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# Exploring perceived control in domestic electricity demand-side response

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Research into consumer acceptance of domestic electricity demand-side response (DSR) highlights loss of personal control as a key concern. This UK focus group study explored people's perceived control in relation to home energy use and DSR. Three DSR offerings were discussed: fixed and dynamic time of use (TOU) pricing and direct load control. Participants' main motivations for control were costs, comfort, time/flexibility and autonomy. The majority viewed a fixed TOU tariff as increasing personal control, particularly over costs. Dynamic TOU pricing divided opinion, with some perceiving more control over costs, while others were concerned about ease of use, requirement for automation, predictability and flexibility. Almost everyone saw direct load control as reducing their control, although some framed this only in terms of control over appliances, while others were concerned about their overall autonomy. Implications for future research and the design, targeting and communication of DSR products are discussed.

**Keywords:** demand-side response; perceived control; consumer acceptance; domestic

## 1. Introduction

The United Kingdom's electricity system is expected to change substantially in the coming decades. There is likely to be an increase in inflexible nuclear, intermittent renewables and carbon capture and storage technology, while demand is projected to increase with the growth in electric vehicles and electric heating (DECC 2011). In such a scenario, there will likely be a more important role for demand-side response (DSR), or '*change in electricity consumption patterns in response to a signal*' (Element Energy 2012, 9). This can be used to provide services for suppliers and network operators including portfolio optimisation, congestion management, peak shifting and balancing (He et al. 2013). This study focuses on domestic DSR, which is an important sector as it accounts for 30% of total UK electricity demand (DECC 2013) increasing to about 50% during peak times (Ofgem 2010).

Smart meters and appliances are key enabling technologies for DSR, facilitating the provision and response to signals between operator and home. The main types of signals employed by DSR operators to influence consumption patterns are price (e.g. in fixed or dynamic time of use (TOU) pricing), volume (e.g. in load capping) and direct control (where loads are remotely

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switched by DSR operators). Response to these signals may be mediated to different extents by consumers, which affects the speed, duration and reliability of response. Unmediated direct control signals should allow more rapid and reliable responses, followed by volume and pricing (He et al. 2013), although the level of automation in response to price signals can also affect this (Frontier Economics and Sustainability First 2012).

Direct load control (DLC) programmes entail some addition of external influence over the action of electrical loads in people's homes. This has been reflected in concerns, conveyed in the literature, around loss of perceived personal control for consumers. Such concern is typified by this observation from Mert (2008, 32) who investigated consumer acceptance of smart appliances:

> ... many consumers do not like the idea that the energy utility has control over the devices ... Consumers are used that [*sic*] electricity is available all the time and that they are able to operate their appliances whenever they want ... they are afraid that if operation is influenced by the energy provider there might be a deterioration of comfort.

Many other recent studies have reported similar concerns (Downing 2009 in relation to sustainable community infrastructure; Kranz, Gallenkamp, and Picot 2010 around smart meters; Stragier, Hauttekeete, and De Marez 2010 on smart appliances; Paetz, Dütschke, and Fichtner 2012 on home automation; Parkhill et al. 2013 on demand-side management; Rodden et al. 2013 around automated response to DSR; Darby and Pisica 2013 on remote control of appliances; Balta-Ozkan et al. 2014 on smart homes). Understanding and addressing such concerns are important as perceived control has been shown to be a factor in technology or service acceptance (Venkatesh 2000), and the effectiveness of DSR programmes is dictated in part by the size of the participating load which in turn depends on the number of people who choose to participate. The present study therefore sets out to explore in detail (a) what it means to people to be 'in control' in the context of home energy use (and what affects this), and (b) how people think their level of control would change under different DSR offerings (and what affects this). This paper reports the results of four focus groups which addressed these questions and considers their significance for future DSR research, development and policy.

## 2. Perceived control and technology acceptance

Control is a multifaceted psychological concept. Skinner (1996) lists over 100 constructs which psychology researchers have related to it, and provides a theoretical framework which can be used to guide research in this area. This section summarises the key aspects of this framework as they are used to structure the analysis presented in section 4.

