



Department
of Energy &
Climate Change

What people want from their heating controls: a qualitative study

October 2013 – Appendices

The views expressed in this report are those of the authors, not necessarily those of the Department of Energy and Climate Change (nor do they reflect Government policy).

Credits

This appendices which accompanies the main report was written by Simon Rubens and Joe Knowles of new experience. The research team comprised Simon Rubens, Joe Knowles and Jessica Morris of new experience and Sue Clegg of Qualquest. Recruitment services were provided by Recruitment For Research.

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What people want from their heating controls: a qualitative study

Appendices

Prepared by new experience ltd

October 2013

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1. Introduction

This document contains the appendices to Rubens, S., Knowles, J. (2013). *What people want from their heating controls: a qualitative study* main report. New Experience conducted the research and prepared the report for the Department of Energy and Climate Change (DECC) between February and May 2013.

The overall purpose of the research was to gather requirements for smarter heating controls by studying how people use their existing heating controls. The research programme had the following phases:

Phase 1 – self reporting and energy monitoring: 43 participants in and around London and Manchester (including a pilot participant) were asked to record their everyday heating-related behaviours for up to 12 days using an online or paper diary. In addition, 21 of these households recorded temperatures in their homes over seven days using Joulo recorders (www.myjoulo.com) and then uploaded the data.

Phase 2 – In-home research: researchers visited the same 43 participants to conduct in-home, in-depth interviews about their use of heating, following up on data entered in the diaries and uploaded from the temperature recorders. A 'long-list' of requirements was inferred from this phase of research.

Phase 3 – Participatory design workshops: 23 participants, including four from the previous research phase took part in six-person, 2.5 hour workshop sessions: two in Manchester and two in West London. The workshops included a number of interactive exercises that included designing their own 'ideal' heating controls, and culminated in participants 'voting' for those requirements they considered most important to them.

The following appendices contain supporting materials used in the study, a complete list of the prioritised requirements and the outputs of some extra analyses, not included in the main report.

Appendix A: Sample online diary

Example household diary ☆

File Edit View Insert Format Data Tools Help Last edit was 3 minutes ago

Simon Rubens ▾

Comments

▶ 1 other viewer

Share

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	A	B	C	D	E	F	G	H	I
1									
2									
3	Person involved	Day	Time	What you/they did	Why you/ they did it	Room or location	Comments		
4	Jane	Saturday	8am	Turned up thermostat	Heat house for day	Hallway			
5	Jane	Saturday	9am	Turned on radiator	To dry clothing	Spare room			
6	Jane	Saturday	11.30am	Took off jumper	Felt too warm cooking	Kitchen			
7	Mike (husband)	Saturday	3pm	Put on gas log fire	He likes it on when watching football	Sitting room			
8	Jane	Saturday	9pm	Turned down thermostat	Going to bed	Hallway	Went to bed early to watch a movie		
9									
10									
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25									
26									

+ Sheet1 ▾

Appendix B: Sample paper diary

Household Heating Diary

Quick reference to what we're asking you to do...

The behaviour involved: any adjustments to thermostat, heating controls, or radiators; anything else related to thermal comfort such as using an electric heater or gas fire, putting on or taking off a jumper etc.

Person involved	What you/they did	Why you/they did it	Room or location	Comments
Jane	Turned up thermostat	Heat house for day	Hallway	

The name of the person who was involved

What prompted the person to act as they did

The room or location where the person was

- Any general thoughts (e.g. your home felt cold all day)
- Anything unusual
- Anything else you think might be interesting to us
- Where it was you felt too warm or too cool, if different to room or location in previous column

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Example Day

Household Heating Diary

Person involved	What you/they did	Why you/they did it	Room or location	Comments
Jane	Turned up thermostat	Heat house for day	Hallway	
Jane	Turned on radiator	To dry clothing	Spare room	
Jane	Took off jumper	Felt too warm cooking	Kitchen	
Mike (husband)	Put on gas log fire	He likes it on when he watches football	Sitting room	
Jane	Turned down thermostat	Going to bed	Hallway	Went to bed early to watch a movie

Any questions? Please do not hesitate to contact new experience ltd

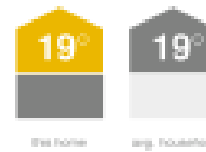
3

Appendix C: Sample Joulo plot of temperatures



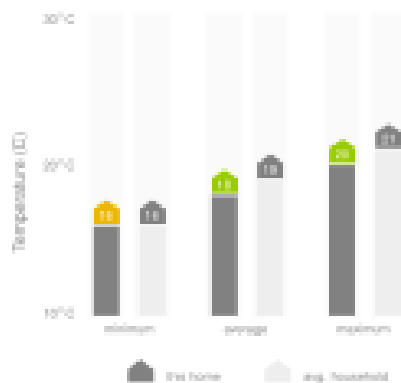
The thermostat set point is **equal to the average**.

