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THE POTENTIAL ROLE OF FINANCIAL PAYMENTS IN INCENTIVISING SHIFTS IN RESIDENTIAL ELECTRICITY USE IN THE UK: FINDINGS FROM A SMALL-SCALE EXPLORATORY FIELD STUDY

Peter Bradley, Alexia Coke and Matthew Leach

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The potential role of financial payments in incentivising shifts in residential electricity use in the uk: findings from a small-scale exploratory field study.

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ABSTRACT

This paper presents findings from a small-scale exploratory UK-based study which aimed to test two novel financial incentive approaches for encouraging the shifting of residential electricity consumption to off-peak hours. The two approaches were devised to attempt to overcome barriers to household participation and response in tariff-based approaches to load-shifting by rewarding consumers for shifting to off-peak consumption when deemed feasible by them. The participation rate in this study was better than those often reported for voluntary time-of-use tariff-based trials. Moreover, participants responded positively to both trials by reducing their overall usage of peak period electricity by 26% and 16% respectively and increasing the proportion of off-peak consumption by approximately 35% on average in both trials, when taking account changes in total consumption. Whilst it is not possible to draw any firm conclusions based on this, given the small number of participants, it does suggest that the use of financial incentives to encourage demand response is worth further investigation. The study also found: (a) that participant household response differed according to particular electricity-using devices and related social practices, indicating there may be different elasticities for different household energy services; and (b) that different incentive structures appealed to different participants. This indicates that demand response may require a range of economic measures to encourage broad participation.

1. INTRODUCTION AND BACKGROUND

Generating economic measures that are effective in sustaining reductions in peak electricity consumption has long been a goal within the power sector as a potentially inexpensive alternative to building extra energy-generating capacity for marginal periods. Not only are there strong economic arguments for focusing on such demand response in the UK, more recent concerns about climate change have led to analyses that suggest reducing peak loads through shifting the time of usage can reduce carbon dioxide emissions (Bradley et al 2013, Ofgem 2010), as well as be important for increasing the reliability of an energy system based on renewable energy sources (DECC 2012, Ipakchi and Albuyeh 2009, Spees and Lave 2007). Demand response therefore has an important role to play in enabling an electricity system that is low carbon, affordable and energy-secure. But it requires a level of active participation by electricity customers, and evidence suggests that this depends not only on the use of enabling technologies that reduce the costs of involvement, for instance through the provision of information, but the availability of effective incentives to encourage on-going participation and response.

1.1 Empirical evidence

1.1.1 The effectiveness of ongoing tariff-based approaches for residential load-shifting

Whilst the use of dynamic and semi-dynamic pricing in the form of real time and time-of-use tariffs are a popular mechanism for long-term ongoing demand response, there are concerns that such pricing mechanisms may largely appeal to consumers who already have patterns of energy consumption that coincide with off-peak periods, although evidence for this is mixed (e.g. Mostafa Baladi et al, 1998). Whatever the reason, response rates to tariff-based approaches in residential settings, though variable, tend to be relatively low, with average reductions of only 5% in peak usage in 15 trials from across the States (Faruqui and Sergici, 2010, Newsham and Bowker, 2010).

Whilst a review funded by DECC (2012) of 30 domestic demand side response trials in a number of different countries highlights the variability in reductions (from 0% to 22%) between ‘day-in day-out’ tariff-based pilots, most have occurred in contexts where electricity-based space cooling or heating is the norm. These are contexts where shifts in usage are seen as easier to achieve. Recent trials in the UK have suggested that Time-of-Use tariffs in this context may be able to generate load-shifts of up to 10%, but

even these pilots have also tended to involve some electric water and space heating (Darby and McKenna, 2012; AECOM, 2011). Coupled with low participation rates averaging less than 5% (Mostafa Baladi et al, 1998; Braithwait and Faruqui, 2001), voluntary ongoing tariff-based schemes have so far largely failed to deliver on their potential promise as effective economic instruments to encourage load-shifting in the residential sector.

1.1.2 'Barriers' to tariff-based approaches for residential load-shifting

The economics literature hints at a variety of reasons for this, although McMakin et al (2002) argue that economics cannot fully explain energy use behaviour. Probably the most important from an economics perspective is that the scale of benefit offered is not perceived by the consumer as sufficient to compensate for the disruption or inconvenience to everyday living caused by shifting usage to off-peak periods (Kim & Shcherbakova, 2011; Faruqui, Haris et al, 2010). Another important reason is the lack of consumer knowledge and 'bounded rationality' (Simon, 1957), where time-poor consumers may make 'sufficing' decisions ((Kim and Shcherbakova, 2011) based on a combination of inertia and incomplete or inaccurate knowledge about their electricity usage and the tariffs available (Kim and Shcherbakova 2011, FERC 2009).

Common behavioural biases, highlighted in behavioural economics, such as 'limited user capacity' in assessing options, 'loss aversion' (as opposed to valuing material gains), discounting of the future, and preferences for the 'status quo' (Ofgem, 2011: 1) are possible relevant factors here. Another associated barrier is lack of access to, and understanding of, technology that can facilitate shifts through reducing 'assymmetries in information' (Torriti et al, 2010: 1575), for instance electricity monitoring equipment (Faruqui, Sergici et al, 2010) or timers on electricity-using devices and appliances (Kim and Shcherbakova, 2011).

The psychology literature on pro-environmental energy behaviour goes beyond questions of consumer rationality based on optimising or sufficing utility to focus attention on the personal and contextual elements that help to explain individual action in relation to energy use. It appears from this literature that what motivates people to reduce energy use – for those that do – are not simply the costs of energy but the values, attitudes and beliefs they hold that relate to energy use (Gatersleben et al, 2002; Abrahamse and Steg, 2002), the social norms they recognise and apply (Alcott, 2011;

Bradley, 2014), their commitment to shifting (Heberlein and Warriner, 1983), and/or their social interactions and social orientation (McCalley and Midden, 2002). There are some concerns that the use of financial incentives, which are seen as providing an extrinsic motivation for participation and response may erode other intrinsic motivations, such as biospheric or altruistic values (AECOM, 2011).

Sociological studies of domestic energy use also potentially contribute to understanding household response to demand-side measures. In particular, they highlight the seeming temporal rigidity of certain forms of home-based electricity using practices (such as cooking an evening meal or watching TV), as well as the invisibility of electricity use within energy-related routinised practices of consumption (Shove, 2003; Shove and Warde, 2004; Burgess and Nye, 2008; Hargreaves et al, 2010). They suggest that the shifting of times of particular energy-using practices to take account of off-peak periods may be perceived or experienced as causing disruption and inconvenience, even discomfort, within the context of everyday living (Hargreaves et al, 2010; Shove, 2003), and may be seen as beyond an individual's control (Hargreaves et al, 2010; Torriti, 2012).

Taken together, the insights provided by the above literatures provided the conceptual framework for this study, as summarised in Figure 1 below.

Figure 1: *Consumer barriers to participation and response in tariff-based approaches to shifting residential peak electricity use*

1.1.3 The effect of incentive-based approaches for residential energy use

The design of this study was motivated by the question of whether the use of financial incentives might overcome some of the barriers to participation and response identified for tariff-based approaches to residential load-shifting. However, whilst there are many studies that have analysed the implementation of dynamic and semi-dynamic pricing for residential demand response, none have tested the potential effectiveness of financial incentives for such a purpose, as far as we are aware.

There are some studies, however, where financial incentives have been used to encourage energy conservation. Though again the results of these studies have been mixed, overall they suggest people will reduce energy use if the incentives offered are perceived to be sufficient (AECOM 2011, McMakin et al, 2002, Stern et al, 1986), and the information, marketing and implementation is effective (Stern 1999, Stern et al, 1986). It is important to note, however, that Stern et al (1986) found that whilst larger incentives do increase participation in energy conservation measures, modes of marketing and implementation may be a more important factor than the size of financial incentive. Stern et al (1986) explained the tenfold variation in participation levels between energy conservation programmes offering identical financial incentives as being the result of both the effectiveness of the marketing methods used and the degree of trust customers had in the implementing organisations.

In addition, a brief review of the use of financial incentives in other fields, such as voluntary blood donation, suggests that payment can erode participation by those who are already doing what the financial incentive is meant to encourage, but for altruistic reasons. This may suggest that those who are already consciously using off-peak as opposed to peak-time electricity for environmental and/or social benefits might be discouraged by financial payments from taking such action, or from participating in such a scheme in the first place. However, unlike blood, energy is an item that is regularly traded and paid for, so whether this is the case for demand response is unclear, given that it appears this has not been the subject of any studies.

1.2 Research aim and rationale

Given the lack of exploration of incentive-based approaches to residential load-shifting, the aim of this study was to explore how a group of electricity consumers responded to

two different incentive structures designed to encourage the shifting of electricity usage to off-peak times. The two measures differed in terms of the level of incentive offered and the way benefits were allocated. Both, however, were based on the premise that the use of financial payments to reward residential consumers for off-peak usage was likely to be more attractive than a fixed time-of-use tariff which penalises peak period electricity consumption through higher pricing. It was hypothesised that the use of financial incentives facilitates consumers to trade off between priorities at different times, allowing them to shift their usage when they deem it feasible, and thereby providing flexibility for consumers in ways that a rigid tariff-based system does not. The study design also involved assessing the environmental orientation of participants in order to explore whether this negatively impacted on their response to financial incentives.

2. METHODS

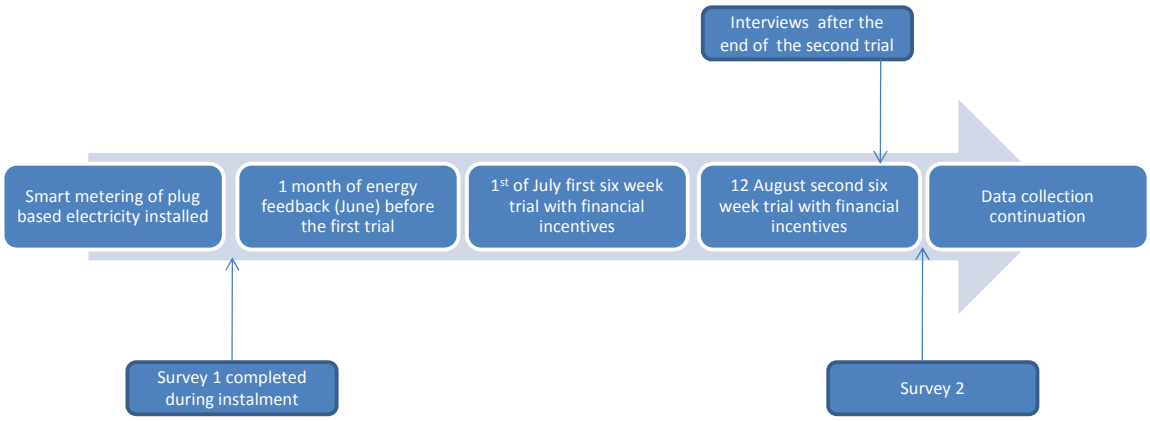
2.1 Methods overview

A small exploratory study was therefore set up to explore residential response to the two different incentive-based measures devised, using a 'real world' UK experiment in a block of flats where electricity is not used for central space heating or cooling. After recruiting participants in the case study site, the first phase of the study involved the collection of electricity use data for a month from each participating household in order to provide a benchmark with which to compare the results of the two trials. The trial using the first incentive structure was then implemented for 6 weeks, followed by a second six-week trial to test the response to the second incentive measure.

Energy monitoring equipment was installed for each household in order to provide detailed electricity usage data for the study. In some instances this provided consumption information down to the individual appliance level for certain devices. This information was also made available to participants through a website in order to help them shift consumption during the trials. In addition, the research incorporated two surveys, before and after the trials, to generate a better understanding of participant circumstances and attitudes in relation to the study. Semi-structured interviews were also conducted to capture participant perspectives and experiences of attempting to shift electricity consumption to off-peak times, and what role the incentives on offer had within this.

A flow chart of the methods used in the study is provided in Figure 2. It identifies the stages and timings of key elements of the study, in particular the implementation of the financial incentive trials.

Figure 2: *Flow chart of study methods*



2.2 Recruitment of participants

The study was done in collaboration with Thameswey Energy. A recruitment letter and email was sent by Thameswey Ltd to all the residents of a recently-built block of over 100 flats, for which they provide electricity from a Combined Heat and Power (CHP) plant. The flats therefore do not use electricity for mains space heating. The letter outlined the methodology of project and identified potential benefits to residents from participation in the study, both in terms of the information provided by the energy monitoring equipment that would be supplied and which they could keep, and the incentives for shifting that would be on offer. Expected benefits to the research community and future energy customers were also outlined. The letter is provided in Appendix 1[1]. As a result, eleven participants were recruited from this building. Of these, one participant was dropped from the study after not responding to requests for information required by the study, despite repeated attempts.

2.3 Monitoring of electricity use and provision of feedback

Electricity usage data from each household for a month prior to the trial was provided to the study team by Thameswey in order to provide a benchmark for comparison with electricity consumption during the trials. Electricity monitoring equipment was also

[1] The trials were updated as now detailed in the main paper, due to issues around timing.

installed for each participating household. This provided detailed feedback to both the household and the study team on household energy use during the trials. Feedback from the electricity monitoring system in this study (Alert-Me) was web-based, meaning users needed to log onto a website to access real-time information on their energy usage. In some instances, however, this equipment was able to provide information on consumption down to individual appliance-level, but only for smaller devices, as larger appliances such as washing machines were fitted. In addition to electricity monitoring devices, six timers were disseminated to each household for use during the six week trials to help participants shift electricity use for particular appliances to off-peak times of day.