The first major distinction is between objective (or actual) and subjective (or perceived) control. The focus of this study is on the latter, in that it is concerned with people's beliefs about (rather than a physical evaluation of) changes in objective control conditions in DSR offerings. Within the concept of perceived control, Skinner identifies three principal domains: the agents, means and ends of control. These can be connected or related in a number of ways. Perceived agent–means relations refer to the extent to which people think that the agent of control (e.g. themselves) is able to access and employ a certain means of control (e.g. turning down thermostat). Means–ends relations, on the other hand, refer to people's perceptions of the extent to which available means (e.g. turning down thermostat) are effective in achieving a given end (e.g.

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reducing heating costs). People's perception of their ability as an agent to achieve a given end may be referred to as their overall perceived control or self-efficacy (Bandura 1977, 1989).

Skinner (1996) also describes a number of other constructs distinct from, but directly related to, perceived control:

- Potential antecedents of control: These are factors that may contribute towards perceptions of control such as choice, information and predictability.
- Motivation for control.
- Self-determination or autonomy, which Skinner suggests to be outside the domain of control proper, being more concerned with freedom of behaviour than any contingency between actions and outcomes.

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There are strong theoretical grounds for believing perceived control to play a role in consumer acceptance of new technologies and services. It has been integrated into various general models of human behaviour, perhaps most prominently, the Theory of Planned Behaviour, which suggests that intention to act results from a combination of attitudes, norms and perceived behavioural control (Ajzen 1991). Other models utilise more objective ideas of control, albeit less explicitly. Stern's Attitude-Behaviour-Context model (Stern 2000) takes account of the context in which people live, including factors such as regulation, available technologies, financial costs and knowledge, all of which may be viewed as constraints on the level of control that people have over their actions. Triandis' Theory of Interpersonal Behaviour (Triandis 1977) also integrates attitudes, social factors and affect (the experience of feeling) in the formation of intentions, but suggests that actual action is also dependent on facilitating conditions (similar to Stern's 'context'). Again, such conditions could be otherwise construed as the option to exercise control.

The Technology Acceptance Model (TAM) (Davis 1989) applies the Theory of Reasoned Action (Ajzen and Fishbein 1980) to the domain of technology acceptance. Disregarding the subjective norm element of the theory, it defines two variables as affecting the attitude towards use – an individual's perceived usefulness and perceived ease of use of the technology. The TAM has frequently been extended to incorporate other constructs such as social influence (Venkatesh et al. 2003), trust and risk in e-commerce (Pavlou 2003) and perceived/subjective control (Spiekermann 2008; Stragier, Hauttekeete, and De Marez 2010; Kranz 2011). Kranz 2011 specifically focused on acceptance of smart meters and found subjective control to be a significant predictor of behavioural intention to use this technology.

The Introduction presented evidence from previous research that loss of control is a concern to some people when considering DSR, while the current section has outlined previously theorised connections between control and acceptance. The next section describes the method by which the present study explored people's perceived control in the context of home energy use and DSR.

## 3. Method

### 3.1. *Research population*

Geographically, the study is restricted to England. While the UK electricity system is interconnected internationally, the bulk of DSR activities likely to be required to benefit the UK grid will need to take place locally. The unit of enquiry is individuals who are wholly or partly responsible

for making decisions about household energy bills, since it is these people who will ultimately choose whether or not to participate in DSR programmes.

### 3.2. *Focus groups*

The research objectives demand an explorative approach to generate a range of views on control in relation to DSR and home energy use. Focus groups are a type of group interview which Krueger and Casey (2000, 4) describe as permitting the researcher '*to understand how people feel or think about an issue, product, or service*'. They have previously been used to explore people's views on DSR (Darby and Pisica 2013; Rodden et al. 2013) and agency in relation to energy use (Fell and Chiu 2014) and have the advantage of allowing participants to reflect and comment on each other's views.

