in this section concerns a household energy efficiency intervention run by Leicester City Council, (LCC), which offers 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 seventy five percent of the total cost of the efficiency improvements made and are not conditional upon age or income. The package of technical interventions used in each home, includes; loft and cavity wall insulation, a condensing boiler, radiators, thermostatic controls, and compact fluorescent light-bulbs (CFLs). The combination of technical interventions used in each home is depended upon the condition of the current boiler, insulation, and thermostatic controls etc.

The projects catchment areas are the Gypsy Lane and Humerstone Lane areas of the city, north of the city centre. The scheme is funded by the UK government through the single regeneration budget (SRB) round 6. LCC is monitoring this project, to assess the impact of technical interventions on energy use and associated carbon reductions. This assessment is being conducted as part of the Econ' homes scheme funded by the EU which has nine European partners.

Description of Research Undertaken

Nine interviews were conducted with participants in the energy efficiency scheme and four interviews were conducted with householders living in the projects catchment area that had not applied for the scheme. In two cases two adult members of the household were interviewed together and in all other cases one adult member of the household took part in the interview. All of the interviews were conducted face to face. The interviews with the participants' in the scheme lasted between forty minutes and an hour, while the interviews conducted with non-participants were shorter lasting about ten to fifteen minutes. This work has been conducted as part of the ongoing investigation of the Chess Grant Scheme (SRB6) energy efficiency intervention. Other research conducted includes:

- A whole house energy survey recording the house geometry and the construction and heating systems, enabling a National Home Energy Rating (NHER) (and the SAP value), to be obtained for each of each of the properties
- Weekly electricity and gas usage collected by LCC staff.
- The measurement of internal temperatures by CaRB researchers over a period of six months.
- A survey of the appliance ownership and use, of those taking part in the scheme, by CaRB researchers

Findings

Who took part?

In the intervention

In total, sixty-two individual households took part in the Chess Grant scheme. While LCC have collected some background information about those living in the households taking part in the scheme, via a questionnaire, it would seem that many participants failed to return questionnaires and the data for fifteen households is missing. Further socio-demographic data was also collected by CaRB researchers, via a postal questionnaire, however this data is currently under analysis and unavailable for this report, and as the response rate obtained by this questionnaire is fifty percent it will also leave us with out basic socio demographic information for fifty percent of the participants in the scheme.

In the forty seven households for which data is available the number of occupants in each household varies between one and seven. However, the data available to date does not enable us to establish a breakdown between adults and children. Although some data exists regarding the annual income of each household, the data must be regarded as suspect because the categories used in the collection of this data were blurred into each other. For example, a category was established of £10,000 – £20,000 but the following category was listed at £20,000 - £30,000 as such an individual earning £20,000 per year cannot be accurately placed. Due to this twenty-six cases must be classified as unknown. However, the data for those with household incomes of more than £30,000 and less than £10,000 is clear. In six cases the annual household income is greater than £30,000 a year, in fifteen cases the annual household income is less than £10,000 and in a further fifteen cases no data is available.

At this time, no information is available on the ages of the participants or the employment status of participants.

In the interviews

The scheme is only open to people that own their own properties. Therefore all those that took part in the interviews are home owners.

Of the eleven interviewees [six women and five men] that took part in the scheme, eight are over sixty years old and three are aged between forty one and fifty years of age. Of these eleven interviewees one is a single parent living with her two adult children, two have two children under the age of sixteen and one lives alone. Four of these interviewees live in households in which the main wage earner is retired and five live in households where at least one of the adults are in full time employment. None of these interviewees have high incomes, three have household incomes of less than £20,000 per annum, and none have a household income over £40,000 per annum.

Two men and two women living in the SRB6 catchment area that had not made an application for a grant under scheme were also interviewed. Two of these interviewees are between twenty one and thirty years old, one is aged between thirty one and forty, and one is aged between forty one and fifty. One of these interviewees lives alone, the other three live in households which comprise of two adults, and all four households at least one person in fulltime employment. Three have household incomes of between £21,000 and £30,000 per annum and one has a household income of between £31,000 and £40,000 per annum.

Full details of the socio-economic background of the individual interviewees are listed in the appendices.

Why did they take part?

A desire to improve the energy efficiency of homes played a very minor role in motivating interviewees to take part in the scheme; all of the schemes participants we interviewed indicated that their main reason for applying for the scheme was to save money. In all but one case, this desire to save money was primarily related to the cost of replacing heating and hot systems, rather than reducing the cost of energy bills. Only two interviewees [3 and 7] commented that they hoped to reduce their energy bills as a result of the improvements they had made to their homes and most said that had not thought about improving the thermal insulation of their homes prior to taking part in the scheme.

Of those interviewees that took part in the energy efficiency scheme seven explicitly stated that they were motivated to do so by financial reasons related to the cost of replacing heating and hot water systems. This is clearly indicated by the following quotes which are representative of respondents' replies when questioned about why they decided take part in the scheme.

"We were after a new boiler you see, so we thought we might as well try, so we thought we will try, because boilers are so expensive you need help" [interview 2].

"My boiler was really old and it needed replacing and they are quite expensive that's what made me mind up really" [interview 3].

"Err personally money..... I wanted to be rid of the back boiler, that was the main issue for me.....to buy a nice fire to go with the back boiler was about 3000 pounds anyway [Interview 6].

However, two of the interviewees did not explicitly state they took part in the scheme due to the cost of replacing their heating and hot water systems. One of these [interviewee 1] said that she knew her boiler needed replacing and technicians sent to assess her requirements under the scheme found her boiler to be dangerous. This respondent has an income of less than £10,000 per annum and she indicated that a new heating system would have been beyond her means without the financial aid made available by the scheme. One respondent defiantly did not take part in the scheme due to a desire to reduce the cost of replacing their heating and hot water system, as they had replaced their heating system prior to applying for the scheme. However, this respondent also took part in the scheme primarily for financial reasons. When asked if the scheme was worthwhile they replied "yes it saved us money".