2.4 The surveys

Survey 1 was sent to participants to complete after the installation of the electricity monitoring kits in May. The survey mainly used closed questions arranged on a seven point scale (Likert 1932) in order to assess participant attitudes and beliefs, particularly as related to the environment, their energy supplier, energy shifting and technology use, as well as socio-economic circumstances. The questions on their self-reported general environmental behaviour (Kaiser & Wilson 2000), motivations towards the environment (Pelletier et al 1998), orientations to biospheric and other values (de Groot & Steg 2008), and self-identify in relation to the environment and technology (Terry et al 1999), were included in order to explore the hypothesis that people who are pro-environmental might not be willing to participate in an energy shifting scheme based on financial incentives.

Participants were also asked about their betting-related behaviour because it was thought that the lottery-style pooled incentive trial might be more attractive to those for whom this is common practice. In addition they were asked about their socio-economic details, such as employment status, income levels, gender, age, and living arrangements. The survey is provided in Appendix 2. All ten of the final participants completed survey 1.

Survey 2 was implemented towards the end of the second trial. The purpose was primarily to look for any changes after the two trials. The scaled questions about general environmental behaviour, which included five that were directly or indirectly related to domestic energy behaviour, were therefore repeated, as were the questions about

attitudes and beliefs related to the shifting of electricity use, the energy supplier and gaming and betting. In addition questions were asked that focused on participant experience of any inconvenience caused by attempting to shift electricity consumption, as well as on how much they felt they used various kitchen equipment and appliances. This survey is provided in Appendix 3. Six out of the ten participants completed this survey.

A survey was also sent to all those in the building who did not volunteer to participate in the study (over 100). Of these, only four household representatives filled in the form, one of whom had wanted to be in the study but whose application form was never received. This survey included questions about non-participant attitudes towards their energy supplier, their self-identity, their feelings and motivations about energy shifting, and their socio-economic background. But it also encompassed two open-ended questions which asked about the reasons the respondents decided not to participate in the study and what they thought is the main barrier to shifting electricity use.

The results of these surveys were input into excel spreadsheets to facilitate the calculation of the measures of pro-environmental behaviour, values and identity [see Murtagh et al (2013) for more details on the specific items used and how the resulting measures are calculated] and to allow for the comparison of answers both within and between households, and how they are distributed. The samples were too small, however, to warrant the use of statistical analysis

2.5 The financial incentive trials

Two six week trials were implemented during the study: the first began at the start of July 2013; the second started on the 12th of August 2013. Following EDF Economy 10, off-peak hours were determined as between 11pm and 7am and between 1pm and 5pm daily. The financial incentive offered to encourage shifting to off-peak times was 9p per kilowatt hour (kWh). This was calculated based on the difference between kWh peak and off-peak 2013 charges on EDF Economy 7 which was 13.74p per kWh and 4.89p per kWh at the time of the study[2].

[2] The EDF data that we used to inform the level of incentive is available at: http://www.edfenergy.com/products-services/for-your-home/documents/product-terms/fixed-price-2013.pdf

2.5.1 The first trial

At the start of both incentive trials, an 'incentive account' was created for each participant and identified to them. The money put into the account at the beginning of each trial was equivalent to the amount of electricity used by the household during the benchmark period[3] at the rate of 9p per kilowatt hour. For an average UK household, this would be £37 (413 kWh of electricity use over a 6 week period multiplied by 9p per unit)[4]. This value of 9 pence was revised up from an initial estimate of 6 pence.

The amount of money participants kept at the end of the first six week period depended on the proportion of their electricity use that occurred at off-peak times during the trial in relation to their overall consumption during the benchmark period. In the example of the average household above, therefore, if three quarters of all their electricity consumption was off-peak during the six week trial, then they earned approximately £25, because this is roughly 0.75 of £37.

The reason it was decided to base the financial incentive on the benchmark period rather than on consumption during the trial periods was so as not to inadvertently reward an overall increase in electricity usage. In other words, as long as household total consumption did not rise in comparison with benchmark usage, the more participants shifted electricity-using activities into off-peak periods, the more they were financially rewarded.

2.5.2 The second trial

The second trial introduced both a competitive element to the pilot and a much larger potential reward (addressing the scale of benefit barrier) by pooling the incentives earned by participants from shifting their consumption, and awarding the resulting lump sum to one of the participating households, based on a draw. Those who shifted a greater proportion of their electricity usage to off-peak in comparison to their benchmark consumption had more chance of winning the pool.

[3] But multiplied up to take account of the fact that the period for each trial was 6 weeks, but the benchmark data was only for a month.

[4] https://www.ofgem.gov.uk/ofgem-publications/64026/domestic-energy-consump-fig-fs.pdf

The same amount of money was put into the account for the start of the second 6 week trial and the same financial reward was attached to shifting (9p per kWh unit). However, this time the individual earnings from all the participants in the trial were pooled together at the end of the trial and awarded to just one household participant, based on a draw. Based on the average household consumption figures used earlier, this meant a potential pool for the winner of over £300, had everyone shifted all their consumption to off-peak. The actual amount of the pool available for winning, however, depended on the proportion of each individual household's off-peak usage in comparison with their benchmark total consumption at a rate of 9p/kWH.

Importantly, however, each participant's chance of winning increased with an increase in the proportion of electricity they used in off-peak hours in comparison with peak periods. If a participating household used 43% of their electricity in off-peak periods, then they were awarded the equivalent of 43 tickets for the draw, whilst another household with 33% off-peak usage would be awarded the equivalent of 33 tickets. One 'ticket' was then drawn randomly from the aggregate number of tickets awarded to all the participants though a process modelled in excel. Therefore, although the draw for the pool was random, those who had a higher proportion of off-peak usage had a higher change of winning.

2.6 Interviews

Participants were invited to take part in an interview towards the end of Trial 2. Five agreed to be interviewed before the end of the second pilot, and two agreed after both trails were completed, making a total of seven interviews. The aim was to gain a more in-depth understanding of participant experiences, particularly in relation to the barriers they encountered in attempting to make shifts in electricity consumption and whether the incentives on offer helped to overcome these. The interviews were largely semi-structured in nature, with questions based on an interview guide to focus discussion, though each interview started with an invitation for initial comments about the study to encourage participant reflections in as open a way as possible (Kleining 1998). The aim was for the interviewer to guide rather than lead or restrict responses (Sarantakos 2002).

The interviews were recorded digitally, re-played and transcribed as required. They were then coded thematically (Braun and Clark, 2006) in relation to concepts and

hypotheses identified during the planning of the research, in particular the barriers participants faced in load-shifting and whether the financial incentives on offer helped to overcome these, in comparison with Time-of-Use tariffs.

3. Findings and Analysis

3.1 Participation

3.1.1 Participation rate

The participation rate for the study was approximately 8%, with ten out of eleven participants who began the study, completing it. This rate compares reasonably well with voluntary time-of-use studies, although the data on the latter is mixed. Yet the great majority of the households in the building still did not join the study. The very low response rate to the questionnaire sent to non-participants makes it impossible to know why this was. However, the answers from the three people who did respond hint at a range of reasons. One of these respondents wrote that he had not fully understood the nature of the trials, although interested in the idea of shifting his electricity use. Another of these respondents indicated that it was his/her distrust in the promise of anonymity in being part of the study which had been the rationale for not participating. The third respondent said that she felt she would not benefit from the financial incentives on offer because she was ill, and participating would restrict the 'versatility' of her energy use, despite the fact that the measures were designed to offer flexibility to opt in and out.

As noted in the introduction, Stern et al (1986) found that marketing, communication and trust in the supplier were all important factors in explaining differences in the success of different energy conservation programmes which offered the same financial incentives. The initial survey responses from participants and non-participants alike point to a reasonable level of trust in the supplier[5], but the study did not include any marketing strategy beyond the sending of a letter to invite participation. Moreover, two of the three

[5] Participants were neutral or in positive agreement with the statement that they had trust or confidence in their supplier, approximately a third strongly so. This was the case too with two of the three respondents

non-participant responses suggest they may not have understood what the incentives involved, and it appears that whilst all of those interviewed who did choose to participate had understood the first trial, the second had caused some confusion: one participant admitted he had not understood the pooled incentive and two others gave answers which suggest they had misunderstood on what basis it was awarded. Another participant also admitted that she had thought participation in the study was compulsory, having only skimmed the recruitment letter. Taken together, this data could suggest that if there had been a more active method for marketing and communicating the study, participation rates may have been higher. However, this is speculative.

3.1.2 Socio-demographics of the sample of participants

Of the ten who completed the study, four were women and six were men, five of whom were in the 20-29 age bracket, two in the 30-39, two in the 40-49, and one in the 60-69 age group. Seven of the participants classified themselves as white (not necessarily British), two as Asian/Asian British and one as black/black British. Six lived on their own, and four shared (three with partners); none lived with children. All were in employment, with household incomes of £20,000-£39,999 (five), £40,000-£59,999 (four) or £60,000-£99,999 (one). As Table 1 below summarises, it was a relatively diverse group, but employed and relatively well-off in comparison to the national average for household incomes. However, there were no families with children represented.

Table 1: *Socio-economic profile of study participants*

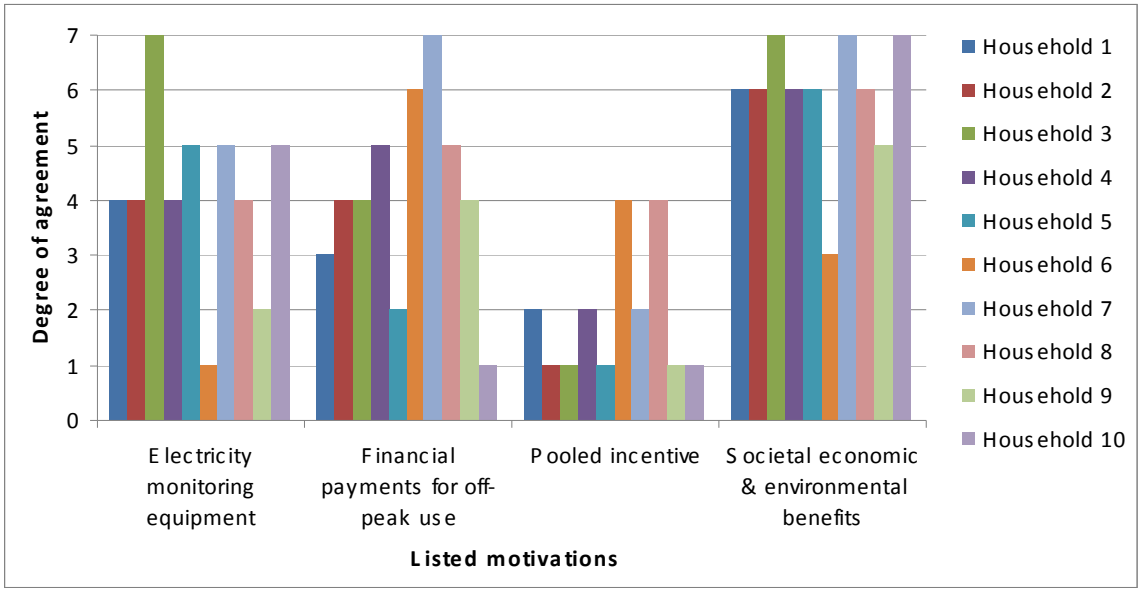
Gender		Age				Ethnicity			Occupancy		Household income		
M	F	20-29	30-39	40-49	60-69	White	Asian/British Asian	Black/Black British	Sole	Shares	20-40K	40-60K	60-100K
6	4	5	2	2	1	7	2	1	6	4	5	4	1

who chose not to participate, with the other respondent only marking below the neutral level in relation to one of the two trust-related questions.

3.1.3 Participant stated reasons for participating in the study

As the bar chart below (Figure 3) indicates, all of the participants except one agreed (eight strongly or very strongly) that they had chosen to participate in the study because of perceived societal economic and environmental benefits. Four agreed to a certain degree, one very strongly, with the statement that they had decided to participate because of the opportunity to keep the electricity monitoring equipment. Four (three of whom were different from those who had agreed that one of the reasons they had become involved was for the electricity monitoring equipment) also agreed to varying degrees that they had been motivated to join because of the financial payments for off-peak use. However, none claimed that they had been motivated by the pooled incentive.

Figure 3: *Participant responses to list of motivations for participating in the study*



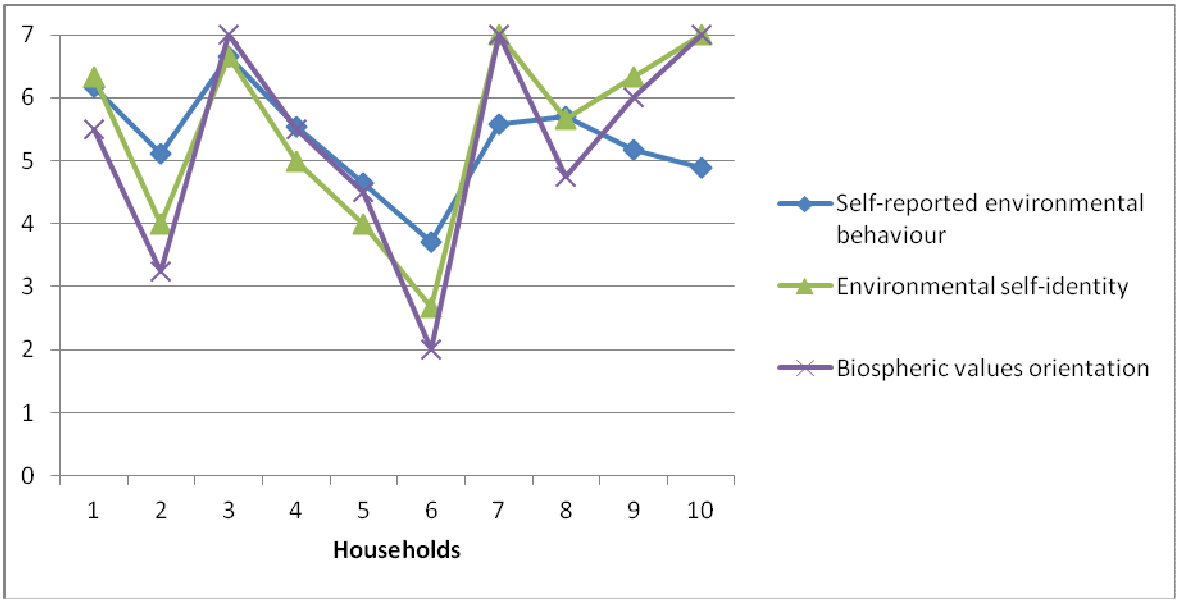
Some of these responses may reflect perceptions of social desirability, as one of the participants later admitted that he had in fact been very motivated by the potential amount that might be won in the pooled incentive measure. However, the interviews also reflected a range of motivations for participation that went beyond the actual financial incentives offered in the trial: from wanting to reduce their electricity use for environmental and/or financial reasons to exploring what impact shifting might have on their lifestyle.