#### 3.2.1. *Sample*

Snowball sampling was used to recruit participants as this allowed pre-determined characteristics to be targeted (the seed person was requested to recruit people fitting these characteristics). An even mix of men/women was sought along with a mix of ages. Four groups were held in total ($n = 22$), as follows:

- Pilot group with energy specialists based in the authors' university department ($n = 6$)
- District heating group (as an example of an energy technology with an element of external control – in this group, participants had no room thermostats to control heating) ($n = 5$)
- Gas central heating group (a responsive, on-demand heating technology with no direct external control) ($n = 8$)
- Economy 7/10 TOU tariff[1] group (external influence over energy use through prices, all with night storage heating) ($n = 3$)

The pilot group provided an opportunity to trial the discussion schedule while also collecting the views of people with special interest and expertise in the subject of energy use. Levels of interest in energy and environment issues in the non-specialist groups varied with some people's work fairly directly related to home energy use (e.g. plumber and builder), and were highest in the district heating group where participants were recruited through a group for people interested in the sustainability of the development. Table 1 gives more information about the participants.

#### 3.2.2. *Data collection and analysis*

Groups were facilitated by the lead author and followed a consistent structure, each lasting about an hour. The first part of the session was used to discuss people's views on control over energy use in general, the extent to which it was something that could be controlled and what people wanted control over. The facilitator then gave a brief overview of the rationale for DSR (outlining in basic terms the main benefits highlighted here in section 1). Participants were handed short descriptions of the following customer offerings: flat unit price for electricity; fixed TOU tariff; dynamic TOU tariff with smart appliances; and DLC with the specific example of space and water heating (see Appendix for materials). The offerings represent a range of different DSR signals and are based on actual programmes. General, illustrative rather than specific pricing indications were provided so as to avoid heavily influencing people's views with cost considerations at an early stage in the discussion.

Each participant was then asked to mark on a scale their response to the question, '*All things considered, how much control would you have, compared to now?*' for each tariff option (see

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Table 1. Focus group participant details.

| Participant code | Sex | Age | Tenure | How pay elec.? | Heating | TOU tariff | Switch in last year |
|---|---|---|---|---|---|---|---|
| PIL1 | M | 25–34 | Rent | Other | Gas | N | N |
| PIL2 | F | 25–34 | Rent | Direct deb | Elec (storage) | N | Y |
| PIL3 | M | 25–34 | Own | Direct deb | Gas | N | Y |
| PIL4 | F | 35–44 | Rent | Direct deb | Gas | N | Y |
| PIL5 | F | 25–34 | Rent | Direct deb | Gas | N | Y |
| PIL6 | F | 25–34 | Rent | Direct deb | Gas | DK | N |
| DH1 | F | 55–64 | Own | Direct deb | District | N | Y |
| DH2 | F | 35–44 | Rent | Direct deb | District | N | N |
| DH3 | M | Not given | Own | Quarterly | District | N | N |
| DH4 | M | 45–54 | Own | Direct deb | District | N | N |
| DH5 | M | 45–54 | Own | Direct deb | District | N | Y |
| GCH1 | M | 55–64 | Own | Direct deb | Gas | N | Y |
| GCH2 | F | 55–64 | Own | Direct deb | Gas | N | Y |
| GCH3 | M | 65–74 | Own | Direct deb | Gas | N | Y |
| GCH4 | F | 45–54 | Own | Direct deb | Gas | N | N |
| GCH5 | F | 55–64 | Own | Direct deb | Gas | N | Y |
| GCH6 | F | 65–74 | Own | Direct deb | Gas | N | N |
| GCH7 | M | 55–64 | Own | Direct deb | Gas | N | N |
| GCH8 | F | 55–64 | Own | Direct deb | Gas | N | N |
| TOU1 | M | 35–44 | Rent | Quarterly | Elec (storage) | Y | N |
| TOU2 | F | 55–64 | Rent | Prepay | Elec (storage) | Y | N |
| TOU3 | F | 45–54 | Rent | Direct deb | Elec (storage) | Y | Y |