Was taking part a positive experience?

On the whole, the participants in the intervention, we interviewed, were very happy with the administration of the scheme. When asked if they felt the scheme was well organised comments such as "absolutely" [interview8] and "we can't fault them in any way" [interview 5] were the norm. Although some of the interviewees [1, 4, 6 and 8] had problems with the contractors engaged by the schemes administration. One was given contradictory information by the contractors assessing the condition of their current heating system, one had problems with the contractors installing their loft insulation and two found that the thermostats installed by the contractors malfunctioned. However, these issues did not reflect badly on the scheme because they were resolved effectively and efficiently by the administration team.

The only strongly negative comments made by respondents in relation to the administration of the scheme concern the way in which it is advertised. Primarily it was promoted by leafleting the areas in which residents were eligible for financial aid and by placing notices in the local free newspapers. However, this form of advertising seemed to have had little impact, as six of the nine interviewees that took part in the scheme did so because it was recommended by friends and family. These six respondents could not remember receiving the leaflets or had read them and felt that that the scheme sounded “too good to be true” [interview 8] and therefore must be an attempt to defraud them in some way.

For example, one of these interviewees commented, “[t]he strange thing about it, is that everyone around here was sent a leaflet and I reckon about 90 odd percent went in the bin. No one read it. I think you get too much rubbish in the post promising something for nothing. Too good to be true, that’s what they probably thought” [interview 8]. Another interviewee when asked if anything could be done to improve the scheme replied “make it more advertised so more people get to know about it.....My neighbour didn’t know about it. Although I never thought to tell her about it because I thought she would have got a leaflet but, maybe she thought what’s that, it is not going to apply to me” [interview 3].

Of the four interviewees that had not taken part in the scheme, two could not remember receiving the leaflets and two stated they had read the leaflet but had thought it was fraudulent, or that it wouldn’t apply to them because they were not in receipt of benefits. One of these interviewees was unhappy because they had recently borrowed money to replace their boiler. When questioned about the scheme they said “I remember reading the leaflet, I thought what a load of crap, and at the time I thought who is going to give me seventy five percent of the money for stuff like that; it is not as if we are on benefits or anything. I wish now I had taken it more seriously”. This was not an isolated case. Interviewee 7 had received a grant under the scheme for insulation but, had installed a new heating system two months prior to applying for the scheme. This interviewee had read the leaflet, but thought that he would not be eligible because he was not in receipt of state benefits. This interviewee did not take the scheme seriously until his brother mentioned to him.

The interviewees that participated in the scheme are not merely please with the administration of the scheme, they are also more than happy with all of the major energy efficiency measures taken in their homes. Comments such as “it was a professional job” and “I can’t complain about anything” were the norm. Although one respondent [interview 1] did say that initially she was “disappointed” because she had what she described as “set backs”. This elderly lady was one of the participants in the scheme that had problems with the thermostat controls on her heating system and she found the installation of her new heating system stressful.

The only energy efficiency measure participants are generally dissatisfied with is the energy efficient CFL light bulbs supplied to those taking part in the scheme. All of them commented that they either did not use the CFL energy efficient light bulbs they were supplied with at all, or that they would only use them in particular rooms and/or light fittings. The reasons they gave for this are that they found the light bulbs to be unattractively large, not bright enough and they can not be used with dimmer switches. The following quotes are typical of the comments made by respondents when questioned about the use of energy efficient light bulbs.

“They gave me some my love but, I can’t use them on dimmer switches, so it is just table lamps I use them in” [Interview 1].

I have only got them 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 [interview 3].

"Where we can we do use them, we don't use them in here [the living room], because they are a bit bulky" [interview 4].

"The reason we haven't got them in here [the living room] is because they are too long, if they made them a bit smaller then we would have them in here as well" [interview5]

"I have not used them because they are ugly. They are really really ugly. I thought about putting them in the hallway, which is the light if you go out you leave on" [interview 6].

"Err we would like some smaller ones, I don't know if you can get energy efficient light bulbs for them [halogen insets] [interview 7].

Would/ do participants advise others to take part in similar schemes?

Four of the nine interviewees, that took part in the scheme, said that they had advised friends and/or relatives living in the local area to apply for grants under the scheme and the other five said that they would recommend taking part in similar schemes. On the whole, these attitudes were influenced by personal gains, rather than the idea that interventions of this type contribute towards reducing energy consumption, as a means of improving the environment. For example, interviewee 2 said that "we are right pleased we took part in the scheme, we would advise anyone to have a go" and then went on to say that the best thing about taking part in the scheme is that "our house is warmer". Four other interviewees also said that their house is warmer since they had the new insulation and/ or heating systems fitted in their home, and would advise other people that schemes of this type were a good idea on these grounds. Other interviewees [4 and 5] said that they are pleased with the thermostats fitted to their radiators, because it allows them to vary the temperature of the radiators in different rooms. Three interviewees also expressed the opinion that they are pleased they took part in the scheme because they would not have been able to afford the improvements made to their home if they had not done so [1, 5 and 8], and "why shouldn't others also benefit" from similar schemes.

Two interviewees did express opinions which indicated that they felt the scheme might help participants to reduce their energy consumption and this might contribute to improving the environment. However these opinions were tentatively expressed.

"I suppose it gives people the chance to make the home more efficient they probably want to, but its' having the funds available"[interview 3]

"Saving money and the energy thing, the ozone layer and all that, is a problem not for us but, what children what are our children and their children going to have to live through" [interview 6].

Can the intervention be reshaped to improve the experience for participants?

There are some lessons relevant to future energy efficient interventions designed to improve the efficiency of homes that can be learnt from the experiences of the research participants discussed in this chapter.