… it was more …kind of noticing …how much …it went down a bit, and that was really nice. … it was the energy reduction (Household 10)

I was trying to understand how much I could shift it, and also whether this was the kind of behaviour that would have a significant impact on me, as opposed to being something that was just a second-order consideration. (Household 1)

Indeed as the line chart below (Figure 2) which shows how participants scored on a number of measures of their pro-environmental orientation suggests that, with the exceptions of Household 5, 6 and also 2, it does appear that the participants were relatively, strongly or very strongly pro-environmental in attitudes and self-reported behaviour. As such, this sample seems to roughly reflect DEFRA's (2008) estimates of the proportion of the UK population that is environmentally-aware (44%), the willing and cautious (28%) and the disengaged (28%).

Figure 4: *Degree of participant pro-environmentalism using 3 survey-based measures*



What is encouraging about this result is that it does not appear that those with pro-environmental (and/or altruistic) orientations were necessarily put off from participating by the financial incentives offered, as the designers of the study potentially feared. Those who were interviewed saw receiving payments for demand response as being

different from being paid to donate blood, where introducing financial incentives has caused a decline in blood donation by existing donors (Mellström and Johannesson, 2008).

> *…I think the difference between the blood study and the energy consumption is you're actually paying for the energy consumption. ... You're not paying to give blood.* (Household 1)

> *… energy that I have no choice but to use, that's…to me, that's a different thing* (Household 5)

> *…I guess it's the psychology of the thing, because people might view it as you're selling blood, whereas they don't want to see it like that. And this is more about your own energy consumption and sort of the wider picture of, you know, environmental concerns. So, that…I think the two things are quite different, psychologically-speaking.* (Household 8)

Their opinions were more mixed as to whether other people might be put off joining an electricity shifting scheme by the offer of financial payments, with a few wondering why it would, but two thinking that it might: '… I think it depends on you as a character. If you're very much into saving the planet and reducing consumption of electricity and stuff like that, financial incentive shouldn't matter – it becomes part of life' (Household 5). Yet in this study, this does not appear to have been the case. Indeed, as illustrated in the answers below provided to questions that probed participant reasons for getting involved in the study, four of those interviewed suggested that the financial payments had created an additional motivation to change their electricity usage, although for two at least this was not only in terms of shifting their times of consumption, but reducing total electricity use.

> *I like to use as little energy as I can myself …so, to me, it was helpful to know that, oh, not only am I doing that which I would be doing…which I plan to do anyway, but that effort has been sort of recognised in a way as well, and I'm getting something for it, so it's just adding…giving extra motivation.* (Household 8)

Of getting benefit for money and also like my consciousness, like I said, I like to do something good for the environment. (Household 7)

One of these participants suggested he would have participated in the study even had there been no financial incentives, but still an offer of monitoring equipment. For him, like three others of the seven participants interviewed, the financial payments appear not to have been the primary motivation for their involvement. 'I think, for me, personally, it's more about my energy usage feedback. So, for instance, if I put it this way, that if there were little to no reward associated with the study …but the equipment was still given for free, I'd still go for it' (Household 8). However, for at least one of the others who was interviewed – someone who did not score highly on the pro-environmental metrics – it was clear that the financial incentives had been the reason he had decided to participate in the study: 'at no point, and I'm being honest here, at no point have I worried about me saving energy for the world and being green. For me, this is purely about saving money'[6] (Household 5).

In summary, therefore, participants' verbally-communicated motivations for choosing to get involved in this incentives-based demand response study were mixed and sometimes multiple: the potential financial payments on offer, testing self-efficacy in shifting or reducing energy use, cutting bills, and/or contributing to social and environmental welfare. What interviewee experiences in this study may point to, however, is that the offer of a financial payment may be more important for incentivising demand response among those who have less environmental concern (where this is presented or perceived to be the reason for load-shifting); but the use of such incentives may also provide an additional incentive to those who are pro-environmental.

Though the small size of the sample makes extrapolation difficult, the 8% participation rate achieved in this study is better than that reported for many voluntary demand response programmes in the US, despite limited marketing. Those who did participate were relatively diverse and it does not appear that an individual's degree of pro-environmental orientation or their socio-demographics were a predictor for participation.

[6] His reference to 'saving money' (rather than earning money which the use of a financial payments approach suggests) could possibly be an indication that he had not fully understood what the trials entailed; or that he was equally interested in reducing energy use to save on bills; or that, as behavioural economics suggests, loss is of greater concern than reward, the concept that informed the idea of the incentive account in the study.

Though attempts were made to ascertain why the remainder of the building's households did not participate, only three people returned the questionnaire. There is some evidence from those who did respond or participate, however, that the study – particularly the measure in Trial 2 – was not always completely understood. This could indicate that there was an issue with the relative complexity of at least one of the trials, and therefore how the study was communicated. If this is the case, it is possible this impacted on participation rates, although again this is speculative.

3.2 Response

This section presents findings on how participants responded to the two financial incentives trials for electricity shifting and how they found the experience. Table 2 below summarises the electricity consumption of each of the 10 households over the period of the intervention. The second column provides an extrapolated[7] figure of the total electricity use per household for a six week period before the trials began. This acts as the benchmark usage. The third and fourth columns provide total electricity consumption per household during the six weeks of Trial 1 and Trial 2 respectively. Columns 5 and 6 calculate the differences between the total consumption and benchmark consumption for each household in Trail 1 and Trial 2 respectively. Columns 7, 8 and 9 then show the proportion of the total electricity consumption that was off-peak during the Benchmark period, Trial 1 and Trial 2 respectively. Column 10 states the difference in the proportion of off-peak consumption between the Benchmark and Trial 1 per household. Column 11 does the same, but for Trial 2, and the last column provides figures for the difference in the proportion off off-peak usage between the two trials. The last two rows give the average and median figures respectively across the sample of households.

[7] The study extrapolated from four weeks of Thameswey electricity consumption data for each household in April-May 2013 to create the figures in these columns.

Table 2: *Comparing electricity usage during the Benchmark, Trial 1 and Trial 2 periods*

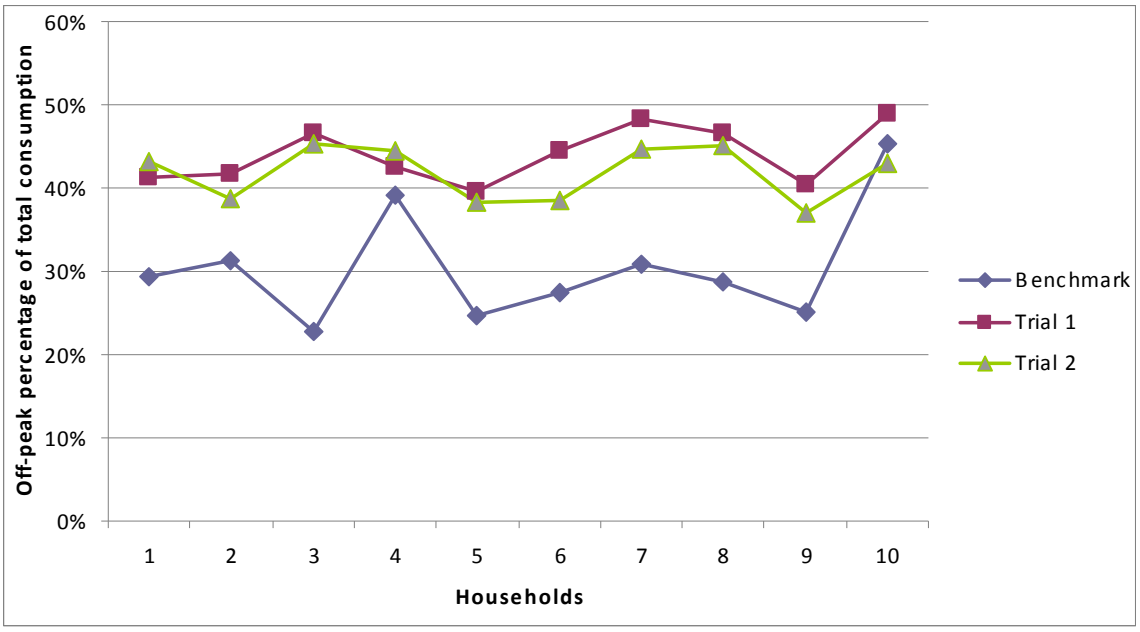
Household	Total electricity consumption (kWh) *Benchmark*	Total electricity consumption (kWh) *Trial 1*	Total electricity consumption (kWh) *Trial 2*	Difference in total consumption (kWh) between Benchmark and Trial 1	Difference in total consumption (kWh) between Benchmark and Trial 2	Off-peak percentage of electricity consumption *Benchmark*	Off-peak percentage of electricity consumption *Trial 1*	Off-peak percentage of electricity consumption *Trial 2*	Percentage shifts in off-peak consumption between Benchmark and Trial 1	Percentage shifts in off-peak consumption proportion between Benchmark and Trial 2	Percentage shifts in off-peak consumption proportion between Trial 1 and Trial 2
1	217	231	207	13	-10	29%	41%	43%	12%	14%	2%
2	256	212	209	-45	-47	31%	42%	39%	10%	7%	-3%
3*	328	278		-50		23%	47%	45%	24%	23%	-1%
4	118	131	115	13	-3	39%	43%	44%	3%	5%	2%
5	268	262	302	-6	34	25%	40%	38%	15%	14%	-1%
6	182	195	191	13	9	28%	44%	38%	17%	11%	-6%
7	157	127	148	-30	-9	31%	48%	45%	18%	14%	-4%
8	221	183	193	-38	-29	29%	47%	45%	18%	17%	-1%
9*	234		304		69	25%	40%	37%	15%	12%	-3%
10	397	274	338	-122	-59	45%	49%	43%	4%	-3%	-6%
Average	238	210	223	-28	-5	30%	44%	42%	14%	11%	-2%
Median	228	212	207	-30	-9	29%	44%	43%	15%	13%	-2%

*Household 9 was away for 4 weeks during Trial 1 and Household 3 was away for a similar period during Trial 2. Total consumption figures have therefore been excluded, as these would have been misleading. However, proportional off-peak figures for these households electricity consumption during these periods have been included as these represent what they were doing during the two weeks they were at home.

What these results show is that all the households increased the proportion of their off-peak consumption in Trial 1 in comparison with the Benchmark by an average of 14% (between 4 and 24%) and nine out of the ten households increased the proportion of their off-peak usage by an average of 11% (5% to 23%) in comparison with the Benchmark, but by 10% when taking account of the one household where the proportion increased. It was on this basis that financial payments were awarded. But as Figure 5 below shows, the two households (4 and 10) that already had the highest off-peak usage were the ones that shifted least, perhaps because they

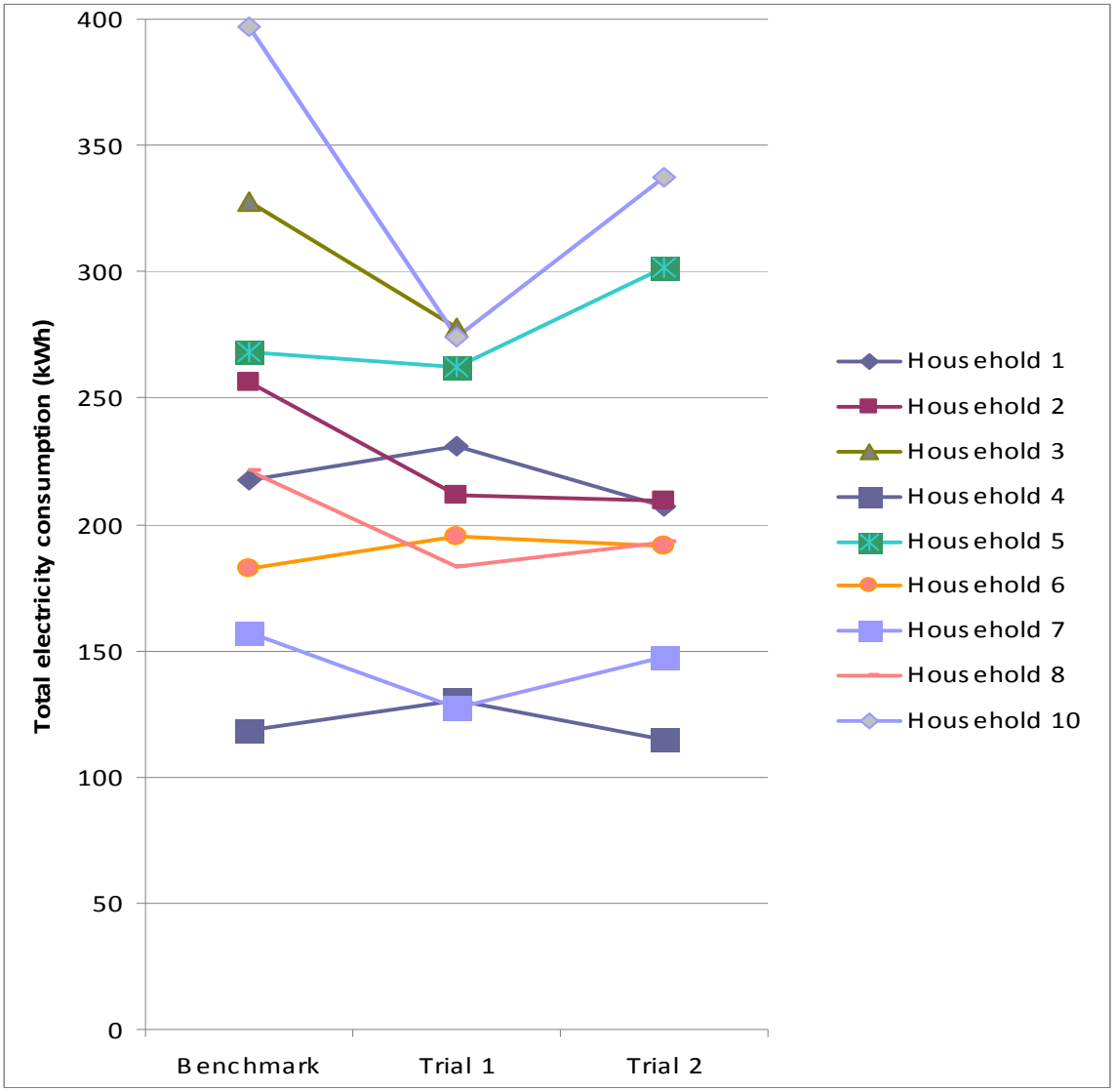
were already doing as much as they could in what, in the study, were classified as off-peak hours.