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Appendix for scale). This instruction was intentionally vague to allow people to interpret control as they chose. Participants were asked to do this without consulting with each other, the aim being to obtain individual viewpoints before they could be influenced by the group. Each participant was then asked to explain the reasons for positioning different options on the scale, and the results for the group noted together on a single chart by the facilitator. Participants were then invited to comment on the group results. Subsequent discussion was guided towards what people thought they would gain or lose control over in DSR scenarios and what affects this. The extent to which this would relate to their acceptance of DSR was also discussed. Finally, participants were asked to complete a short questionnaire which provided the information contained in Table 1. All groups were audio-recorded and subsequently transcribed. Content analysis was conducted by the lead author in NVivo 10 using codes generated from multiple passes of the data. These codes were collected under common themes, including those outlined in section 2 as relating to different aspects of control (e.g. motivations, antecedents, agents, means and ends). Results from the scale exercise were charted in Excel.

## 4. Results

In the following section, participants are identified by a two- or three-letter group code (PIL = pilot group, DH = district heating, GCH = gas central heating, TOU = time of use tariff) followed by a number for each participant in the group (e.g. TOU2 is participant 2 in the TOU tariff group).

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### 4.1. *Perceived control and home energy use in general*

Participants introduced a range of motivations for control in the larger context of home energy use. Most commonly, they referred to bills, or spending on energy. There was substantial discussion of control of temperature, both in terms of direct control over heating systems and more generally of homes – the motivation being control over one's comfort. Another important motivation related to time – that is, being able to do things with electricity when you want to do them (*'we like to do things when we want to do them and I doubt very much whether we'd change that', GCH2*). This was allied to ideas of flexibility and predictability. Participants with night storage heaters in particular were dissatisfied with the level of control they had over when their homes were heated. Overarching it all was a general sense of energy being tied to control over one's home or general autonomy (e.g. in a discussion about DLC: *'That means they're controlling your life basically', TOU2*). There was very little mention of control over energy or electricity themselves. Different participants viewed the relative importance of these motivations differently.

The perception across the groups was that energy use was not something people have many choices around, although the reasons for this sometimes varied from group to group. There was a strong feeling that certain energy services, such as heating, were non-negotiable (e.g. *'I try and work with it with what I've got, the heat I can't live without', TOU2*). This effect was increased when other occupants such as housemates or children were mentioned (e.g. *'if you had a baby it'd be different . . . that baby determines the timing rather than you determine the timing', TOU3*). People differed in the options they had available to them to reduce energy use. The most marked difference was between people who owned their own homes (houses) and people who rented, or owned in blocks. The former group spoke more about possibilities of installing insulation or replacing boilers themselves, while the latter spoke more about behavioural measures (or even unsuccessful attempts to get landlords to take more permanent measures) – reflecting a difference in the availability of different means of control over energy use. Participants with storage heaters or district heating often spoke at their frustration at the lack of personal control these systems gave them over their heating (*'there is no fine control . . . people open windows, that's the control', DH1*). Such frustrations were in little evidence with participants with gas central heating.

Lack of information was a notable antecedent for people feeling a lack of control over certain appliances. For example, participants on Economy 7/10 tariffs were not confident of the times between which the night-time tariff was in operation or of the difference in price between peak and off-peak rates. One participant had requested a prepayment meter so as to more easily track their expenditure on energy, and others expressed interest in using energy monitors (although often cited reasons for why they had not, such as lack of access to their meter). There were also cases of people exercising control with possible unintended consequences. For example, one participant on Economy 7 adjusted their water heater to come on later (thereby providing hot water later) – with the likely result that they were paying for peak rate electricity to heat water.