Solutions to problems

Promoting the intervention - Both the high level of incentives offered to home owners to improve the energy efficiency of their home, and the way the scheme was promoted contributed to people's initial disbelief in the legitimacy of the scheme. There are a number of ways in which this problem might be mitigated:

- Formal letters from the council personally addressed to householders eligible for any given scheme may be more believable than leaflets.
- The incentives offered by the scheme could be reduced allowing more people to benefit from the scheme, as well as reducing the notion that the scheme is fraudulent.
- Schemes could be promoted at events run by local community groups lending them the legitimacy of the organisations involved.

Employing Contractors- the importance of the careful vetting of the companies employed to undertake work, is highlighted by the problems encountered by some of the interviewees with the companies contracted to carry out work in their homes. The fact that these problems did not reflect badly on the scheme, also illustrate the effectiveness of efficient administration in promoting positive impressions of energy efficiency interventions.

The non-use of energy efficient light bulbs- participants dissatisfaction with energy efficient light bulbs maybe improved by offering a selection of CFL bulbs, as there is a wide range of energy efficient CFL bulbs available, which are designed for use in many different sizes of light fitting. However, this may not be the whole solution for a number of reasons. Firstly CFL bulbs can not be used with dimmer switches. Secondly, even CFL bulbs which are chosen to fit householders current light fittings may still be perceived as ugly by householders, as CFL bulbs are a different shape and give a different quality of light to traditional incandescent light bulbs. Recent research exploring energy consumption and household lighting has indicated that use of lighting relates as much to establishing a mood as clarity of vision, a desire to have stylish interiors can override environmental principles, and lighting choices made by householders tend to co-evolve with the household lighting portrayed by the media (Crosbie and Guy 2007). This work suggests that the uptake of energy efficient lighting is unlikely to improve unless more effort is put into the design and marketing of dedicated energy efficient light fittings, which are stylish and therefore desirable (Crosbie and Guy 2007).

Milton Keynes Energy Park: Energy Efficient private housing

Milton Keynes Energy Park: Description of Intervention

In 1980 the Milton Keynes Development Corporation began to specify high energy efficiency standards in its buildings, both domestic and non-domestic. Setting these targets was possible through the planning and land ownership powers vested first in the Development Corporation, and now in English Partnerships through the New Towns (Sustainable Procurement Task Force, 2007). In the domestic sector, the work of the Milton Keynes Development Corporation brought about the development of the Milton Keynes Energy Park (MKEP), which was established in 1986 for the residential development of low energy homes.

MKEP is situated in a low density town located North-West of London. The majority of the dwellings built in the initial phases of the MKEP essentially follow conventional housing design for the UK, but they were built to higher standards than required by the building regulations at that time (Edwards, 1990). They incorporated energy efficiency features, such as increased floor and wall insulation, frequent use of double glazing, and condensing boilers, so that they corresponded to SAP ratings of 75-90 (Edwards, 1990). Some dwellings contained novel or experimental systems, such as gas-air central heating or heat recovery ventilation systems (Summerfield et. al. 2006).

Description of Research Undertaken

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 have been 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. A sample of twenty-nine dwellings also supplied hourly monitored temperatures in three rooms, and a social and behavioural survey of the occupants was also conducted (Edwards, 1990). People currently living in eighteen of the twenty nine houses that were part of the Edwards study were recruited for follow up research by the CaRB team in 2005.

From the 2005 sample of eighteen homes, the residents of seven were interviewed as part of the research presented in this report. Four of the interviews were conducted face-to-face and three were conducted over the telephone. In three cases couples were interviewed together. The interviews lasted between 45 minutes and 1 hour. This work has been conducted as part of an ongoing socio-technical investigation of the homes in the Milton Keynes Energy Park. Other scheduled research includes:

- ongoing energy, temperature and relative humidity monitoring
- and a detailed survey of energy use.

Findings

Who took part?

The intervention

CaRB researchers collected socio-demographic information about the people recruited to take part in the 2005 study however the focus of this research was on buildings rather than occupants. As such, the socio-demographic information is incomplete and we have no data about the education status of research participants.

Thirty nine adults and eight children live in the eighteen houses that make up the 2005 sample. In two cases those living these houses live alone, in ten cases they are occupied by couples and in six cases they are occupied by couples with children. At the time the research was conducted four of the children were aged five years or less, one child was between six and ten, two were between eleven and fifteen years old and one was seventeen years. Of the adult members of the households ten were aged thirty or under, eleven were between thirty-one and forty years old, five were between forty-one and fifty years old, nine were between fifty-one and sixty, two are over the age of sixty-five and two did not provide their ages.

At least one adult is employed in sixteen of the households and in two of the households the residents are retired. Seventeen of the households live in owner occupied properties and one lives in rented accommodation. Five of those taking part in the study have an annual household income of £30,000 or less, one of these has a household income of less than £10,000 per annum. Four participants have a household income of between £31,000 and £40,000 per annum. Five have annual household incomes of between £51,000 and £60,000. Of the remaining four participants all but one, for which there is no data available, have annual household incomes in excess of £60,000 and, two of these have incomes in excess of £91,000 per annum.

In the interviews

Of the ten people that took part in the interviews four are male and seven are female. In three cases married couples were interviewed together. Six of the interviewees are in their forties, two are in their fifties and two are over sixty years old. Eight of the ten interviewees are married, one interviewee lives alone and one is widowed. Two of the households have children under the age of seventeen. Five of the interviewees work full time and one works part time. Of the remaining three interviewees two are retired and one looks after her two young children on a full time basis. One of the interviewees has an annual household income of less than £15,000. However, all of the other interviewees have relatively high incomes. Two have yearly household incomes of more than £61,000, two have household incomes of between £51,000 and £60,000 per annum year and five have a household income of between £41,000 and £50,000 per annum. There is a wide variation in the education of the interviewees. Six have degree level qualifications, while two are educated to O' level/GCSE standard and one interviewee left school with no formal qualifications.