Figure 5: *Comparing percentage of household off-peak electricity usage over the study*



However the proportional figures above do not take account of the changes in overall consumption that are also evident in Table 2. Though encouraging reduction in electricity consumption was not an aim of the study, it was important to the purpose of the study that total consumption did not rise. What Figure 6 below illustrates is that during Trial 1, three of the households' overall consumption went up in comparison to the benchmark, and six decreased, with only household 5 approximately maintaining usage levels. The picture for Trial 2 is similar in that three households had higher overall consumption than the benchmark, but only one of these was the same as in Trial 1. Half of the households overall consumption was higher than in Trial 1, and half lower.

Figure 6: *Comparing household total electricity consumption over the study*



Whilst the reductions observed may be partly explained by the fact that at least three of the participants suggested that a primary motivation in joining the study was to see if they could reduce their energy consumption, other factors may also have come into play. Changes in the number of daylight hours may have had some effect, with there being more hours of darkness during the benchmark period than during the two trials, and Trial 1 occurring when it was lightest (hot water and space heating were not provided by electricity). Holidays may also have impacted on electricity use, although the relevant results of the two households where participants told the researchers they were away for four of the six weeks (during Trial 1 for

Household 9 and during Trial 2 for Household 3), have been excluded from this Figure. It is possible therefore that not all the electricity savings observed were the result of deliberate attempts at reducing consumption.

Shifts in ambient temperature may also explain rises in total consumption in some cases: the participant from Household 1 mentioned that the building is very well-insulated, but he found that this means it can get very warm in the summer. This meant, he said, he had needed to use a fan. It is not clear when he did so, but it was an unusually hot July when the end of Trial 1 took place, and Trial 2 began.

Whatever the reason for any increases or decreases in total consumption, taking these changes in overall usage into account shows that the percentage increases in off-peak consumption were in many cases much greater than at first glance, giving averages of 34% and 35% increases respectively for Trial 1 and Trial 2 (see Table 3 below for details), as compared with 14% and 11% that the proportions in Table 2 suggest.

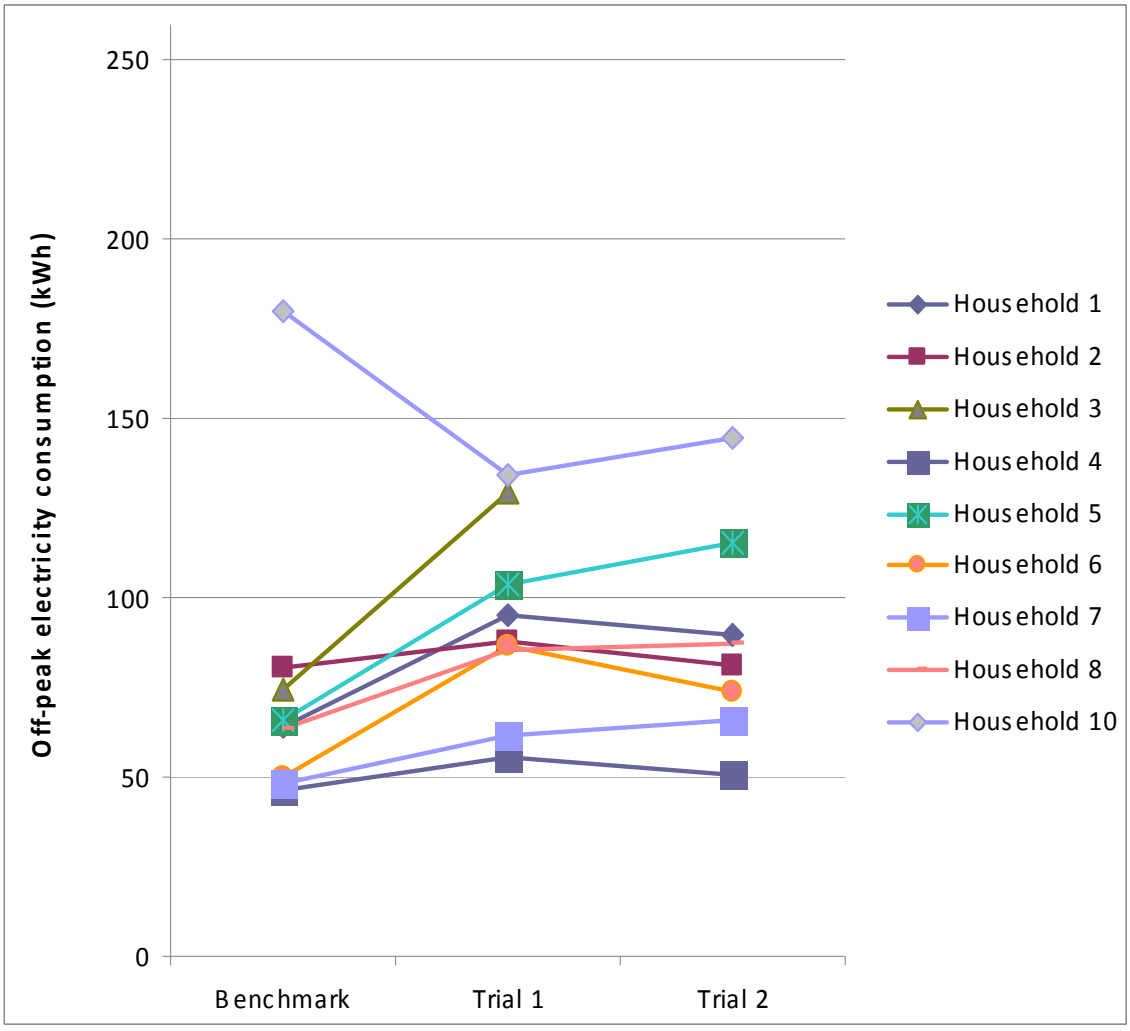
Table 3: *Comparing changes in off-peak consumption over the study*

	Off-peak consumption figures				
Household	**Benchmark**	**Trial 1**	**Trial 2**	**Percentage difference between Trial 1 from Benchmark**	**Percentage difference between Trial 2 and Benchmark**
1	64	95	90	49%	40%
2	80	88	81	10%	1%
*3**	74	130		74%	
4	46	56	51	20%	10%
5	66	104	115	57%	74%
6	50	87	74	73%	47%
7	48	61	66	27%	37%
8	63	85	87	35%	37%
*9**	59		113		92%
10	180	134	145	-25%	-20%
Average	73	84	91	36%	35%
Median	64	88	87	35%	37%

*Household 9 was away for 4 weeks of Trial 1, and Household 3 was away for 4 weeks of Trial 2.
The respective usage figures have thus been excluded.

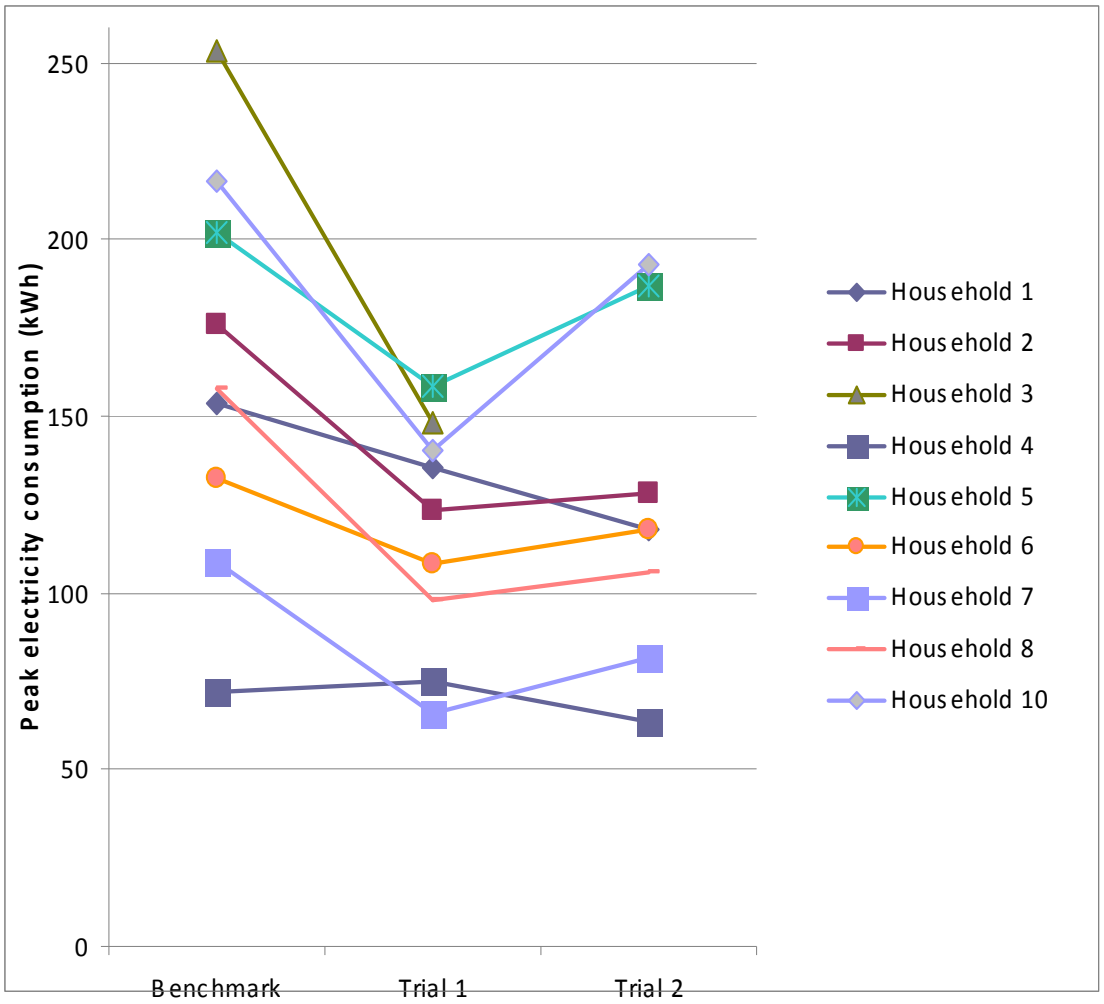
But most interestingly, the two charts below of changes over the course of the study in total electricity consumption during off-peak (Figure 7) and peak periods (Figure 8) illustrate that whilst all fully participating households (apart from 4) did reduce their electricity usage in peak periods in Trial 1, all (apart from Household 10) did this partly by shifting their electricity consumption to off-peak. This was true for eight out of nine of the households in Trial 2 as well. However, the peak-time consumption of 7 of these households rose in comparison to Trial 1, in two of the cases possibly partly because their off-peak usage fell a little. However, half of the households had a higher proportion of off-peak consumption in Trial 2 than in Trial 1.

Figure 7: *Total off-peak electricity consumption by household over three study periods*



* The data from Household 9 has been excluded because of having been away for 4 weeks during Trial 1; The Trial 2 data for Household 3 has also been excluded because they were away for 4 weeks during that period.

Figure 8: *Total peak electricity consumption by household over three study periods*



* The data from Household 9 has been excluded because of having been away for 4 weeks during Trial 1. The Trial 2 data for Household 3 has also been excluded because they were away for 4 weeks during Trial 2.

Though the differences in usage between trials may be partly due to changes in temperature that may have resulted in the use of electric fans mentioned earlier, it may also be partly due to a fading off of interest in using the monitoring equipment to reduce energy as has sometimes been noted in other studies (e.g. Hargreaves et al, 2010). Indeed one of the interviewees (Household 5) who had said what he had found most interesting about the trials was the understanding he gained about the amount of electricity different equipment used, which caused him to switch some items off, also admitted that he had not recently accessed the information, possibly indicating signs of monitoring fatigue (Household 5).

However, overall the patterns above do suggest that, to different degrees, both trials did incentivise a shift in electricity usage from peak to off-peak periods for most participants. Moreover, the data shows that some participants responded more to Trial 1, and others more to Trial 2. This is reflected in differences in participant responses to interview questions which attempted to explore which trial they preferred:

> *For me, yeah, the first one, I would say, yeah. … [because] well, [simple]* (Household 7)

> *… the first one… There was a clear, direct flow-through from [what I did] to what it would do to my energy bill. … I could internalise what I thought I was doing… The first one had clear incentives. The second one was…effectively gaming with other people… I was quite happy to do all the things I'd been doing during the first trial, but I wasn't going to go the extra…* (Household 1)

> *… once I saw a bigger figure in the second trial, that was a bigger incentive. … The fact that I saw, I think it was 300-odd quid, I've made a determined effort to do something. Whereas, before, it was …you know, this would be good to do, and I know…there is some kind of reward, but I don't know exactly how much it's going to be.* (Household 5)

It is possible that these differences in participant preferences in relation to the trial are partly a function of whether they enjoy the kind of risk-taking that playing the lottery or betting involves, and this was explicitly mentioned by one participant and implied by another: '… if you've got a gambling instinct and you're basically sort of risk-taking, the second one had sufficient incentive. I know that I'm very risk-averse – everybody tells me I'm risk averse.' (Household 1). The research attempted to test this hypothesis by including questions in the participant surveys on whether participants played the lottery, bet on sports and/or entered competitions for prizes, and if so, to what extent. The purpose of these questions was to assess participant involvement in this kind of associated risk-related behaviour and explore whether this helped to explain who responded more to Trial 2. Interestingly, three of the participants who did play the lottery increased their proportion of off-peak electricity use in Trial 2, and three of those who did not, reduced their proportion in Trial 2. This could suggest that there is a potential correlation between lottery playing and the appeal of the pool-based incentive of Trial 2, though the very small sample size and the fact that the remaining third of the sample showed no such correlation makes this assertion very tentative.