Setting **1 degree less**, will save **9%** of the heating bill over the course of a year.

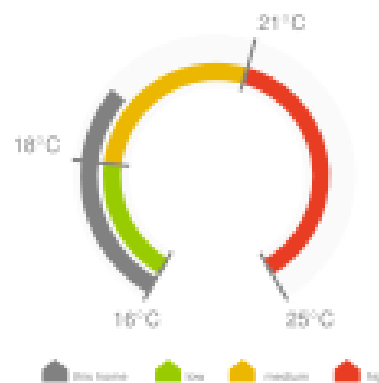


This is a comparison of the thermostat set point temperature against average UK households.

Average Temperatures

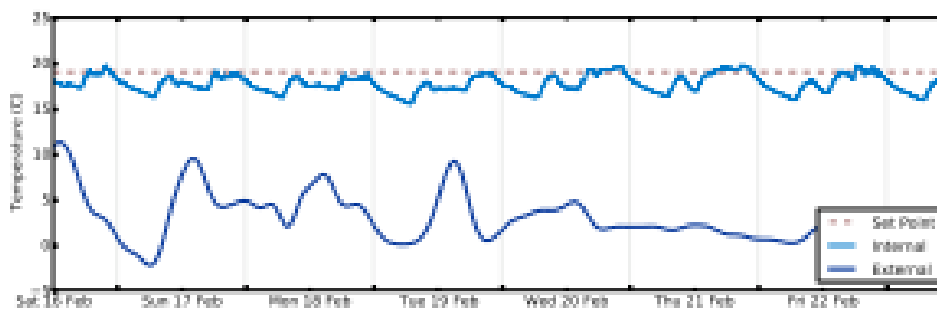


Thermostat Set Point

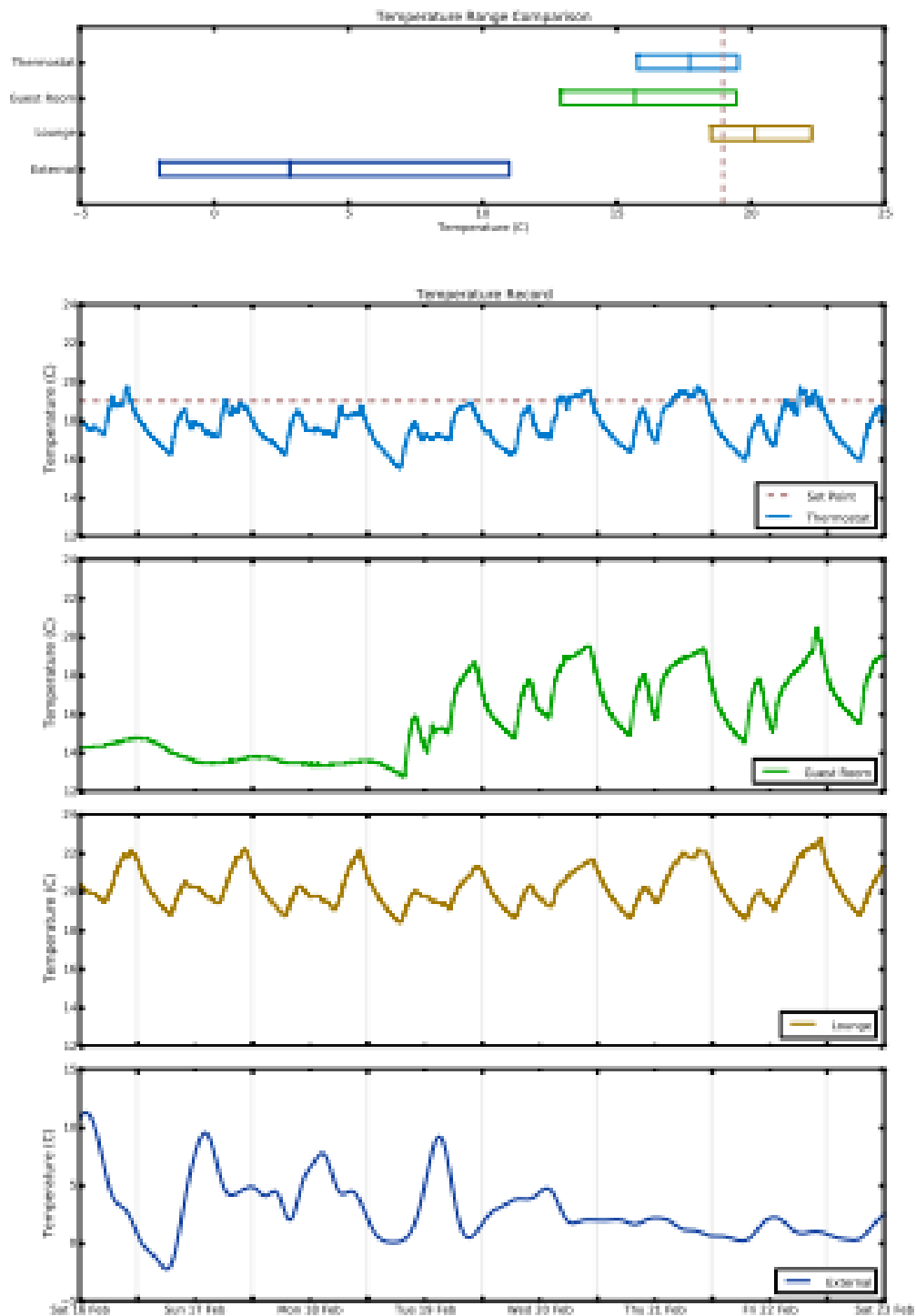


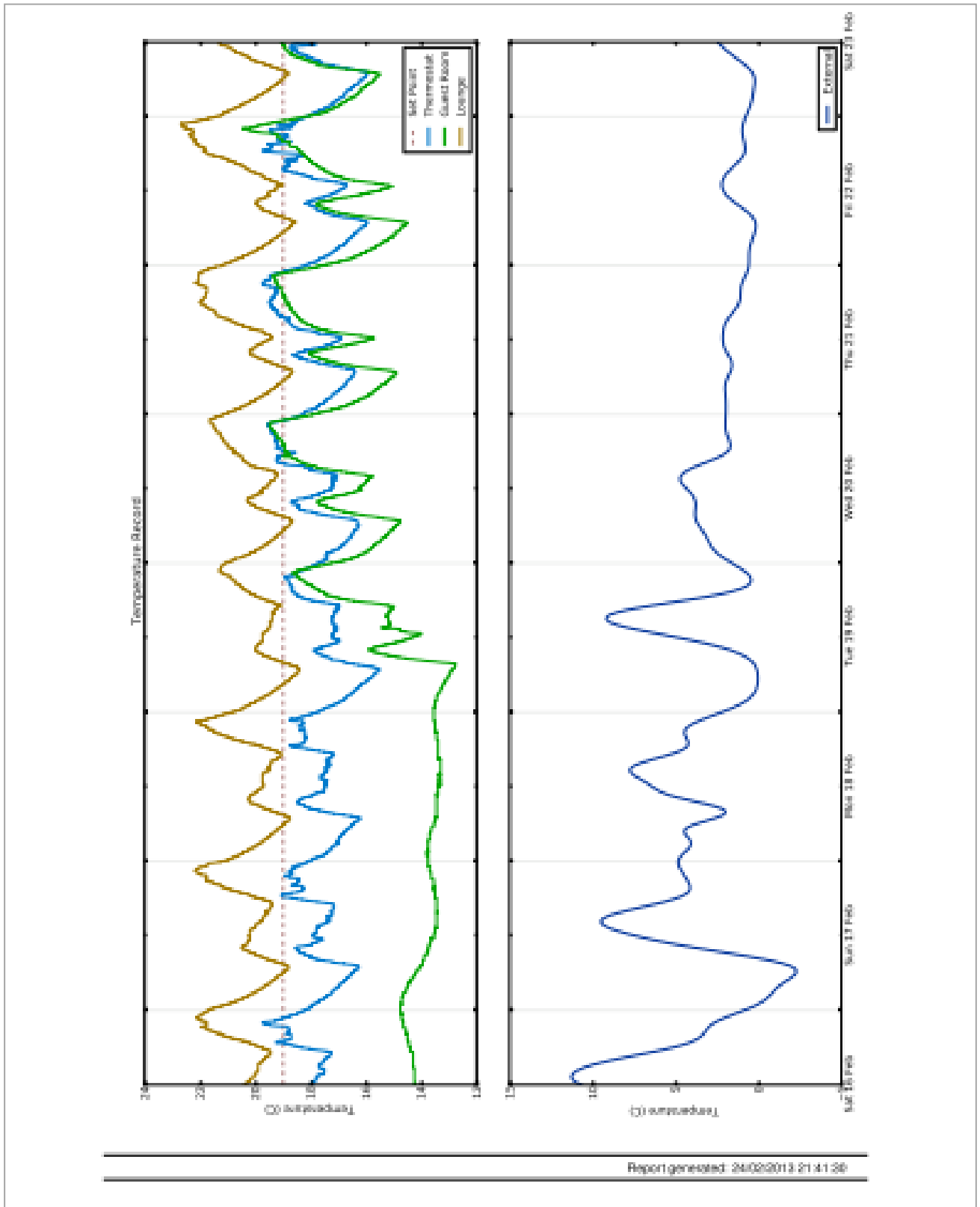
Temperature Record

Internal temperature recorded by the Joulo logger and external temperature near N14



Report generated: 24/02/2013 21:41:20





Appendix D: In-home discussion guide

Introduction (10 minutes)

Thank you for agreeing to let us into your home. I am <name> from *new experience*, and this is my colleague <name>.

Before we start, I'd like to go over a few details and instructions with you. Firstly, as we mentioned on the briefing call, we'd like to record today's session, and I will take some photographs throughout. These will be used for research purposes only. With your permission I will start the recording.

The purpose of the research is to understand how people use their heating system in order to improve the way heating can be controlled. Your feedback will play a very important part in helping people better manage their heating.