### 4.2. *Perceived control and DSR*

Figure 1 charts participants' written responses to the question, '*All things considered, how much control would you have, compared to now?*' for each tariff option. To create the chart, participants' marks on a scale were transposed into Excel by measuring the positions of the marks. The question phrasing was deliberately vague so as to allow participants to interpret it as they

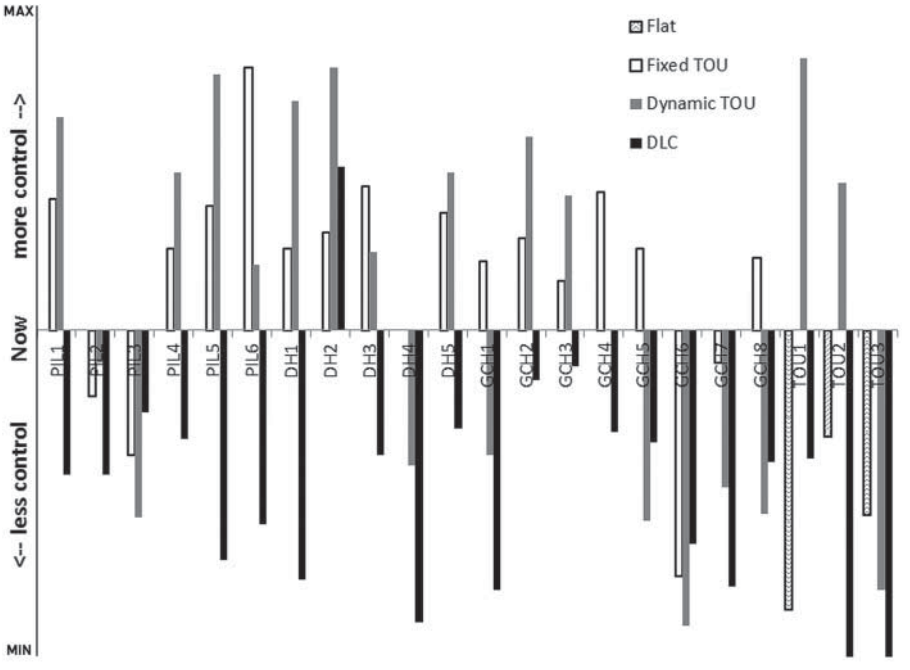


Figure 1. Participants' self-reported perceived control expectations under different DSR offerings. Bar lengths were calculated by measuring the position of participants' marks on the scale.

chose (the interpretation being a focus of subsequent discussion). Strong caveats are required – this chart compares on the same axes people's subjective judgements in relation to different concepts (e.g. some people were considering control over spending, others over time). These data are presented here as they suggest something of the direction and extremeness of people's first reactions to the DSR offerings.

A repeated measures analysis of variance (ANOVA) with Greenhouse–Geisser correction showed that mean perceived control differed statistically significantly between tariff options ($F(2.05, 40.97) = 14.15, p < .0005$). *Post hoc* tests with the Bonferroni correction revealed that people's control expectations were significantly lower for DLC than for flat rate ($p < .0005$), fixed TOU ($p < .0005$) and dynamic TOU ($p = .001$) tariffs. There were no other significant differences between the tariffs, although people's control expectations for the fixed TOU tariff approached significance in exceeding those for the flat rate tariff ($p = .072$).

A clear majority of people (white bars in Figure 1) considered fixed TOU tariffs to increase their level of control over fixed rate tariffs (or in the case of those already on TOU tariffs, flat rates were associated with loss of control). In this case, control was mainly conceived of as over costs. Antecedents such as simplicity, predictability and familiarity (e.g. with existing Economy 7/10 tariffs) were highlighted as adding to the feeling of control.

The picture was more varied in relation to dynamic TOU tariffs, where there was a relatively even spread of people who thought that these would give them more or less control. Where people felt that their control would increase, this was generally in relation to costs – the impression being that these could really be minimised by carefully planning when to use certain appliances (*'you have got some more control cause you can look at the, "oh right OK let's put the washing machine*

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*on now"', GCH4*). Where people thought that they would lose control, this was generally due to the complexity of such arrangements and the lack of predictability (*'the prices change so often it's difficult to predict, I just thought I'd never understand it', GCH7*).