However, it is important to note that the one participant who explicitly said that he had been more motivated to shift electricity consumption by Trial 2, also said that were a pooled-base incentive offered by his energy supplier, his motivation to shift usage would need to be buoyed by winning the pool, otherwise it would wane: 'The pooled element makes it a bigger figure, and it certainly makes it a stronger incentive for me to want to do it, but I think, over time, if I wasn't achieving it and getting some kind of reward, in my world, there'd be a cut-off point of saying, do you know what, I've had enough of this now' (Household 5).

In summary, then, households did respond to the trials by increasing their off-peak electricity consumption by an average of 36% in Trial 1 and 35% in Trial 2 respectively when their changes in total energy use are taken into account. These shifts were associated with peak reductions of 26% and 16% respectively which compare favourably to tariff-based reductions. Being a very small-scale and short-term exploratory study, however, these findings require confirmation through further trials. In this study, a number of the participants achieved these results partly by decreasing overall electricity use, a strategy which provided them with a double dividend of reduced bills as well as potential (in the case of Trial 2) financial payments.

Some participants appear to have responded more to the first trial and some more to the second, although other factors may also have been involved. However, only one of the seven participants who were interviewed explicitly expressed his preference for the second trial, despite the level of incentive on offer. This may be partly the function of some misunderstanding of what the second Trial involved, as discussed earlier, but for a couple of the interviewees, it was the uncertainty of whether they would win the pool, despite their efforts, that made Trial 2 a less popular incentive. Individual tolerance to risk may therefore have played a role in participant preference for one trial or the other, and in their actual response to the respective trials.

3.2.1 Participant experiences and perceptions of barriers to responding to financial payments

However, the interview and survey data also suggest that many of the barriers to participation and response that were identified earlier for tariff-based approaches to demand response – perceived disruption to existing habits and patterns of living; insufficiency and/or uncertainty over scale of benefit; lack of access to/understanding of facilitating technology; limited consumer knowledge and bounded rationality; participant values, attitudes, beliefs, priorities,

norms and social interactions; and preventative current circumstances and accommodation – remained to some extent for the forms of incentives trialed in this study. The height of these barriers differed not only (as we have seen above) by participant, and therefore by trial, but by electricity-using practice.

The most frequently mentioned barrier to shifting consumption to off-peak periods and thus to engaging and responding to the incentives was the temporal pattern of everyday living, what one participant (Household 7) called 'lifestyle' and another (Household 10) called 'routine', particularly as structured by the conventional patterns of the working week. This is illustrated in the quotations below:

> *I like to do something good for the environment, so it is good. But again, like I say, like sometimes it's very difficult to do that – it depends on the lifestyle…* (Household 7)

> *Work, because I work during a significant portion of the cheaper tariff, and as much as I do have certain appliances that you can programme, there is an effort to learning how to programme it and doing it… For me, that's the biggest barrier.* … (Household 5)

> *I guess the main barriers would be the time, kind of the morning, the morning routine, and the evening routine, and then, because none of us are stay-home people, or none of us work from home, so we're unable to kind of shift the energy that we've always used at that time.* (Household 10)

But it was clear from the interviews that there were certain electricity-using domestic practices that interviewees were more amenable to shifting to off-peak times than others. In particular, three interviewees mentioned that they had shifted doing the laundry to off-peak times, facilitated in two cases by timers on their washing machines (they did the laundry late), and one by the fact that she worked at home so could do it in the afternoon. This last participant also had moved using her dishwasher to after 11pm, which she said was easy for her and her husband to do because they were usually up late. Two other participants noted that they had not been able to shift their use of the dishwasher to off-peak hours because there was no timer on the machine (and presumably they went to bed earlier, or were concerned about noise), However, two of the interviewees also highlighted the potential problems such switching could cause.

… the washing, I guess, should be a little bit easier to be done automatically, but again, from a practical point of view, it then sits in the washing machine until you come to empty it out and you get more creases that way, whereas if you do it, if you're here when it finishes, you take it straight out and there's less creases. (Household 5)

The letter sent round the building to ask people not to use machines after 10pm in consideration to others in the building (Household 3)

Conventions, rules or norms in relation to what is perceived as acceptable behaviour (wearing uncreased clothes, for instance), and the type of domestic space (in this case study, flats without a garden), therefore, also impact on the timing of such practices, beyond the issue of whether the related devices being used have a timer, a barrier mentioned by two of the participants. This is particularly highlighted in the next quotation.

... on a Saturday afternoon, I'm pulling out the washing from the machine and …put on the dryer, and then I might have visitors; whereas, if I go back to my old routine, that's already tucked away and out the way and the visitors don't see it. As it is, they sometimes see it [out in the lounge]. (Household 5)

However, it seemed that for most of the participants, appliance-based washing of clothes and dishes were practices that were perceived as potentially moveable to off-peak periods. In contrast, cooking an evening meal during peak usage was not seen as a practice that could be shifted, even where a cooker had a timer, because of the pre-planning this would require, questions over the quality of the food that would then be produced, being hungry, and (implicitly) social norms about eating times.

So, main barriers there would be…I think it's timing, timing-related… So, obviously, certain things like operating an oven or a hob or a kettle, you can't shift that to off-peak obviously because you need to cook when you need to cook; but other stuff, like washing machine and all that, what I've started doing now is I'll push my washing in, but the washing machine has a timer and I can delay it, so which is quite handy, because then I don't need to stay awake until off-peak hours – I can just put it in, put it on a timer, and it will go on while I'm asleep. ... not in the cooker because, like I said, with the cooking, it's really, you know, you have to have dinner at eight or something, you can't

really do much – you can't, you know, shift your dinner timing. That's harder to do. (Household 8)

I even got a pamphlet out, starting to think, well, I could turn the oven on and do it automatically, but it gets a bit complicated then. ... During the week, it's really difficult because...,I would come back from work and the oven went on. Even though I knew that it was in a peak, more expensive time, I had no choice. That was me cooking, you know. I couldn't come home to cook and then go back to work – you know, it's just impractical. (Household 5)

For example, like, if you are coming from work and you are hungry…and you don't have the time to pre-plan everything… (Household 7)

What this suggests is that different practices have different temporal plasticity, with some being perceived as easier to shift than others, depending on the equipment involved (the stuff), related social conventions and the competencies required (e.g. knowing how to use a timer on an appliance) (Shove and Pantzar, 2005). As a result, some practices were seen as easier to do off-peak than others, with cooking in the evening being seen as the least moveable. This may explain why the participants were generally more positive in the questionnaires about being able to shift some of their consumption to off-peak as opposed to the question that asked generally whether they felt they would be able to shift usage, although all felt to varying degrees that shifting electricity consumption was a good idea[8]. Although a very small sample, this reinforces the analysis above that suggests that the height of the barriers preventing the shifting of energy consumption varies according to the practice (energy service) involved. This echoes findings from other studies (e.g. Hargreaves et al, 2010[9]), which together suggest that price elasticities for demand response may vary according to particular energy service, and the related practice and electricity-using device. From our review the majority of price elasticity studies of

[8] By the second survey, after they had been through the two trials, participants' scoring of their feelings of efficacy in relation to shifting *some* energy had risen for two of the participants, stayed the same for two and fallen for another two, whereas the scores fell slightly for four of the participants and drastically for one in response to the question on efficacy in relation to shifting energy generally.

[9] Although it is important to note that Hargreaves et al (2010) question whether the term 'barriers' is helpful when trying to understand how people engage with energy monitors and load-shifting more generally.

energy/electricity are conducted at an aggregate level. One relatively rare example of a study that is appliance based is by Reiss and White (2005)[10].

As the quotations below suggest, the participants were willing to shift electricity-using practices as long as they felt they both had temporal control over the practice and that they did not perceive this as causing excessive disruption to their ways of living.

> *It's got to work for me. And it is, to me, it's this incentive in saving money. If I can save money from it, I will change my pattern, but I've got to save money, and I don't mind being inconvenienced, but not too much, if that makes sense… what I try and do is…at weekends in particular, where my time is my own, that's the key time for me to shift my use pattern to… Because I know in my head, oh, for four or five days, I had no choice but to use the oven, I definitely need to make sure between… two and five or whatever it was, that's my time for washing machine, PlayStation, television, you know, iron, hoover…* (Household 5)

> *Well, I think, basically, it's encouraged me to try to shift consumption to the off-peak times, but obviously, where it wasn't practical, it didn't.* (Household 1)

> *… suppose you don't have to [spend] energy, you can get some benefit from the [programme] as well. Otherwise, you carry on with your life.* (Household 7)

But one interviewee also explicitly pointed to the role of competing priorities which might come into play in deciding whether to shift usage or not in any one evening.

> *… you're tired, you've got to think about the following day, you've got other, you know, [phoning] and stuff to do, and then it's all, oh [sighing], no, I'll just switch the TV on…oh, maybe I shouldn't… You could go two ways, where you just give up and think, oh sod that, you know, I'm just going to do what I want to do, to no, no, no, there's a reason why I'm not going to turn the TV on.* (Household 5)

It was an individual's assessment of the balance between what one participant called the 'hassle factor' (Household 1) caused by shifting the practice and the perceived benefits

[10] From their research, they state that there are two "types" of households with respect to electricity demand behavior: those who use electricity for space heating or air conditioning and exhibit some electricity price elasticity, and those who do not and are price insenstitive.

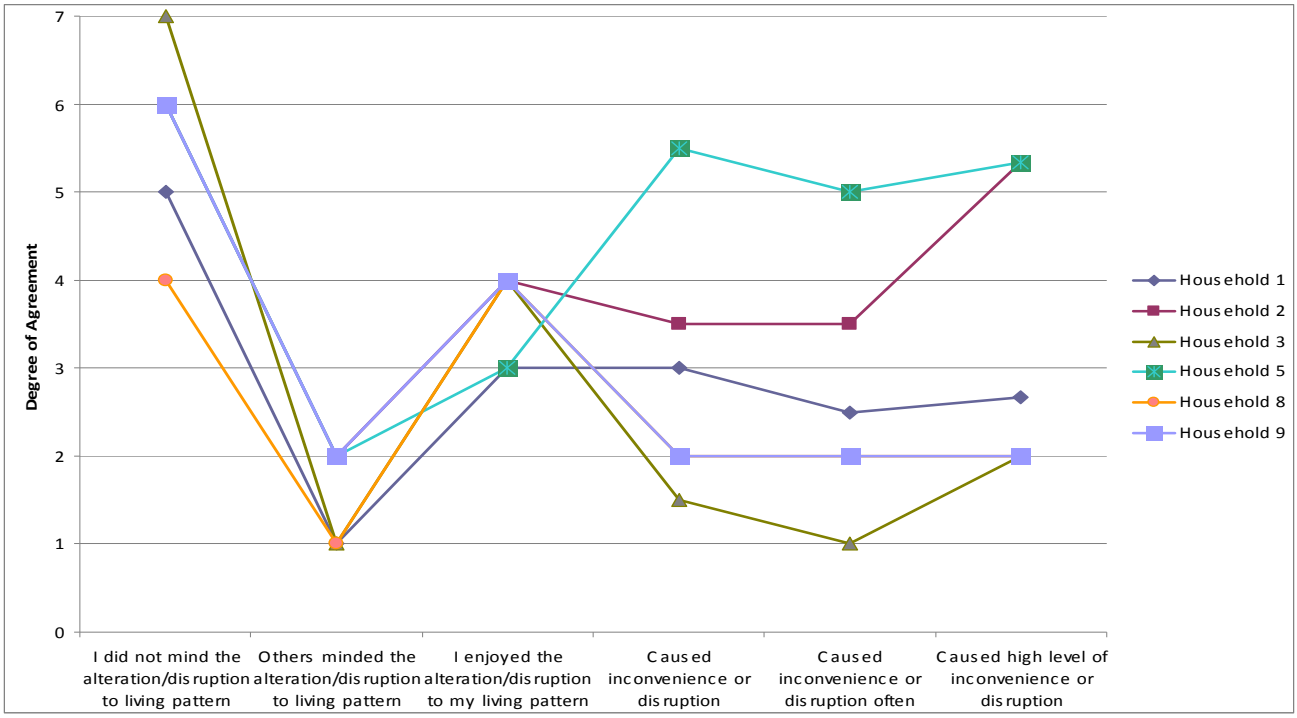
(economic, environmental and/or social) which a couple of participants suggested was a key determinant of how much was shifted.

> *if I'm honest, I guess it's the financial aspect that's put me into that routine. What would then – when the financial aspect disappears, the convenience factor then comes in ... So, if I'm honest, once the financial incentive is gone, the washing will probably be nine o'clock in the morning, which is where it always used to be, just because it fits my lifestyle.* (Household 5)

> *… it was the trade-off between, well, how much more can I do, how much is that actually going to inconvenience me, as opposed to just make me think about what I need to do* (Household 1)

Though the ease of fitting temporal changes in practice into overall patterns of everyday living evidently plays a role, the degree a participant chose to shift also appears to have been influenced by the way s/he constructed, measured and weighted inconvenience and benefit, and this seems to have differed from participant to participant. For example, the participant from Household 5 felt that within the trial he had gone a long way to try and win the pool in Trial 2 in that, as the chart below (Figure 6) and his interview responses indicate, he had put himself through what he experienced as quite a lot of inconvenience. However, his shifts from peak time to off-peak time, and reductions in electricity use, were not as great as that of Household 3 in Trial 1, where the participant reported very little feeling of inconvenience or disruption.