When the interviews were carried out, the respondents had lived in their homes for between three and half years and eighteen years. Four of the interviewees had lived in their homes for more than seven years, one had lived in their home for eleven years, and the remaining interviewees had lived in their homes for seven and three quarters and three and half years respectively.

Full details of the socio-economic background of the individual interviewees are listed in the appendices.

Why did they take part?

Energy efficiency was not the primary reason behind the research participants' decision to live in the MKEP. Although many of the participants mentioned energy efficiency when discussing their choice of residence, it was considered less important than other factors, such as the location, price and aesthetics. Some of the interview participants said that their choice of residence had been affected by the need to move house quickly.

The respondents from five households [3, 4, 5, 6 and 7] indicated that the location of their house was the main reason they had chosen it. The location of the MKEP was considered to be good because it enables residents to commute to work easily. The respondent from interview 6 not only drew attention to location, but also indicated that price and the availability of property were important factors in his decision to move into his current home. When asked why he decided to buy his current home he simply stated that "[i]t was in the right place, at right price, at the right time" [Interview 6]. The respondents from interview 4 also commented that the size of property and the price were significant factors in their decision to purchase a house in the MKEP.

The respondents from four of the interviews [1,2, 5 and 7] said that they choose to live in the MKEP because the properties are extremely attractive. These views were most clearly expressed by the couple from interview 1, as the male respondent put it "It was gut instinct. It wasn't that we wanted to live in an energy efficient house" [Interview 1]. His wife explained that this attraction was due to the overall aesthetics of the buildings – in particular the design of the gardens. "It was purely because I came in and looked at everything and the garden..... and I thought this will do" [Interview 1].

It would seem that the most significant factor effecting research participants' decision to live in the Milton Keynes Energy Park is the location, as they wished to live within easy travelling distance of their place of work. However, this does not refer to the choice of a specific property but rather the choice of *area*. The choice of a specific property appears to be motivated by the aesthetics of the property and the selling price.

Was taking part a positive experience?

The people we interviewed are pleased with many aspects of the design of their properties in the MKEP, which they believe make their home a more pleasant to live than the other properties available to them. In four cases this was attributed to the high levels of thermal comfort afforded by the energy efficient design of their homes, and in three cases it is attributed to the general layout and style of their properties. This positive attitude was maintained by interviewees despite the fact that all but one experienced some problems with their properties. These problems involve the overall build quality of the houses, a difficulty in altering the fabric of the houses and the rapid obsolescence of the heating and hot water systems.

Five respondents [1, 2, 4, 5, 6] drew particular attention to the ability of the houses to maintain a pleasant temperature throughout the year. They attributed this to the high

level of insulation in the homes which, as well as maintaining their thermal comfort also helped to lower their fuel bills. This is well expressed by one of the respondents who explained that "They 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 you don't get the same oppressive heat that you did in our previous house" [Interview 6]. The interview data also suggested that, while interviewees enjoyed lower heating costs they valued the fact that energy efficiently housing provides a more constant indoor temperature over and above any cost saving it afforded them. One of the men interviewed said that the experience of living in an energy efficient home had led to both himself and his wife becoming more aware of the lifestyle benefits the buildings could deliver and stated that "I think we have been a bit spoiled with a house like this... I would go for one like this every time" [Interview 1].

As mentioned earlier, all but one of the respondents identified problems with the overall build quality and the design of the properties. Respondents from interviews 3 and 5 drew attention to the fact that the windows had been badly installed. "We had the windows replaced because the old ones were drafty, the builders were dodgy" [Interview 3]. A second respondent also encountered problems with the construction of their home. "...the builders had messed up the central heating pipes in the kitchen and over a period of about ten years it's been leaking water into the concrete... The pipes were buried in the concrete floor..... I dug up the pipes and replaced them with polythene central heating pipes, so a continuous run so no joints to leak, put them in a channel and tiled over them for access" [Interview 7].

Respondents from interviews 3, 4 and 6 also drew attention to the relatively rapid obsolescence of the heating and hot water systems installed in their homes. These interviewees had all lived in their homes for more than seventeen years and commented that the original boilers began to deteriorate after some six or seven years. The male respondents from interviews 4 and 6 commented that it had been difficult to maintain the original boiler due to a shortage of parts "...it was becoming more and more difficult to get parts for [the boiler]" [Interview 6]. These problems had led both households to replace their boilers with more modern technology that could be easily maintained.

The respondent from interview 3 is the only resident in the interview sample that still has their original boiler. The boiler is part of a heating system which operates on warm air vents. This system is uncommon in the UK and is incompatible with the majority of domestic boilers. As the boiler is nearly twenty years old, it has deteriorated with age and is no longer operating at peak efficiency. However, the cost of replacing the boiler on a like for like basis is prohibitive. "Well, the boiler is nineteen, twenty years old for a start and you can't say that's energy efficient ...If we get some money we're thinking of having the boiler done. But to get a new boiler put in, I was quoted five grand. But to put in one of these low level gas boilers the cost was near £14,000" [Interview 3]. Although interviewee 3 has a relatively healthy household income of between forty-one and fifty-thousand pounds a year, the investment required is still a significant percentage of that income.

Would/ do participants advise others to take part in similar schemes?

All of the respondents said they would recommend houses similar to their own. In four cases this was because the buildings are able to maintain a higher level of thermal comfort than less energy efficient buildings. Two respondents said any recommendation would be due to the layout and size of the properties. While another interviewee commented that whilst they would recommend energy efficient homes they would do so because of the general principle rather, than their specific experience.

Can the intervention be reshaped to improve the experience for participants?

The experiences of the residents of the Milton Keynes Energy Parker raise several issues relevant to the design and construction of future energy efficient developments.