Dynamic TOU tariffs also saw concerns about the level of automation required and the way in which this might regiment people's lives (*'We're not robots!', TOU3*). Concerns about shifting certain practices such as cooking came out most strongly here, and it was pointed out that the demand was high at certain times for a reason, and that you could not control when everyone else decided to use electricity. One TOU group participant thought that people might start out with good intentions but ultimately find themselves unable to maintain them, and align control with responsibility and potentially blame: *'it's kind of 'cause you're to blame now . . . you are going to probably be using your appliance when everyone is using them . . . everyone is getting home at a certain time and everyone wants dinner at the same time', TOU2*.

Almost everyone associated DLC with loss of control. The main reasons cited for this were people's desire to have electricity when it is needed (not when someone else decides you need it), and a general association of this approach with other agents controlling your life in general (e.g. 'Big Brother' or 'Soviet' style control was cited). That latter was demonstrated very strongly in the gas central heating and TOU tariff groups, and this general sense of a loss of autonomy in the face of DSR was summed up succinctly by a participant of the latter group: *'Our lives would be determined by energy rather than freedom', TOU3*. Often, there was a feeling that people would unexpectedly be cut off, also reflecting concerns about lack of information.

Where people thought that they would gain control in DLC, or lose only a little, this was generally to do with convenience – either of managing costs or of managing appliances themselves (*'If it's . . . something that happens in the background and doesn't actually affect your usage . . . for me personally I don't think I have an issue with them controlling it', PIL3*). It was suggested that consumers would be providing a valued service and that this should be reflected in energy price (*'they've got to give . . . it* [electricity] *to you virtually for nothing . . . that's the sort of scale they've got to do', GCH3*). There was consensus in the district heating group that they would probably be more accepting of DLC since they were accustomed to external control over their heating (and, indeed, saw that it may offer some improvements over their current situation if implemented effectively).

Where people were concerned about losing control in DSR scenarios, this was often associated with lack of trust in either third parties or technology. Participants related stories of energy companies and other comparable organisations (e.g. phone companies) acting without their interests at heart as a basis for this concern (*'wait till you get over the limit and they charge you whatever they want', PIL4*). It was pointed out that even though technology might work the majority of times, concern about the possibility of failure featured prominently. People recognised a misalignment between their own ends (e.g. energy services) and those of energy companies (e.g. profit) being sought through the same means (electricity-using technologies in the home), causing them to be doubtful as to whose ends the energy company would prioritise. However, there were mixed views as to whether other bodies (e.g. government or community groups) would be more trusted to take on roles in DSR.

While the concept of choice was frequently raised as a fundamental antecedent to feeling in control, the option of a limited override in DLC was not widely viewed as a sufficient choice as compared to the greater freedom that was perceived to be afforded by other DSR approaches. It was also suggested that a lot of people would be likely to override at the times, rendering the system ineffective (*'how do you stop there being a mass of overrides 'cause we all want to go and watch Manchester Utd and Man City', GCH7* ).

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## 5. Discussion and conclusions

This study set out to explore in detail (a) what it means to people to be 'in control' in the context of home energy use (and what affects this), and (b) how people think their level of control would change under different DSR offerings (and what affects this). The focus group results presented in section 4 highlight the multiple dimensions of perceived control in relation to home energy use, and DSR in particular. When people spoke about their motivations for control, the main topics were spending, service level (e.g. comfort), time/flexibility and a sense of autonomy (although as outlined in section 2, Skinner (1996) regards this as a concept outside the boundaries of control proper). The principal antecedents of perceived control (or lack of it) were trust, information, predictability and choice. Trust was especially important where DSR introduced additional agents, such as in DLC. Overall expected perceived control was consistently highest for fixed TOU tariffs, more varied for dynamic TOU tariffs with automation and consistently lowest with DLC.