Today's visit will have a few different parts:

- we will start by exploring a bit about your general thoughts on how you and others use the heating and how you get/ stay warm;
- we will ask you to take us on a tour of your home, ask you to show us the heating in each room, and explain a bit about how you stay warm in that room;
- on the tour we will take a close look at your heating controls and how you use them;
- we will then sit down again for a bit and talk more in depth about how you use your heating;
- finally we will talk to you a bit about where you may be spending more than you need, and your ideal heating controls. If we have time, we may discuss some new-technology heating controls.

Before we continue, as I pointed out on the briefing call, I work for an independent research agency; nothing that you do or say will offend me, so please just give me your honest thoughts and opinions. Also please remember there are no right or wrong answers.

I will be typing and writing notes throughout the session so please bear with me if there are any silences or stoppages while I catch up. The session should last up to two and a half hours. We have a lot to get through so please don't be offended if we have to move things on a bit.

Do you have any questions?

Heating preamble (10 minutes / 20 minutes)

1. You've probably been thinking a bit more than normal about your heating and how you stay warm in the last few days; is there anything in particular you feel you've learnt?
2. Is there anything you want to tell me about your heating straight away?
3. Are there any special factors you consider in heating your home? *E.g. young children, pets*
4. Are you able to stay warm? If not, why not?
5. What, if any, are your main priorities in relation to heating your home? *Probe cost (gently), comfort, health*
6. To what extent does cost play a part in how you heat your home?

Household overview of members and routines (10 minutes / 30 minutes)

7. Who lives with you in your household?
8. Please describe the comings and goings of each household member over a typical week, using this 7-day calendar and coloured pens to denote different people. You can draw a line to indicate the times they are mostly home, and a dotted line to indicate when they may or may not be at home depending on circumstances. Please annotate to explain what they are doing at home, or why a period depends on circumstances
9. How are weekdays different to weekend days for your household?