- Construction problems –Three of the residents interviewed encountered problems with the construction of their houses such as leaking pipes, drafty windows and a lack of ventilation.
- Obsolescence – The problems encountered by respondents in finding replacement parts for some of the heating systems installed in the properties indicating that highly specialized technology is likely to hasten its obsolescence.
- Location – The majority of the residents said that their choice of house was determined by its location. Most of these expressed a strong preference for houses that are near their place of work.
- Aesthetics – The appearance of the property is considered important by a majority of the residents. The garden is also an important contributor to the owner's satisfaction with the properties.
- Thermal comfort - The fact that the properties maintained a comfortable temperature all year round is seen as valuable by research participants.

These findings suggest that:

- It is important that well designed proven technologies are used within energy efficient buildings
- Developers of energy efficient buildings may be advised to install technologies that are less efficient but, more common and therefore more likely to have readily available replacement parts when in need of repair.
- Energy efficient housing developments should be situated close to major transport routes and/or close to major centres of employment.
- It is important in the case of energy efficient housing projects that the appearance of properties is not sacrificed for efficiency gains, reduced building costs, or reduced land costs.
- To promote energy efficient properties, designers and developers should focus less on economic factors and more upon the aesthetics of the buildings and their ability to create and maintain the thermal comfort.
- Energy efficient buildings should be promoted in terms of the benefits they can bring to people's standard of living.

Informing the development and implementation of Domestic energy efficiency interventions

Introduction

This chapter discusses how the findings from the case studies presented in the previous chapters can be used to inform the development of domestic energy efficiency interventions and related research. To do so, we return to the five questions addressed in the analysis of each of the case studies from a more general perspective.

- Who took part in the interventions?
- Why did they take part in the energy intervention?
- Was taking part in the intervention a positive experience?
- Would/ do participants advise others to take part in similar schemes?
- Can the interventions be reshaped to improve the experience for participants?

In the final section of this chapter we summarise the findings from the research presented and offer some general recommendations for improving future domestic energy efficiency interventions and related research.

Who took part in the interventions?

Two hundred and four households took part in the energy efficiency interventions discussed in this report. Discounting participants in the interview research, disparate, and in some cases very little, information was gathered about the people who make up these households. Extensive data was collected in the case of all of the interventions; but in most cases more emphasis was given to the collection of technical data, about buildings, than was given to the collection of data about the people who live in those buildings.

In the case of the EST hot water study information was collected, by the administrators, about the numbers of adults and children in each household and the employment status of the main wage earner, but no information was collected about the income, educational status or gender of those taking part. As might be expected, in an intervention of this type, detailed information regarding the nature of the building, the type of heating system and the location of boiler was recorded. CaRB researchers conducting the Milton Keynes study, of 2005, collected rather more economic and socio-demographic information than was the case for the EST research. However, this study also overlooked the education status of the householders. Naturally the necessary technical details such as, square footage, number of bedrooms, number of floors, and structural changes to the properties etc were collected by those working on the Milton Keynes study.

In the case of the Chess Grants Scheme, attempts were made to collect comprehensive economic and socio-demographic information about participants as part of the monitoring of the intervention by LCC funded under the Econ' homes scheme. A self administered questionnaire was used to capture information about the number of occupants in each house, household income and educational status. This questionnaire also captured information about house type and the presence (or absence) of particular

domestic appliances. Completed questionnaires were collected by LCC staff. However, despite this fifteen of the intervention participants failed to return the questionnaire and this data is missing for those participants. A postal questionnaire was also used to capture more extensive socio demographic data about the people taking part in the scheme⁸. However, the fifty percent response rate obtained reduces the value of this information (Edwards *et al.* 2002). This is not a poor response rate for a postal questionnaire; rather it is about the best that can be expected from this data collection method. The vagaries of postal questionnaires were not trusted in the collection of technical data about house geometry and heating systems etc. This information was collected by professionals undertaking surveys of the houses in person. Administered questionnaires, and housing surveys are much more expensive than postal questionnaires (Bryman, 1992). Therefore it would seem that when financial are choices made in the design of research methods priority is given to the collection of data about houses, while collecting information about the people living in the houses is very much a secondary concern.

The research conducted into the Accent Homes intervention is different on two counts; firstly, in the small number of participants, and secondly because, qualitative in-depth interviews are an integral data collection method within this research. Socio-demographic details were collected by those 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. However, much more comprehensive data about the people that live in the households taking part in the interventions was collected during the interviews than it would be possible to collect using any form of questionnaire. This information about participants has proved essential to the interpretation of the temperature and humidity data collected as part of the research into the Accent Homes pilot project by CaRB researchers (Crosbie, Hasim and Ward, 2007).

The, patchy and 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. 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).

How can we begin to understand 'why some people and not others take part in energy efficiency interventions', if we don't know 'who takes part in energy efficiency interventions'. 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 (Crosbie, 2006). On a more positive note, the work presented throughout this report, and the frameworks for conducting this research currently under development by the whole of the CaRB team, are a step in the right direction towards developing sound methodologies for addressing the social and technical aspects of domestic energy demand.

Conclusions

The collection of data about the people who live and work in the buildings needs to be given a higher status in energy research. This in turn is illustrative of the fact that there is an urgent need for the development and diffusion of integrated methodologies, which can be used to address both the social and technical aspects of household energy consumption.

⁸ The data from this questionnaire is currently under analysis and not available for this report.

Who took part in the research?

In this section we examine what the background of the interviewees tells us about the types of people that take part in energy efficiency interventions and research.

In total forty three people were interviewed from thirty-five different households, but four of those interviewed, had not taken part in the intervention. Therefore some thirty-nine people were interviewed from thirty one households which had participated in energy efficiency interventions.