Figure 9: *Participant responses to Survey 2 questions about inconvenience caused by trials*



This difference in experience may be partly explained by the fact that Household 3 worked at home and went to bed late, so they found it relatively easy to shift the timing of practices in comparison to those who worked elsewhere, as with the participant from Household 5. But the study was framed in somewhat environmental terms and the participant from Household 3, in contrast with the participant from Household 5, scored highly in relation to pro-environmental measures, and possibly this may have meant that she experienced less inconvenience because the shifts were more aligned to her intrinsic values and identity. In addition, the participant from Household 5 referred to himself as a 'man of routine', and implied that changing temporal patterns of particular practices was therefore particularly challenging. Whether pro-environmental orientation or a preference for routine had any actual bearing on these participants' perceptions of inconvenience is not possible to say from this study. What is important to note is that, for the participant in Household 5, the level of financial incentive had been high enough, particularly in Trial 2 as he says below, to incentivise him to shift his electricity usage when he felt this was feasible, despite the relatively high levels of inconvenience he experienced[11].

[11] Though this household also increased its overall consumption during Trial 2.

… when we moved into the second period… and I saw the amount that potentially is up for grabs, I was more determined to make an effort because I thought that's not an insignificant amount of money so I want a chance to do that. So, I actually purposely have tried to shift as much as I can to do that. So I would argue, in my case, if the incentive is big enough, I will change my lifestyle as much as I can. But the working bit, I can't change, unfortunately, so there will always be…that element of putting the oven on at a peak time because that's the time I get home. (Household 5)

Two of the other participants felt that the financial payments they received in the first trial were 'good' (Household 8). One of these participants (Household 8) talked about how the money off-set what was an already low electricity bill, and the other mentioned that if one calculated potential net payments over a year based on the payment they had received, it was a decent amount (Household 3). However, the financial incentives had not been the primary motivation for participation for this latter participant: she said that the reductions and shifts they had made were something she had wanted to do anyway. This was echoed by Household 10 too who indicated that the 'financial [incentives] didn't work kind of that much' in that she was more interested in reducing consumption and this had been her main reason for becoming involved in the study.

But for other participants the financial incentive was not large enough to have incentivised them to shift in the longer term:

Financial incentive is all very well, but they are marginal on a relatively low energy use property... to be honest, the level of incentive was there, but it wouldn't have been sufficient given…given the trade-off between the convenience and the incentives to make me want to do that all the time. (Household 1)

From what I saw, it was [a tiny amount] and didn't really make… You have to have an amount which [compares] with the amount which you pay every [month]. …at least in my home like, the main charges in the bills, they are coming from maintenance fees and… they are all….inside the bill, so this is fixed tariff, so even if you [save] amount of energy you spend, still you get these kind of high bills (Household 7)

These mixed responses to whether the incentives on offer were sufficient enough to outweigh the inconvenience caused and thus incentivise shifting appear to have been independent of household income, as whilst Household 1 reported an annual income of above £60,000 Household 7 reported an income level of between £20,000 and £39,999, as did Household 10, and Households 3 and 5 both reported income levels of between £40,000 and £59,999.

What is encouraging though is that a number of participants mentioned that being involved in the study had led to the formation of what they called new energy-saving and shifting habits which they hoped to maintain even once the incentives stopped. An important aspect of this formation of new habits, four of the participants suggested, had been the information provided by the monitoring equipment on patterns of electricity usage by appliance.

> *… I'll keep on doing all the things I have been doing, which I have been doing beyond the trial time as well, because that becomes a force of habit, so I will use the washing machine at a time when I'm told it's off-peak ... Because once you change your habits, …then the habit changes, and it [changes] irrespective of the financial incentive.* (Household 1)

> *… the PlayStation seems to be the one that uses the most. I used to leave that on, along with the TV, along with a lot of things, just left on idle, where now, a lot of things get switched off at night because they're not – I get up quite early and I go straight to work. They're actually then switched off for three-quarters of the day, whereas, before… ... even when it's all finished, I'm now aware that certain appliances use more electricity. I would switch them off rather than leave them on standby…* (Household 5)

> *However, the way we're looking at it is, in the long term, you're going to have to carry on these ways that you've kind of adopted during the incentive – you're going to have to carry them on for the future, just not for the incentive, and I think that is a very good thing now, that you get into a routine of saving the energy and it carries on.* (Household 10)

Two of these participants said that the study had allowed them to see how much they were willing and able to shift. In essence, the pilot therefore facilitated them to test whether they could alter pre-existing habits, one of the barriers identified for tariff-based approaches. What is unclear is whether it was the fact that it was a study (mentioned by one) of short-term duration

or the fact that the nature of the incentives meant that this was done with no cost to them. What is clear is that at least one of these participants came out of the experience with a sense of self-efficacy in relation to shifting: 'Because I've done it now, so I know I can' (Household 5).

All those interviewed who were asked about whether they would accept an incentive-based approach to encourage load-shifting if offered by their supplier said they would consider it if on the basis of Trial 1. Two said they would not if it was on the basis of Trial 2. However, like with the identified barriers for tariff-based approaches, discomfort with the uncertainty over – in this case --- what the payment will be (as opposed to what the bill will be in Time-of-Use) also featured in a couple of participant responses to the trials.

> *... to me, personally… I would probably prefer paying less rather than being rewarded for it. …. just because, you know, then I can monitor ... in real-time, how much I'm saving, rather than waiting for a reward at the end of the month type of thing.* (Household 8)

In the case of Household 5, this was because he perceived the concept of financial incentives as temporary, in the sense that they could be withdrawn. For him, a tariff offered by a supplier suggested greater permanence. As a result, he preferred the idea of a Time-of-Use (ToU) tariff to the financial incentives on offer, although he said whether he accepted any ToU tariff offer from a supplier would depend on the terms offered (and whether he had the time to calculate whether he would benefit financially) as he did not want to find his bills then went up. Four of the other interviewees also said they would consider a ToU tariff based on the same considerations, one of whom also said he preferred the idea of a ToU tariff to the financial incentives offered by the trials because it was 'clear and permanent and transparent… [and] then I know what I'm doing, so I would say, well, actually, I do need to do a wash this morning – how much more is it going to cost me if I do it at 11 o'clock or if I do it at 1 o'clock?'. Interestingly, though, the participant from Household 8 who had said something similar, felt he would not want a ToU tariff because he liked 'to have my flexibility…of being able to use what I want to use, when I want to use'.

The quotations below illustrate some of the varied viewpoints that participants expressed on the comparison between financial incentives and Time-of-Use tariffs:

….the problem that I can see with any incentive versus tariff structure is that it gets complex. ... To say…if I need to do a big wash, I will potentially gain because it's cheaper to do it at this time, that's a lot harder to comprehend I think, from my perspective. I mean, I know the theory of it and [find it quite a] concept – I mean, anything that you can't put on more than a side of A4, probably with a couple of diagrams, people just say, "Oh, this is too complicated!" (Household 1)

If it was an incentive, I think, after a few months, that would die off a little bit, the wanting to do it, whereas if it was a tariff, I'd feel more, secure that that was a long-term thing. ... I think, psychologically, for me…I would actually get fed up with it. Whereas, if it's a tariff, it's all black and white and… I would probably be more likely to stick with that because then it's an official thing from the…[presumably] from the electricity provider… (Household 5)

if they give you a tariff, then you've always got to stay conscious of staying within that tariff … when you kind of do your monthly budget, it kind of hits you more… that's the other thing with having to have a tariff and everything, the idea of having to be penalised for the little extra, and sometimes you can't really help having to use the extra, or it could be just something as silly as forgetting. …the disadvantage about the tariff is the restriction…. The…incentive …the best advantage it has, it kind of gets you into a routine which you can carry on [as you like], but the disadvantage of it is that if then the financial bit of it goes, then a lot of people will give up on the habits that they've picked up. (Household 10)

…I guess it effectively boils down to the same thing. I mean … so, …. let's say you save a pound a day by switching to off-peak, then you'd save £30 a month, whereas if you'd done the same and you get £30 reward at the end, so it's effectively the same, well, I guess, yeah, I view the two quite equivalent. ... I can't say that one way is definitely better than the other or vice versa. (Household 8)

Both the last two households felt that 'possibly you'll attract more people because of the financial incentive' (Household 10) than with a tariff: 'I think …for normal, average people, I can take a guess that that would be a barrier for them, people with families and all, they really can't afford to pay extra during peak hours; but if they weren't being penalised, then I think a lot of

people would quickly jump on board this.' (Household 8) If they are right and the nature of incentives is well-communicated, then the barriers to participation might then be lower for incentive-based approaches than for Time-of-Use tariffs, although this assumption needs to be tested.

What came out strongly from the interviews was that people's response to such incentives varies 'depending on the person, you know, the personality' (Household 7), 'you as a character' (Household 5), or as the participant from Household 10 put it: 'the state of mind of the individual'

> *You can say…as long as it's environmentally friendly, you can sell me virtually anything to help the environment as it is, but I also do appreciate there are people that just don't care about the environment.* (Household 10)

> [Of Trial 2] *I'm sort of independently saying, well, actually, I'm not sufficiently bothered …to go all out to win this particular prize. … I tend to think about it, if I can actually do something, if I can change my habits and I will actually see some sort of positive benefits, to me as well as benefit elsewhere, I'll do that, but if all I can see is I'm changing my habits and somebody else benefits from it, I'm sufficiently selfish to say, well, how can I trust somebody else to do the things that will enable me to benefit?* (Household 1)

> *So I would argue, in my case, if the incentive is big enough, I will change my lifestyle as much as I can. … I'm driven in what I believe is reality and what my bills are each month. So, for me, it's a case of is there an opportunity to save some money and reduce my outgoings in the month, and if there is, I'm up for it. So, I think it depends on the individual, and I think you have to look at the population in general and say, look, out of the whole population, only 25% will actually be interested in this, and then look at the business case and say, well, is it still worth us doing it, because you'll never get everyone. … you've got to work out …what gets their attention, what are they interested in, and it's different for everyone. My nephew would do it because he wants to save the world. He doesn't [care] about saving money. If I'm honest, I think the majority of people would just want to save money.* (Household 5)

But the participant from Household 5 also felt that individual responses to different incentives for shifting electricity usage to off-peak may not only be influenced by individual motivations but by

their ‘personal circumstances, and some people will be able to shift more than others’. An example of this is where one interviewee (Household 9) talked about how he was living in a studio flat which meant he could not put on the washing machine or dishwasher late at night because they disturbed his sleep: ‘I live in a studio apartment, there’s certain things you just don’t want to run at off-peak times because they’re loud and annoying and in the way’. He suggested this would be different for someone living in larger accommodation.

It may also be reflected in the data on the proportion of off-peak and peak electricity usage described earlier. The two households which had the highest proportions of off-peak usage in the benchmark period were the households where there was the least increase in off-peak the proportion of off-peak consumption during the trials. This may be because they were already doing the practices that are easier to shift to off-peak periods during the designated off-peak hours, leaving them only the harder-to-shift practices as possibilities for moving, although there is no direct evidence for this hypothesis.

Overall, though, what the study indicates is that different incentive structures appeal to different people, often for different reasons. But this also means that the barriers to the participation and response that have been identified for tariff-based approaches are not completely overcome by the incentive-based approaches used in this study. Instead what the study suggests is that the height of these barriers varies according to the design of the measure in question, the person involved, and the particular practice (or energy service) in question As a result, the extent to which these issues were perceived as barriers, if at all, varied across participants. Moreover, there is evidence that risk-aversion was an additional barrier for at least one of the participants in Trial 2.

However, the most frequently mentioned barrier to load-shifting generally – and thus to all measures to encourage demand response – was existing patterns and habits of living, as partly determined by the temporal demands of work. The ‘barrier’ of whether the incentive on offer is perceived as sufficient is therefore integrally related to – and traded off with – the extent to which inconvenience is experienced, with the habitual temporal rigidness of some practices (preparing the evening meal for instance) being seen as more difficult to shift than other practices (e.g. appliance-based washing). This suggests there may be different price elasticities in relation to shifting the timing of different energy services.

4. Conclusion

The purpose of this study was to test in one block of flats in the UK whether the use of financial incentive-based measures to day-in day-out residential demand response in the electricity sector are able to overcome some of the barriers to participation and response encountered in Time-of-Use tariff-based approaches to load-shifting. The 8% participation rate for this study was better than for many conventional demand response trials, but it was a small, short-term study with 10 participants and therefore further research will be required to ascertain whether this can be replicated, or even improved, given there was no concerted marketing campaign involved.

Overall the qualitative and metering data together suggests that most of those involved in the study made deliberate attempts to shift the timing of their electricity usage, and in a number of cases to reduce, their electricity consumption, a motivation for participating in the study mentioned by a few of the participants. Whilst the financial incentives were not the only reason given for study involvement, six out of seven of those interviewed suggested that being financially rewarded for shifting electricity usage to off-peak provided an additional incentive, with one participant saying it had been fundamental to motivating him to actively engage.

Participant response to the trials saw an increase of 14% and 11% in off-peak usage in Trial 1 and Trial 2 respectively in comparison to a benchmark period. When taking into account changes in overall electricity use, which particularly involved reducing overall consumption in some households, off-peak electricity usage in Trial 1 rose on average by 36% and by 35% in Trial 2. This was accompanied by average reductions in peak-time use of 26% in Trial 1 and 16% in Trial 2 when compared with Benchmark usage. These latter figures compare favourably with studies of 'day-in day-out' tariff-based approaches, particularly given tariff-based trials have tended to occur in contexts where electricity-run space cooling or heating is the norm, which was not the case for this study.