Home tour to be recorded on paper (25 minutes / 55 minutes)

1. What's this room used for? When and by who?
2. When do you need/ want the room to be warm and when cool?
3. Do you use any other means of heating to stay warm in this room? If so when and why?
4. Does the room ever feel too warm/ cool? When? What do you do about it? Open windows?
5. Do you ever adjust the radiator valve? When and why/ why not? *Probe on how use it, usability (poor feedback, numbers on it?), stiff, understanding. Take photo if poor Prompt with diary data*

Note apparent unnecessary/ wasted heating, open windows/ doors, radiators obscured, sunshine, use of room for drying laundry etc.

Anyone in the room? Ask their views on the heating; what they do with the heating, their frustrations and what would work better for them:

Use and understanding of timer (15 minutes / 1 hour 10 minutes)

Take close-up photo and note model name/ number

10. Please show me the things you typically do with your timer. *Connect to diary events*

- (Re)set on and off times
- Temporary changes to on and off times
- Switch between: once, twice, constant, manual
- On-the-fly changes using override/ advance
- Other e.g. +1 hour/ boost

11. Are there any functions you don't use? Why not? *Probe understanding of functions on display*

12. Please show us the times it comes on and goes off for heating. Do they vary by day/ week-weekend? *Did they know already?*

13. Why these times? Are they the ideal times for you? Would you prefer other times?

14. Please change the time it comes on *Are they able to do this?*

15. *If applicable hot water:* Please show us the times it comes on and goes off for hot water.

16. *If applicable hot water:* What temperature do you set your hot water to be?

17. *If applicable hot water:* Do you ever run out of hot water?

18. Are there are any things you find confusing or are unclear on? *Probe as per box.*

19. What do you think of the way it looks?

20. How would you change it? *Probe functions, design and usability.*

Timer usability issues

Poor visibility of system state – on and off times

Non 1:1 mapping of controls to function

Whether need to confirm changes to 'on' and 'off' times, and if so how

Meaning of Advance/Override/Boost and how to cancel it

Difference between Auto, Once, Twice and Constant

Need to program week days and weekends separately when not relevant

Language and abbreviations such as 'Hold.', 'Man.', 'Cont.'

Eco and Boost buttons

Poor legibility

Dexterity issues

Accessibility to view display and to manipulate controls

Convenience of location of the timer relative to where they are in the home

Note general usability issues as per box on right

Use of thermostat (10 minutes / 1 hour and 20 minutes)

Take close-up photo and note model name/ number.

Is it in a draught/ direct sunlight/ over a heat source?

21. Please show us the settings you use on your thermostat.

22. When and why do you adjust the thermostat?

23. *Connect to diary events. What settings do they use? Do they mention the actual temperature on the dial? Are they using it to turn on/ off, or turn it up or down?*

24. Is there an ideal temperature for you? What? Why? *Do they care about actual temperature? Do they use a thermometer anywhere?*

25. What do you do differently, if anything, when the weather is colder? *Set it higher?*

26. What do you do, if anything, to warm up quicker? *Set higher than needed?*

27. Any are there any things you find confusing or are unclear on? *Probe as per box.*

28. What do you think of the way it looks?

29. How would you change it? *Probe functions, design and usability. Do they want something different to a thermostat?*

Thermostat usability issues

Poor visibility of system state – whether boiler is firing

Confusion between target and actual temperatures – on digital displays that flip between them

Eco and Boost buttons

Poor legibility

Dexterity issues

Accessibility to view display and to manipulate controls

Convenience of location of the thermostat relative to where they are in the home

Note general usability issues as per box on right

Follow-up discussion after tour (10 minutes / 1 hour 30 minutes)

30. Were your heating controls here when you moved in?
31. Who chose them?
32. Who set it up the first time?
33. Have you changed the settings since the timer was installed?
34. How did you learn how to use the timer?
35. Do you have/ use a manual?
36. What do you think the thermostat does? Why?
 - A temperature regulator
 - A switch to 'click' the heating on
 - Dimmer switch

Managing their heating (30 minutes / 2 hours)

37. Let's confirm how you manage your heating.

Base on tour, diary, temperature plots and box on the right. Be sure to pick up on any particular areas of interest in the diary.