In twenty one of the households in which the interviews took place there were no family members with graduate qualifications. This seems strange as several studies have suggested that there is a strong correlation between education, environmental concern and environmental behaviour (e.g. Aaker and Bagozzi, 1982; Roberts, 1996; Zimmer et al, 1994; Straughan and Roberts, 1999; Chan, 1999). The numbers of less well educated people in our interview sample might suggest that the correlation between education and environmental behaviour is weaker in the case of domestic energy efficiency interventions.

Another finding to arise out of the socio-demographic information about those that took part in the interviews is that they are predominantly older people. Only two of the interviewees under thirty years of age, seventeen are in their forties, six are in their fifties and seventeen are over sixty years of age. It must also be pointed out that the interviewees under thirty years of age did not take part in the interventions. These findings would seem to suggest that older people are more likely to take part in energy related research and indicate that the take up of domestic energy efficiency interventions may become more likely as people grow older.

The households of the interviewees are predominantly made up of couples and couples with children. Only five of the interviewees live in single person households and only two of the interviewees are single parents. If we only count those interviewees that took part in the interventions the number of single person households is reduced to three. 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 interviewees in each of the case studies that 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 interventions discussed in this report. However, as detailed in the previous section, this is not possible because the relevant data was not collected regarding the socio-demographic background of those participants.

Conclusion

These findings suggest that those designing and promoting household energy efficiency interventions should not assume that participants are highly educated and that greater efforts need to be made to encourage those living in non-traditional family units and young people to take part in energy efficiency interventions and research.

Why did they take part?

The majority of people interviewed were primarily motivated to participate in domestic energy efficiency interventions by self-interest, rather than by environmental concerns. Or in other words, the benefits the different interventions could bring to participants lifestyles were a far stronger motivational factor than environmental issues.

This self-interested behaviour cuts across income and educational levels and was common throughout all four interventions. In the case of Accent Homes and Milton Keynes Energy Park the residents interviewed choose to rent/buy their current properties because they were in a more desirable area and were of a superior design to the alternative properties available to them. All of those interviewed taking part in the Chess Grants Scheme indicated that their main reason for applying for the scheme was to reduce the cost of improving their properties. In the case of the EST hot water study many of the interviewees were at least partially motivated to take part by a desire to save money on energy bills and/ or the fee offered for taking part in the study.

Design, ascetics and style played a significant role in the acceptance of the interventions by research participants as serving their self interest. This is most clearly indicated by the Chess Grants scheme. In which, participants were more than happy to have new heating and insulation fitted at great inconvenience, but were not prepared to use the CFL light bulbs they were supplied with, free of charge, because they are ugly and do not fit well their current light fittings. In the case of the Milton Keynes Energy Park and the Accent Housing pilot project the layout of the properties and their aesthetic qualities were major factors in residents desire to live in the properties. The importance of ascetics was also raised in the EST study as interviewees indicated that they were prepared to take part in the study partly because the monitoring equipment is unobtrusive and would not impact on their lifestyles and homes.

Of the few participants expressing environmental concerns as motivational factor in their decision to participate in interventions most have young children or grand children. On the whole, 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 Chess Grants Scheme, one of the grandparents we interviewed expressing a very strong concern for the effects of pollution on their grandchildren's lives does not use the CFL light bulbs they were supplied with. The reason given for this, is that they do not look good in their current light fittings.

Conclusion

The findings suggest that peoples' general attitude towards environmental issues play a very minor role in motivating them to take part in domestic energy efficiency interventions. It would seem that the decision to take part in domestic energy interventions is driven by self interest, which is calculated not only by the cost of the intervention in monetary terms, but also by assessing how well the technologies used in interventions fit with current lifestyles expectations and tastes.

Was taking part a positive experience?

In most cases the interviewees, regardless of the intervention in which there were participating, found taking part a positive experience. This is because, on the whole, interviewees' expectations of the intervention were met during the realisation of the intervention.

In the case of Accent Homes and Milton Keynes Energy Park many of the residents interviewed found that living in their home reinforced their belief that the properties in these developments are of a superior design to the alternative properties available to them. For example, many believed that they had more aesthetically pleasing homes, better levels of thermal comfort and lower heating cost, than would have been the case had they chosen to live in one of the other types of property available to them. In the case of the Chess Grants 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. In the case of the EST hot water study most of the interviewees felt that they were contributing towards an understanding of hot water use and that they had benefited directly from this, in terms of the fee paid for taking part and the possibility of reduced energy bills. Many of the participants in the EST study also found they had suffered very little inconvenience as a result of taking part in the study and felt that they are contributing towards mitigating environmental pollution. Both of which also met with their original expectations of the intervention.

In the cases where participants' initial expectations of the intervention were not met, or were only partially met, by the realisation of the intervention their experience of the intervention was marred. For example, technical problems in the case of the EST study, the Chess Grants Scheme and the Accent Homes properties led some participants to develop negative impressions of the experience of taking part in the intervention. For example, one of the participants in the EST study felt that technical difficulties with the monitoring equipment prevented the collection of information about their normal hot water use behaviour and that this meant that the study was a failure. Another example is supplied by the residents of the Accent Homes flats; they found faults in their properties reduced their quality of life and therefore living in the property was not improving their quality of life, as had been their initial expectation.

Effective administration of the intervention, and the employment of competent contractors, was found to be essential to successfully meeting participants' expectations. In some cases there was a lack of communication between the administrators of interventions and the contractors employed to carry out the work in or on participants' homes, which resulted in mistakes being made and faulty workmanship. The participants from the EST study and the Chess Grants Scheme indicated that these problems were usually resolved quickly and therefore the intervention met their expectations and their perceptions of the intervention remained positive: Whereas, in the case of the Accent Homes, internal disputes within the Accent Group prevented the resolution of problems with contractors, this meant that for some participants their expectations of the intervention were not met, and their perceptions of the intervention were marred.