While it is impossible to generalise from the groups to a more general population, background factors which appear to be associated with people's perceived control in relation to energy use included tenure (renting vs. owning) and existing technology usage (e.g. district heating vs. gas central heating). People with gas central heating (the most common form of heating system in the UK) tended to expect greater loss of control under automated and DLC DSR conditions than the other groups. This is, perhaps, unsurprising as gas central heating provides a responsive service with no external control over its operation. Along with the TOU group, these participants were also more likely to highlight loss of autonomy as an issue than other groups. This appeared to be more of a 'red line' concern than other motivations such as comfort level and flexibility – that is, people who expressed this concern did so strongly and appeared less likely to be willing to negotiate on its acceptability. For example, being assured that DLC would operate unnoticeably in the background or that they have the option to override it did not necessarily make it acceptable to someone with autonomy concerns, while it may for someone who is only worried about the level of service they receive. Among other considerations, this suggests that DSR product offerings may benefit from being developed with specific technology market segments in mind.

As summarised above, the findings point to a substantial degree of variability in how control is perceived in the context of DSR. Fixed TOU tariffs were perceived as enhancing people's control over costs, whereas there were highly mixed reactions with respect to dynamic TOU tariffs in this regard, and DLC was perceived as reducing people's control. That fixed TOU tariffs were perceived as increasing control is of particular importance in the context of consumer acceptance of smart metering programmes such as that currently being undertaken in the UK. Further work determining if this finding holds in the wider population, and on determining the conditions and specific pricing structure of such tariff offerings, could ease consumer acceptance of smart metering and the wider introduction DSR considerably.

Several study limitations should be highlighted. In common with much qualitative research, the small sample size means that generalisations cannot be made about the likely prominence and distribution of the issues raised in a wider population. For example, the group participants were all drawn from urban or sub-urban contexts. It is possible that people living in certain rural areas (with different security of supply issues) may have raised different issues or concerns. Additionally, people who agree to take part in research of this kind may be expected to have more interest in the subjects covered than those who choose not to participate. This is most likely to have been the case for the district heating group, for which participants were recruited via a group interested in the sustainability of the housing development. Some participants experienced

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difficulty in understanding the different DSR offerings, especially DLC. This may be due to lack of clarity of the explanation provided (which could have been more explicit on points such as the bounds within which third parties were able to turn appliances off and on) and is partly a reflection of the complete novelty of DSR to many participants. Only a short time was available to cover the approaches, so the data should be seen as very general first reactions rather than indicative of what might be expected if people were genuinely considering signing up to a DSR programme. However, this does suggest the importance of clear and ongoing communication by DSR operators if they expect people to understand their offerings. It is also noted that at the time the focus groups were being held (September/October 2013), debates around energy prices were especially prominent in the UK news coverage with price rises taking effect at the beginning of a new heating season.

The discussions which took place during this study focused on DSR offerings as largely independent of wider smart grid and smart home initiatives (e.g. controlling heating systems via smartphones). Such affordances as the smart grid might offer should be expected to affect people's overall sense of control in relation to energy. This reflects a wider challenge for work that asks people to reflect on hypothetical scenarios rather than focusing on their actions in real-life situations – indeed, some participants mentioned products such as Tesco Clubcard which might appear controversial in terms of the amount of data they allow companies to collect but which many people opt in to all the same. Future work planned by the authors, along with the results of large trials such as those taking place under the Ofgem (the UK energy regulator) Low Carbon Network Fund scheme are anticipated to shed more light on the similarities and differences between people's expectations and experience of DSR.

The results of this study add detail to previous findings summarised in section 1 which identify loss of control in DSR in a general sense as an important concern for some consumers. They pave the way to a systematic examination of the different motivations and antecedents of control and consideration of how any concerns around them can be addressed through design, targeting and communication of DSR offerings. They should also prompt researchers to consider these different aspects of control in the design of future studies focusing on energy technology and service acceptance. Further research by the authors is underway to explore in a more generalisable way how these facets of control relate to acceptance of DSR and how this varies between groups of people. This is expected to complement practice-based research in this area. In conclusion, the current study has highlighted the multiple dimensions of, motivations for and antecedents of perceived control in relation to energy use and DSR. Understanding and addressing concerns in this area will likely be important to securing transition to a reliable low-carbon energy system at reasonable cost.