The reason that Trial 2 did not generate as high a peak reduction as Trial 1, despite having a very similar off-peak percentage, was that for the majority of households, peak consumption rose in comparison to Trial 1, having mostly fallen from the benchmark period during Trial 1. This might suggest that the incentive measure utilised in Trial 1 (where households received 9 pence for every kWh of off-peak consumption as long as their total usage did not exceed that of their Benchmark period) was more successful in generating a broad response than the pooled

incentive of Trial 2. But there is some evidence that this difference may be partly attributable to the ordering of the trials. Other factors such as friends staying or rising temperatures, leading to the use of fans, may also have played a role.

This makes it difficult to assess whether the financial incentive structure utilised in Trial 1 was more effective than that of Trial 2. Indeed data from the interviews with seven of the participants indicates that at least one of the participants preferred Trial 2 because of the potential size of the pool to be awarded, and attempted to shift more of his usage as a result. Yet a couple of interviewees on very different incomes felt the financial benefits on offer were not great enough in one or other of the trials to incentivise them to make shifts in the longer-term: in one case this was because of perceptions of the electricity bill as already low and in the other, because he felt maintenance costs made up the bulk of the bill, thus dwarfing any return from shifts in usage. This could suggest that for some people bill pricing structure may be a barrier to response.

The barriers to participating and responding to financial payments indicated by participants, were largely similar to those identified for Time-of-Use tariffs, however: perceived disruption to lifestyle, insufficient or uncertain scale of benefit, lack of facilitating technology (particularly timers on dishwashers), limited consumer knowledge and bounded rationality, competing value orientations, beliefs, and priorities, and preventative current circumstances. In particular, for Trial 2, attitude to risk may have played a part in participant response, despite (in the words of Household 9) there being 'a potential for award and no risk of loss'. It was clear from this study that different participants were attracted to different incentive structures (if at all), according to their psycho-social orientations, their existing patterns of living and working, and their living arrangements, be they living alone or with someone else, or in a studio or larger flat. The issue then may well be less about finding one incentive structure that is able to attract all, but a suite of measures that attempt to appeal to different people in different contexts.

The findings also support evidence from other studies that suggest people feel more able and willing to shift some electricity-using practices [washing, for instance] than others [cooking an evening meal] (Hargreaves et al, 2010). Not only does this raise questions about whether 'barriers' is the best term to use when thinking about how to incentivise residential load-shifting (Hargreaves et al, 2010; Shove, 2010), it suggests that different residential electricity services

may have different price elasticities. If this proves to be the case, then economic modelling for demand response may be strengthened by taking this into account.

Based on their detailed study, Reiss and White (2005), state that there are two "types" of households with respect to electricity demand behaviour: those who use electricity for space heating or air conditioning and exhibit some electricity price elasticity, and those who do not and are price insenstitive. Results of this paper suggest that some customers without electric space heating or air conditioning may actually be responsive. This is just one of the potential avenues for further research that the findings of this small scale exploratory study have highlighted.

In particular, this study, has drawn attention to, and begun testing, the potential of financial incentives as an approach to domestic electricity load-shifting, and found that it can help to incentivise demand response for at least some people. Given its exploratory nature, the findings are neither conclusive nor exhaustive (no attempt was made to assess the economic costs of such an approach for instance in relation to potential savings of building and maintaining marginal generating capacity), but by combining meter, survey and interview data, it has also provided a rare insight into the issues of barriers to participation and response to residential electricity shifting more generally in a context where consumer electricity use does not include space heating and/or cooling.

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Appendix 1: Initial letter sent to participants.

Invite to take part in the energy shift study with Thameswey and the University of Surrey.

Dear Sir/Madam,

We are writing to invite you to take part in an energy study being conducted by Thameswey and the Centre for Environmental Strategy, University of Surrey. The study is looking at the role of financial incentives in encouraging shifts in household electricity use to different times of the day. The research is part of a larger study exploring the potential environmental and economic benefits for the UK (and benefits for individual energy consumers) from such shifts in demand. In relation to the environment, shifts in electricity use can help accommodate greater contributions from renewable power. In terms of the economy, shifts in electricity demand can help the electricity system run more efficiently.

The study will consist of:

- Two brief participant surveys (5/10 mins) which provide information about your situation, experience and values;
- The collection of the electricity used by your major household appliances (collected autonomously with no input required from yourselves). A portable 'smart meter' display screen installed and supported by Thameswey will provide energy feedback to you (*The technology is easily installed and does not require physical alteration of existing fixtures, fittings and walls etc).* The metering will collect just electricity use data for 5 months. The equipment will be collected from participants at the end of the study, by Thameswey at the next standard metering visit. However, you have the option to keep the monitoring equipment after the study, if you manage to complete the two questionnaires;
- A three month trial where financial payments are available from Thameswey for electricity shifting at the end of each month, this will start in May. Payments will depend on the proportion of electricity consumption that is off peak (off peak is between11pm to 7 am and 1pm till 5pm).

It is your decision whether to respond to financial incentives available. Participating in the study will not affect your current electricity tariff, so you don't need to worry about this.

Benefits of the study for participant are as follows:

- Financial payment for shifts you make in the timing of electricity consumption;
- Provision of the metering plugs, screen and software that you can keep: The kit provides you with easy to understand information on where in your house (e.g. appliances) electricity is being used. The information in easily accessible. On completion of the study (and two questionnaires) you have the chance to keep this electricity monitoring equipment.
- Information that can help you reduce your electricity bills.

Further detail on the trials and incentive payments is provided on the application form. Your participation or withdrawal will have no bearing on the electricity prices that you pay in future from Thameswey or your relationship with them. If you would like to take part in the study please fill in the attached application form and return to Thameswey in the addressed envelope provided, or send the application form by email to info@ecsc.uk.com Thank you for your co-operation.

Yours faithfully,

John Thorp

John Thorp MBA MSB CBiol FEI FRSA

Group Managing Director

Thameswey Energy

Application form

In order to take part and continue participation in the study you will need to:

- Keep the electricity metering in place when consuming electricity (for as long as you are participating in the study).
- Agree to provide permission for Thameswey to supply information to the University of Surrey on: a.) your monthly electricity consumption over the last year to inform the researchers of the study Surrey. b.) your contact details, so that the researcher can liaise with you when required;
- Have access to the internet.

All data will be held and processed in the strictest of confidence and in compliance with the Data Protection Act. No information that could identify an individual from the study will be disseminated outside the Surrey research team. Due to small size of the study it may be possible that your identity may become known to the researchers working on the project at the University of Surrey. Please note that any electricity use data collected will not be analysed until a week after the time of energy consumption. Any information which could identify an individual, including an email address, will be held separately so that the data are anonymous. If you wish to ask further questions about the study, please contact John Thorp of Thameswey, who can direct you to the relevant researchers at the University of Surrey.

If you would like to take part in the study please provide answers to the following questions: If you work/study, what are the numbers of days that you work/study and typical hours on an average day (please estimate)? Number of days..... Number of hours.....

Further information: The study will last five months in total. For three of these months you will have the ability to attain money based on the extent to which you consume at off peak times. Off peak times are 11pm to 7 am (night) and 1pm till 5pm (daily). In the first month where financial rewards are available, an incentive account will be created for you. Each participant will continue on their current tariff and pay their electricity bill as normal. The money to be put in the incentive account at the start of the month will be estimated based on your long term monthly average figure of electricity use multiplied by 6 pence (this value will treble in the second and third months). For the average household the amount of money put in the incentive account at the start of the first month would be £17 (275kWh of electricity use multiplied by £0.06), and £50 in the second and third months (275kWh of electricity use multiplied by £0.18).

Incentive accounts can only be accessed at the end of the month. The extent of money in the account and available to you at the end of month will depend on how much electricity you consume at off peak times (11pm to 7 am and 1pm till 5pm daily). If all of your consumption is off peak you will receive the full financial incentive account.

When it comes to paying rewards at the end of the third month of incentives, all accounts will be pooled and one of the participants in the study will win the joint account at the end of the month based on a draw (at the start of the month each participant will have at least a 1 in 25 chance of winning – as there is a maximum of 25 people in the study). Each person's chance of winning will change by the end of the month, depending on how much consumption is off peak. Higher proportions of off peak consumption will improve your chances of winning the pool account.

We now need you to read the following text and confirm your participation with the project: I have read and understood the information provided and have been given the opportunity to ask questions on all aspects of the study and have understood the advice and information given. I agree to take part in the study and consent to my data (as outlined in the letter and application form) being used for this study. I understand that I am free to withdraw from the study at any time, without needing to justify my decision.

Signature..... Date..... Email contact.....

Appendix 2: Questionnaire 1a

Questionnaire:

As part of the energy shift study, you will receive electricity metering equipment that will provide useful information about where in your house you use electricity. Before conducting the survey we briefly refer to other key points about the study: In later months of the study you will have the opportunity to earn financial incentives for electricity consumed at off peak times (11pm to 7 am - night and 1pm till 5 pm - daily). By deferring (or shifting) electricity consumption from other (peak) hours to off peak you can increase financial payments attained. As noted in earlier communications, if your overall monthly electricity use increases above your long term average however, financial incentives earnt can be eroded.

In order to understand what people think about participating, technology, and other factors, we would be grateful if you could now complete the short questionnaire following. You can opt out at any time. Responses to this survey will be collected by the Centre for Environmental Strategy and will not be viewed by any Thameswey personnel. All responses will be confidential. Any information which could identify an individual, including an email address, will be held separately so that the data are anonymous. All data will be held in compliance with the Data Protection Act, and no individual data will be disseminated outside of the CES research team.

Email.....

Your participation and views about this study

Please indicate to what extent you agree with the statements below.

	Strongly Disagree						Strongly Agree
I participated in this study because of being able to keep electricity monitoring equipment	❍	❍	❍	❍	❍	❍	❍
I participated in order to receive financial payments for electricity consumed at off peak times	❍	❍	❍	❍	❍	❍	❍
If there was not the chance to win the collective financial payments of all participants in the last month of the study, I would not have participated	❍	❍	❍	❍	❍	❍	❍
I participated with the study due to potential societal benefits (economic and environmental) from the study	❍	❍	❍	❍	❍	❍	❍
Overall, I trust Thameswey as an energy supplier	❍	❍	❍	❍	❍	❍	❍
Overall, I have confidence in Thameswey maintenance	❍	❍	❍	❍	❍	❍	❍
To what extent you believe electricity suppliers can gain from such incentive programmes as offered	❍	❍	❍	❍	❍	❍	❍
To what extent do you believe electricity consumers gain from such incentive programmes as offered	❍	❍	❍	❍	❍	❍	❍

Using electricity at home

Some emotions are listed below. Thinking about shifting your electricity consumption to off peak times, how much do you expect to feel: A

	Not at All						Great Deal
Interested?	❍	❍	❍	❍	❍	❍	❍
Frustrated?	❍	❍	❍	❍	❍	❍	❍
Proud?	❍	❍	❍	❍	❍	❍	❍
Bored?	❍	❍	❍	❍	❍	❍	❍

Please indicate to what extent you agree with the statements below. Although some statements appear to be worded similarly, each one is different.

	Strongly Disagree						Strongly Agree
I believe it is a sensible idea to try to shift electricity consumption to off peak times	❍	❍	❍	❍	❍	❍	❍
I feel capable of shifting my home power usage to off peak times	❍	❍	❍	❍	❍	❍	❍
I feel capable of shifting some of my home power usage to off peak times	❍	❍	❍	❍	❍	❍	❍
I am not keen to shift my power consumption in the home to off peak times	❍	❍	❍	❍	❍	❍	❍
It is straightforward for me to find ways to shift electricity consumption to off peak times	❍	❍	❍	❍	❍	❍	❍
I do not think that shifting my power use to off peak times is a good idea	❍	❍	❍	❍	❍	❍	❍
It will be difficult for me to shift power to off peak	❍	❍	❍	❍	❍	❍	❍

Your general energy-related actions

Please indicate to what extent you agree with the statements below.

	Strongly Disagree						Strongly Agree
I put used batteries in the rubbish	❍	❍	❍	❍	❍	❍	❍
I recycle empty bottles	❍	❍	❍	❍	❍	❍	❍
I bring unused medicine back to the pharmacy	❍	❍	❍	❍	❍	❍	❍
I take a shower rather than a bath	❍	❍	❍	❍	❍	❍	❍
In the winter, I keep the heat on so that I do not have to wear a jumper	❍	❍	❍	❍	❍	❍	❍
I wait until I have a full load before doing my laundry	❍	❍	❍	❍	❍	❍	❍
In the winter, I leave the windows open for long periods of time to let in fresh air	❍	❍	❍	❍	❍	❍	❍
The heating in my home is turned off late at night	❍	❍	❍	❍	❍	❍	❍
I turn off the light when I leave my home	❍	❍	❍	❍	❍	❍	❍
I turn off electric appliances if I'm not using them	❍	❍	❍	❍	❍	❍	❍
I turn off my lap top/PC if not using it	❍	❍	❍	❍	❍	❍	❍
In supermarkets, I usually buy fruits and vegetables loose rather than pre-packaged	❍	❍	❍	❍	❍	❍	❍
If I am offered a plastic bag in a shop, I will always take it	❍	❍	❍	❍	❍	❍	❍
I reuse my shopping bags	❍	❍	❍	❍	❍	❍	❍
I walk, cycle or take public transport to work/or other daily activities	❍	❍	❍	❍	❍	❍	❍
I often drive on motorways at speeds over 70 mph	❍	❍	❍	❍	❍	❍	❍
When possible, on short journeys (around 20 miles), I use public transport or ride a bike	❍	❍	❍	❍	❍	❍	❍

Have you ever been on a time of use energy tariff (as far as you are aware)?

Yes ❍ No ❍

Why do *you* do things for the environment?