Conclusion

If positive perceptions of an intervention are to be maintained throughout its implementation participants must have clear information concerning what to expect from an intervention, and both the administration of interventions and technologies used must be capable of delivering the promised results.

Would participants advise others to take part in similar schemes?

Most of the participants from all four interventions stated that they would recommend the interventions to others. In the case of the Chess Grants Scheme four interviewees said that they had all ready done so. This willingness to recommend the interventions was directly connected to whether the participants' initial expectations of the interventions were met by the intervention. As discussed in the previous section, in the case of, the residents of the Accent Homes flats and one participant from both the EST and MKEP interventions technical problems meant that their initial expectations had not been met. As such, they felt that they could not whole heartedly recommend the intervention to others.

Conclusions

These findings once again highlight the importance of fostering realistic expectations of domestic energy efficiency interventions and the careful selection of technologies and contractors.

How could the interventions be reshaped to improve the experience for participants?

While most of the interviewees are happy with the administration and implementation of the domestic energy efficiency interventions in which they took part problems encountered by a minority of participants 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 EST study and the Chess Grants Scheme commented that the level of information that they were provided with was inadequate. In some cases the information supplied to participants was overly complex and in other cases non-existent. In those cases where information was inadequate participants expectations of the intervention were often not met and their perception of the intervention was marred.

Some of the participants in all four interventions 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.

Some of the residents of the MKEP found that the use of unusual heating systems in their properties hastened the obsolescence of these systems. This reduced residents' satisfaction with their properties and the intervention as a whole.

Conclusions

These findings indicate that in some cases it maybe more productive to use less efficient but more readily available technologies, which it will be possible to maintain easily. They also highlight, once again, the importance of the careful selection of the technologies and contractors used in domestic energy efficiency interventions and the effectiveness of efficient administration in maintaining positive perceptions of domestic energy efficiency interventions.

Summary of findings and recommendations

Motivating people to take part in domestic energy efficiency interventions

The findings concerning why people take part in domestic energy efficiency interventions suggest that people's general attitude towards environmental issues play a very minor role. It would seem that the decision to take part in domestic energy efficiency interventions is driven by self interest, which is calculated not only by the cost of the intervention in monetary terms, but also by assessing the aesthetic qualities of an intervention and calculating how well the technologies used in interventions fit with current lifestyles expectations and tastes. These finding 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 bring to participants lifestyles is likely to increase participation;
- Interventions must be aesthetically pleasing, stylish and fit with current lifestyles if a significant level of participation is to be achieved.

Increasing the inclusiveness of energy efficiency interventions and research

Disparate, and in some cases very little, information was gathered concerning the background of the two hundred and four people that took part in the interventions discussed in this report. This makes it difficult to assess whether particular groups of people are included or excluded from the interventions. These findings suggest:

- The collection of data about the people who live and work in buildings needs to be given a higher status in energy efficiency interventions and research;
- There is an urgent need for the development and diffusion of integrated methodologies, which can be used to address both the social and technical aspects of household energy consumption.

However, it is possible to make some recommendations concerning how to increase the inclusiveness of energy efficiency interventions and research based on the interview data. Of the thirty five households that took part in the interviews it was found that in almost two-thirds no family members have higher educational qualifications, most were made up of older people and only two are single parent households. Given the importance of style and aesthetics in motivating people to take part in the interventions, also highlighted by the interview data, 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 interventions which fit the lifestyles of these groups within society.
- More research is needed to understand why the correlation between education and environmental behaviour might be weaker in the case of domestic energy efficiency interventions than other types of environmentally friendly behaviour.

Maintaining positive perceptions of domestic energy efficiency interventions

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 when participants have clear expectations of an intervention and reliable technologies and contractors are used to realise those expectations they were 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 of the intervention. These findings suggest that

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

EST Hot Water Study: Description of Interviewees

Interview one- was conducted with an adult male living in a five person household consisting of two married adults and three children. Both adult members of the household are in their thirties and the children are all aged five or under. The male adult works full time while the female adult is responsible for child care. The household annual income is between £41,000 and £50,000. The highest level of education obtained by adult members of this household is a postgraduate qualification.

Interview two - was conducted with the adult male living in a two person household consisting of two married adults in their fifties who are both employed full time. The annual household income is between £41,000 and £50,000. The highest level of education obtained by adult members of this household is a postgraduate qualification.

Interview three - was conducted with the adult male of a five person household consisting of two married adults and three children. Both the adults are in their thirties, two of the children are under the age of five, while the third child is between five and ten years of age. The adult male is employed full-time and the female is responsible for childcare. The annual household income is between £21,000, and £30,000. The highest level of education obtained by the adult members of the household is a postgraduate qualification.

Interview four - was conducted with both of the residents in a household consisting of two married adults in their sixties, both of whom are retired. The annual household income is less than £10,000 but the residents take part in a scheme in which a flat rate utility charge is levelled. The highest level of education obtained by adult members of this household is a school leaver's certificate.

Interview five - was conducted with the oldest adult male in a four person household. There are two married adults in their sixties, their adult daughter who is in her twenties and their seventeen year old son. The annual household income is over £61,000 per annum. The oldest adult male works full time whilst the oldest adult female does not work. The youngest adult male is in full time education and the youngest adult female is employed full time. The highest level of education obtained by the members of this household is a postgraduate qualification.

Interview six – was conducted with the adult male in a household consisting of two married adults in their sixties, both of whom are retired. The annual household income is between £10,000 and £15,000. The highest level of education obtained by adult members of this household is a school leaver's certificate.

Interview seven – was conducted with both members of a married couple in their fifties living in a four person household with their adult son and his partner. The younger adults are between eighteen and twenty-one. The household annual income

is between £21,000 and £30,000. The oldest adult male is on disability benefits and his spouse works full-time. The adult son works part-time. The highest level of education obtained by adult members of this household are O' levels / GCSEs.