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## Note

1. Economy 7 charges a lower rate for a period during the night, Economy 10 is similar but also allows limited off peak hours during the day.

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## Appendix

Figure A1 shows the materials used in the focus groups.

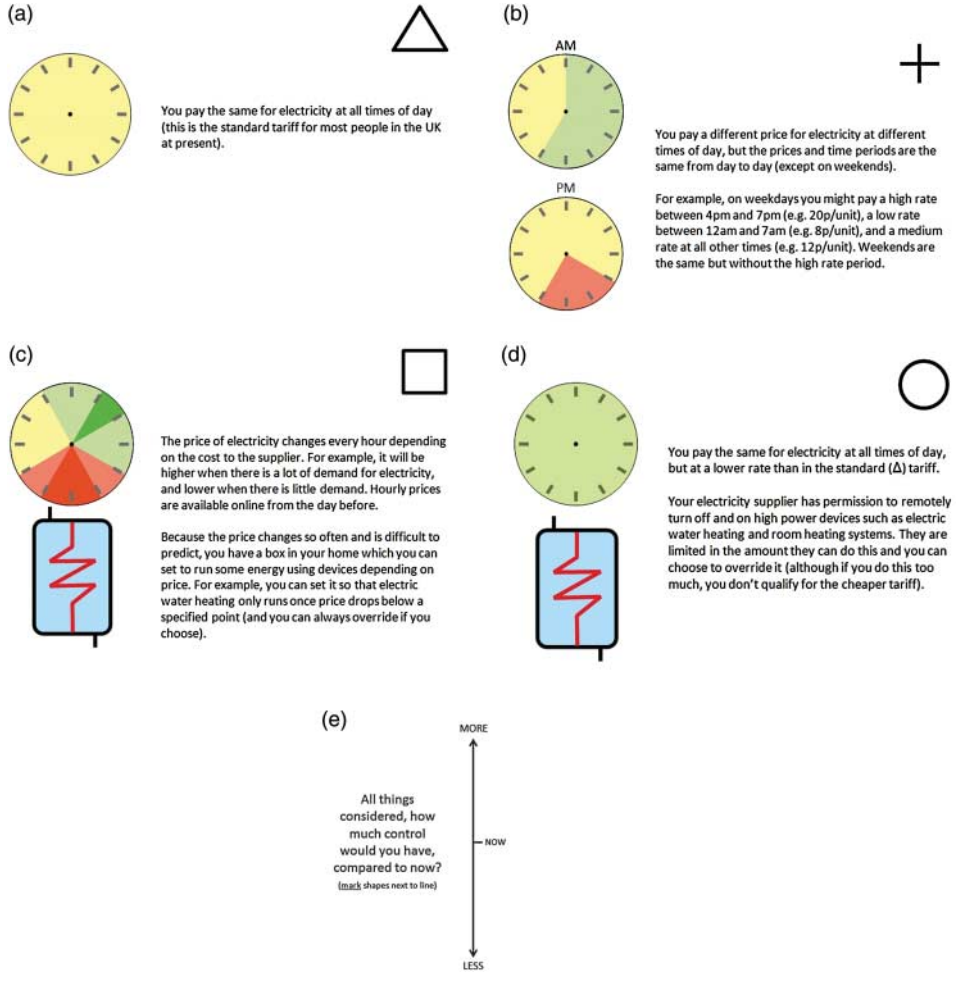


Figure A1. (a) Flat rate tariff description. (b) Fixed TOU tariff description. (c) Variable TOU tariff description. (d) DLC tariff description. (e) Perceived control scale.

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