	Does not Correspond At all					Corresponds Moderately	Corresponds Exactly
It's a pleasure to improve the quality of the environment	❍	❍	❍	❍	❍	❍	❍
I would feel guilty if I didn't	❍	❍	❍	❍	❍	❍	❍
It's a reasonable thing to do	❍	❍	❍	❍	❍	❍	❍
I don't know: I can't see what I'm getting out of it	❍	❍	❍	❍	❍	❍	❍
It's an integral part of my life	❍	❍	❍	❍	❍	❍	❍
My friends insist that I do	❍	❍	❍	❍	❍	❍	❍
It's a way I've chosen to contribute	❍	❍	❍	❍	❍	❍	❍
I like the feeling I get when I do things for the environment	❍	❍	❍	❍	❍	❍	❍
I want to avoid being criticised	❍	❍	❍	❍	❍	❍	❍
It's a pleasure to contribute to the environment	❍	❍	❍	❍	❍	❍	❍
I'd regret not doing something	❍	❍	❍	❍	❍	❍	❍
I don't know: I can't see how my efforts are helping	❍	❍	❍	❍	❍	❍	❍
I would feel ashamed of myself if I was doing nothing to help the environment	❍	❍	❍	❍	❍	❍	❍
It seems that taking care of myself and the environment are inseparable	❍	❍	❍	❍	❍	❍	❍
For the recognition I get from others	❍	❍	❍	❍	❍	❍	❍
It has become a fundamental part of who I am	❍	❍	❍	❍	❍	❍	❍
It's a good idea to do something about the environment	❍	❍	❍	❍	❍	❍	❍
Other people will be upset if I don't	❍	❍	❍	❍	❍	❍	❍
It's a pleasure to master new ways to help	❍	❍	❍	❍	❍	❍	❍
I wonder why: the situation isn't improving	❍	❍	❍	❍	❍	❍	❍
It's part of the way I've chosen to live my life	❍	❍	❍	❍	❍	❍	❍
I would feel bad if I didn't do anything	❍	❍	❍	❍	❍	❍	❍
I don't know: I have the impression that I'm wasting my time	❍	❍	❍	❍	❍	❍	❍
It's a sensible thing to do	❍	❍	❍	❍	❍	❍	❍

Your Important Values

A list of values is given below. In the brackets following each value is an explanation to help explain its meaning. Please rate how important each value is for you, personally, as a guiding principle in your life.

	Not at all Important						Very Important
A varied life (filled with challenge, novelty & change)	❍	❍	❍	❍	❍	❍	❍
Helpful (working for the wellbeing of others)	❍	❍	❍	❍	❍	❍	❍
Protecting the environment (preserving nature)	❍	❍	❍	❍	❍	❍	❍
Wealth (material possessions, money)	❍	❍	❍	❍	❍	❍	❍
Pleasure (gratification of desires)	❍	❍	❍	❍	❍	❍	❍
A world at peace (free of war and conflict)	❍	❍	❍	❍	❍	❍	❍
Authority (the right to lead or command)	❍	❍	❍	❍	❍	❍	❍
Respecting the earth (harmony with other species)	❍	❍	❍	❍	❍	❍	❍

Equality (equal opportunity for all)	❍	❍	❍	❍	❍	❍	❍
Ambition (hardworking, striving to perform)	❍	❍	❍	❍	❍	❍	❍
An exciting life (stimulating experiences)	❍	❍	❍	❍	❍	❍	❍
Preventing pollution (protecting natural resources)	❍	❍	❍	❍	❍	❍	❍
Influential (having an impact on people and events)	❍	❍	❍	❍	❍	❍	❍
Enjoying life (enjoying food, sex, leisure, etc.)	❍	❍	❍	❍	❍	❍	❍
Social justice (correcting injustice, care for the weak)	❍	❍	❍	❍	❍	❍	❍
Unity with nature (fitting into nature)	❍	❍	❍	❍	❍	❍	❍
Social power (control over others, dominance)	❍	❍	❍	❍	❍	❍	❍

About you

Please indicate to what extent you agree with the statements below.

	Strongly Disagree						Strongly Agree
Using new technology is an important part of who I am	❍	❍	❍	❍	❍	❍	❍
I do *not* see myself as someone who cares about the environment	❍	❍	❍	❍	❍	❍	❍
I think of myself as someone who is very interested in new technology	❍	❍	❍	❍	❍	❍	❍
Being 'environmentally friendly' in what I do is an important part of who I am	❍	❍	❍	❍	❍	❍	❍
I am *not* the type of person who is into gadgets and technology	❍	❍	❍	❍	❍	❍	❍
I am someone who is concerned about the environment	❍	❍	❍	❍	❍	❍	❍

Are you: Female ❍ Male ❍ Date of Birth: Month ___ Year ___

Ethnic origin:
White ❍
Asian or Asian British ❍
Black or Black British ❍
Chinese ❍
Mixed ❍
Other (please specify) _____

Living arrangements (this influences energy practices):

I live with one other person not my partner ❍
I live with other people not my partner ❍
I live with just my husband/wife/partner ❍
I live with my partner and non related others ❍

Number of adults you live with?

Number of children you live with?

Work status:
- Self employed ❍
- Employed ❍
- Unemployed ❍
- Retired ❍
- Student ❍

You and your partner's/husband's/wifes's combined income (or just you if not living with a partner):

- Less than £10,000 ❍
- Less than £20,000 ❍
- £20,000 to £39,999 ❍
- £40,000 to £59,999 ❍
- £60,000 to £99,999 ❍
- £100,000 and over ❍

Do you enter opportunities to win prizes? (e.g. filling out a questionnaire to win a prize from a supermarket, or entering opportunities to win prizes that can be related to completing a crossword etc)

Yes ❍ No ❍

If so, how often (on average)? (Please identify whether per week, per month or per year.)

Do you play the lottery?

Yes ❍ No ❍

If so, how often on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

How much would you spend on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

Do you bet on sports, card games or on chances of events happening?

Yes ❍ No ❍

If so, how often (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

How much would you spend on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

Thank you for your participation.

Appendix 3: Questionnaire 2a

As part of the energy shift study, you received electricity metering equipment that provided useful information about where in your house you use electricity. Before conducting the survey we briefly refer to other key points about the study: In later months of the study you had the opportunity to earn financial incentives for electricity consumed at off peak times (11pm to 7 am - night and 1pm till 5 pm - daily). By deferring (or shifting) electricity consumption from other (peak) hours to off peak you had the potential to increase your financial payments attained. As noted in earlier communications however, if your overall monthly electricity use increased above your long term average however, financial incentives earnt could be eroded.

In order to understand what people thought about participating, technology, and other factors, we would be grateful if you could now complete the short questionnaire. You can opt out at any time. Responses to this survey will be collected by the Centre for Environmental Strategy and will not be viewed by any Thameswey personnel. All responses will be confidential. Any information which could identify an individual, including an email address, will be held separately so that the data are anonymous. All data will be held in compliance with the Data Protection Act.

Questionnaire:

Please click on Continue.

Please indicate to what extent you agree with the statements below:

Your participation in this study

	Strongly Disagree						Strongly Agree
I trust Thameswey as an energy supplier	❍	❍	❍	❍	❍	❍	❍
I have confidence in Thameswey maintenance	❍	❍	❍	❍	❍	❍	❍
I had sufficient information to aid my shifts in energy consumption to off peak	❍	❍	❍	❍	❍	❍	❍
Taking part in this study to attain financial incentives caused inconvenience	❍	❍	❍	❍	❍	❍	❍
This inconvenience happened often	❍	❍	❍	❍	❍	❍	❍
Taking part to attain financial incentives altered or disrupted my lifestyle	❍	❍	❍	❍	❍	❍	❍
This altered or disrupted my living patterns often	❍	❍	❍	❍	❍	❍	❍

Please rate the following:

	None						A Great Deal
The level of inconvenience from shifting energy	❍	❍	❍	❍	❍	❍	❍
The level of alteration/disruption to my living patterns from energy shifting	❍	❍	❍	❍	❍	❍	❍
The level of disruption to my living patterns	❍	❍	❍	❍	❍	❍	❍

	Strongly Disagree						Strongly Agree
I did not mind the alteration/disruption to living pattern?	❍	❍	❍	❍	❍	❍	❍
Others minded the alteration/disruption to living pattern?	❍	❍	❍	❍	❍	❍	❍
I enjoyed the alteration/disruption to my living pattern?	❍	❍	❍	❍	❍	❍	❍

Uncertainty about the level of financial incentive I would receive each month caused problems to to me in overspending for the month ❍ ❍ ❍ ❍ ❍ ❍ ❍

If electricity suppliers offered the same/similar incentive programme (for off peak consumption) to the current one, would you participate?

Yes/No

Having had experience of attempting to shift consumption to off peak times, would you consider moving to a time of use tariff in future? (These energy tariffs have different charges for consumption that is peak and off peak)

Yes/No

Participation and involvement of other household members in this study

How many other people do you live with?

If you live with others, please rate the extent to which you believe they (overall) made efforts to use electricity at off peak as opposed to peak times:

Not at All ❍ ❍ ❍ ❍ ❍ ❍ ❍ Great Deal

Using electricity at home

Some emotions are listed below. Thinking about shifting your electricity consumption to off peak times, how much do you expect to feel:

	Not at All						A Great Deal
Interested?	❍	❍	❍	❍	❍	❍	❍
Frustrated?	❍	❍	❍	❍	❍	❍	❍
Proud?	❍	❍	❍	❍	❍	❍	❍
Bored?	❍	❍	❍	❍	❍	❍	❍

Please indicate to what extent you agree with the statements below. Although some statements appear to be worded similarly, each one is different .

	Strongly Disagree						Strongly Agree
I believe it is a sensible idea to try to shift electricity consumption to off peak times	❍	❍	❍	❍	❍	❍	❍
I feel capable of shifting my home power usage to off peak times	❍	❍	❍	❍	❍	❍	❍
I feel capable of shifting some of my home power usage to off peak times	❍	❍	❍	❍	❍	❍	❍
I am not keen to shift my power consumption in the home to off peak times	❍	❍	❍	❍	❍	❍	❍
It is straightforward for me to find ways to shift electricity consumption to off peak times	❍	❍	❍	❍	❍	❍	❍
I do not think that shifting my power use							

to off peak times is a good idea	❍	❍	❍	❍	❍	❍	❍
It will be difficult for me to shift power to off peak	❍	❍	❍	❍	❍	❍	❍

Your general energy-related actions

Please indicate to what extent you agree with the statements below.

	Strongly Disagree						Strongly Agree
I put used batteries in the rubbish	❍	❍	❍	❍	❍	❍	❍
I recycle empty bottles	❍	❍	❍	❍	❍	❍	❍
I bring unused medicine back to the pharmacy	❍	❍	❍	❍	❍	❍	❍
I take a shower rather than a bath	❍	❍	❍	❍	❍	❍	❍
In the winter, I keep the heat on so that I do not have to wear a jumper	❍	❍	❍	❍	❍	❍	❍
I wait until I have a full load before doing my laundry	❍	❍	❍	❍	❍	❍	❍
In the winter, I leave the windows open for long periods of time to let in fresh air	❍	❍	❍	❍	❍	❍	❍
The heating in my home is turned off late at night	❍	❍	❍	❍	❍	❍	❍
I turn off the light when I leave my home	❍	❍	❍	❍	❍	❍	❍
I turn off electric appliances if I'm not using them	❍	❍	❍	❍	❍	❍	❍
I turn off my lap top/PC if not using it	❍	❍	❍	❍	❍	❍	❍
In supermarkets, I usually buy fruits and vegetables loose rather than pre-packaged	❍	❍	❍	❍	❍	❍	❍
If I am offered a plastic bag in a shop, I will always take it	❍	❍	❍	❍	❍	❍	❍
I reuse my shopping bags	❍	❍	❍	❍	❍	❍	❍
I walk, cycle or take public transport to work/or other daily activities	❍	❍	❍	❍	❍	❍	❍
I often drive on motorways at speeds over 70 mph	❍	❍	❍	❍	❍	❍	❍
When possible, on short journeys (around 20 miles), I use public transport or ride a bike	❍	❍	❍	❍	❍	❍	❍

About you

Please rate the extent to which you personally operate the following appliances (if you don't have the appliance put not at all):

	Don't Have	Not at all						A Great Deal
Washing machine/dryer	❍	❍	❍	❍	❍	❍	❍	❍
Dish washer	❍	❍	❍	❍	❍	❍	❍	❍
Cooker	❍	❍	❍	❍	❍	❍	❍	❍
Kettle	❍	❍	❍	❍	❍	❍	❍	❍
Other kitchen appliances	❍	❍	❍	❍	❍	❍	❍	❍
Electric water heating	❍	❍	❍	❍	❍	❍	❍	❍
Electric space heating	❍	❍	❍	❍	❍	❍	❍	❍
Fridge	❍	❍	❍	❍	❍	❍	❍	❍

Please indicate to what extent you agree with the statements below.

	Strongly Disagree						Strongly Agree
Using new technology is an important part of who I am	❍	❍	❍	❍	❍	❍	❍
I do *not* see myself as someone who cares about the environment	❍	❍	❍	❍	❍	❍	❍

I think of myself as someone who is very interested in new technology	❍	❍	❍	❍	❍	❍	❍
Being 'environmentally friendly' in what I do is an important part of who I am	❍	❍	❍	❍	❍	❍	❍
I am *not* the type of person who is into gadgets and technology	❍	❍	❍	❍	❍	❍	❍
I am someone who is concerned about the environment	❍	❍	❍	❍	❍	❍	❍

Do you enter opportunities to win prizes? (e.g. filling out a questionnaire to win a prize from a supermarket, or entering opportunities to win prizes that can be related to completing a crossword etc)

Yes ❍ No ❍

If so, how often (on average)? (Please identify whether per week, per month or per year.)

Do you play the lottery?

Yes ❍ No ❍

If so, how often on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

How much would you spend on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

Do you bet on sports, card games or on chances of events happening?

Yes ❍ No ❍

If so, how often (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

How much would you spend on average (identify as per week, per month or per year)?

Week.....
Month.....
Year.....

Thank you for your participation.