Interview eight – was conducted with the adult male of a four person household consisting of two married adults in their thirties and two children. One child is under the age of five and the other is between six and ten years old. The male adult works full time whilst his spouse is responsible for childcare. The household income is between £21,000 and £30,000. The highest level of education obtained by adult members of this household is a first degree.

Interview nine- was conducted with the female resident of a household consisting of two married adults in their sixties both of whom are retired.. The annual household income is between £10,000 and £15,000. Neither resident in this property has any formal educational qualifications.

Interview ten - was conducted with female resident of a household consisting two married adults in their sixties. The male resident works full time, whilst his wife works part time. The annual household income is over £61,000 per annum. The highest level of education obtained by adult members of this household is a qualification equivalent to a first degree.

Interview eleven – was conducted with the adult male of a four person household consisting of two married adults. Both adults are in their thirties and one child is under the age of five and the other is between six and ten years old. Both adults are employed full time, with the adult female resident working from home. The household annual income is over £61,000 per annum. The highest level of education obtained by the adult members of this household is a first degree.

Chess Grants Scheme (SRB6): Description of Interviewees

Interviewee 1 – lives alone, she is a retired widow over the age of seventy-one, her income is less than £10,000 per annum and she has no formal educational qualifications.

Interviewee 2- lives with her husband, she is aged between sixty-one and sixty-five while her husband between sixty five and seventy years old and both are retired. The household income is between £16,000 and £20,000 per annum and the highest level of education reached by household members is O level/ GCSE.

Interviewee 3 – lives with her husband and two children. The adult members of the family are between forty-one and fifty years of age and the children are aged sixteen and twelve. The interviewee works part-time outside of the home while her husband is in full time employment. The household income is between £21,000 and £30,000 pounds per annum and the highest level of education achieved by family members is O' level/GCSE.

Interviewee 4 – lives with his wife, he is between sixty-one and sixty-five years of age, while his wife is aged between fifty one and sixty both are in fulltime employment. The household income is between £31,000 and £40,000 per annum and the highest level of education obtained by the household is A' level.

Interview 5 – was conducted with a retired couple, they are both between sixty and sixty four years of age. The household income is between £21,000 and £30,000 pounds per annum and the highest level of education achieved by the couple is O' level/GCSE.

Interviewee 6 – is a single parent living with her two children and is in full time employment. She is between forty-one and fifty-years of age and her children are aged seventeen and twenty six. The household income is between £21,000 and £30,000 per annum and the highest level of education achieved by household members is A' level.

Interviewee 7– lives with his wife and three children, he is aged between forty-one and fifty, his wife is between thirty and forty years of age and the children are five, seven and eleven years of age. The interviewee is employed fulltime and while his wife does not work outside of the home. The household income is £30,000 and £41,000 per annum and the highest level of education achieved by household members is first degree.

Interview 8 – was conducted with a retired married couple both aged between sixty five and seventy years. The annual household income is between £16,000 and £20,000 and the highest level of education achieved by members of the household is equivalent to GCSE/ O' levels.

Interviewee 9- lives with his wife they are both aged between sixty-one and sixty five years. The household income is between £21,000 and £30,000 per annum. Both

members of the household are in full time employment and the highest level of education achieved is equivalent to GCSE/ O' Levels.

Interview 10 – lives with his wife both aged between twenty-five and thirty. The household income is between £41,000 and £50,000 per annum. Both members of the household are in full time employment and the highest level of education achieved is first degree.

Interview 11 – was conducted with a single man aged between forty-one and fifty. He works full time and has an income is between £21,000 and £30,000 per annum. The highest level of education he has obtained is equivalent to O' levels.

Interview 12 – was conducted with a married woman living with her husband and two children. The adults in the household are both aged between twenty-one and thirty and the children are both under five years old. The female adult looks after the children while the male adult works fulltime. The household income is between £21,000 and 30,000 per annum and the highest level of education achieved by members of the household is equivalent to 'A' level.

Interview 13 - a single woman living alone aged between thirty-one and forty. She works fulltime, has postgraduate qualifications and an annual income of between £31,000 and £40,000.

Milton Keynes Energy Park: Description of Interviewees

Interview One - The interview was carried out with both members of a two person household which consists of two married adults. The female resident is in her fifties and the male resident is in his early sixties. The female resident works full-time and her husband is retired. The household income is between £51,000 and £60,000 p.a. and this is a combination of the female resident's salary and the male resident's pension. Both residents are educated to degree level.

Interview Two – This is a one person household consisting of one retired female resident in her eighties. The household income is between £10,000 and £15,000 p.a. The highest level of education the resident obtained is a school leaver's certificate.

Interview Three – The interview was carried out with the adult female resident of a three person household which consists of two married adults and their seventeen year old son. Both adults are employed by their own IT consultancy business whilst their son is studying and has a part-time job. Both adults are educated to O-level standard whilst their son is studying for A' levels. The annual household income is between £41,000 and £50,000.

Interview Four – The interview was carried out with both members of two person household consisting of two married adults in their forties living in a detached house. The male resident is employed fulltime and the female resident is employed part time. The male resident is educated to HND standard and his spouse has O' levels. The annual household income is between £41,000 and £50,000.

Interview 5 – The interview was carried out over the telephone with the adult female resident of four person household. The household consists of two married adults in their forties and two young children both of whom are under 10 years old. The female resident does not work and instead is responsible for child care whilst her husband who works full time. The annual household income is between is between £41,000 and £50,000 and both adult residents have postgraduate qualifications.

Interview 6 – The interview was carried out over the telephone with both members of a two person household consisting of two married adults in their forties. Both adults are employed full-time and have degree level qualifications. The annual household income is over £61,000 a year.

Interview 7 – This is a one person household consisting of one male resident in his forties with a degree level education living. The household income is between £41,000 and £50,000.

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