Explore who's involved, any conflicts

38. How do your needs differ around the home from room to room? *Probe whether some rooms could be off all the time, others some of the time*

39. When do you make changes to times? *Probe their threshold for making changes e.g. would need to get up more than 0.5 hours early to bother*

40. Why do you think you manage your heating the way you have described? *Probe as per box.*

41. How typical was the diary period?

42. When might behaviours differ from those reported? *Probe as per box.*

43. What happens in these 'exceptional' circumstances?

Possible modes of control

- Manual on/ off versus timer
- Timer settings: once/ twice
- Radiator valves
- Adjustment of thermostat: on/off; up/down
- Ancillary heaters/ methods

Possible drivers of behaviour

- Habit/ what know/ how told
- Household routines, variability, predictability
- Beliefs: maintaining constant temperature versus warming up and cooling home down; unbalancing system by turning off radiators, preventing damp
- Limitations in relation to controls functionality
- Limitations in relation to controls usability
- Convenience of location to where they are
- Physical constraints e.g. valves won't turn, out of reach

Possible exceptional circumstances

- Holidays, but how long away before turn down heating? Worry about pipes freezing?
- Guests visiting/ staying
- Change in season
- Clock/ hour change
- Changes in routines: e.g. back to school, new work patterns

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44. What frustrations or worries, if any, do you experience with your heating system? →
45. How in control of your heating do you feel you are? Why/ why not?
46. How satisfied are you with the way your heating system meets your heating needs?
47. How does the current system compare to the ideal? How could your heating work better for you?

Possible frustrations

- Maintaining a constant temperature i.e. not fluctuating between 'stone cold' and 'roasting'
- Too warm or too cool
- Can't have all rooms at the right temperature
- Lag/ not heating up fast enough
- Not knowing how long it will take to heat up
- Not on when need it to be on
- Cold when get home
- Cold after a shower
- Cold in bedroom when go to bed

Behaviours and attitudes towards usage and spend (10 minutes / 2 hours 10 minutes)

48. Do you know what you spend on gas/heating, on electricity? How does it vary across the year?
49. Are there any ways you feel you are spending money on heating but not really benefiting?
Probe for possible ways and see which they are aware of/ which they perceive to be wasteful. Look at temperature plots with them. →
50. What, if anything, do you currently do to minimise your spend on heating?
Probe close doors, turn off/ down heating in some rooms etc.
51. How could your heating controls help you save on your heating bill? What would they need to let you do that you can't now?

Possible examples of 'waste'

- Heating unused rooms
- Heating on 'too late' or 'too high' at night, or come on 'too early' in the morning
- Heating on when home unoccupied for long periods (all day, when away on holiday) whether for pets or other reasons
- Heating on too high so that home (or specific areas of it) is unpleasantly warm and/or measures are taken to reduce heat such as opening windows, removing layers of clothing
- Forgetting to turn heating off or down when going to bed or going out
- Radiators obscured by sofas, curtains etc.

Ideal heating controls (10 minutes / 2 hours 20 minutes)

52. We've talked a lot about your heating. Please summarise for me the frustrations you currently have, and when you may be paying for energy you don't use
53. Why do you think you can't have your heating exactly as you would like it?
54. If anything was possible, even thought control(!), how would your heating controls work to help you heat your home exactly the way you want it?
55. Do you want to interact with the controls or would you rather not think about them?
56. There are other heating controls on the market that learn your comings and goings to turn the heating up or down automatically according to whether you're in or out, or a room is empty. How would that work for you?
57. There are heating controls on the market that let you control your heating from your phone from wherever you are, in or outside the home. How would that work for you?

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58. Suggest any (cool) ideas that come to mind based on the discussion and get feedback *e.g. card switch like in a hotel that you insert on entering home, and remove on leaving, but that perhaps has sensor to tell home when you're returning*
59. What difference would they make to how you use your heating?
60. How would you feel about getting a new set of controls? What if anything would stop you?

Other members of the household (10 minutes / 2 hours 30 minutes)

Where we haven't spoken to other main family members on the tour, we will talk to them briefly where possible.

As was mentioned when you were recruited, we'd like to talk briefly to some other people in the house.

Speak to other family members and ask them about their views on the heating; what they do with the heating, their frustrations and what would work better for them

End of session wrap up

That's all we have for today, so thank you for taking part. We are really grateful for your feedback in both the diary and today's session.

Appendix E: Workshop discussion guide

Introduction and purpose of the session 10 minutes

Goal: To explain to everyone why they are there. They will have consent forms to fill out.

As people come in, greet, hand out name tags. Get them to complete the consent form and fill in the user type forms. Explain that they can annotate and edit the user type forms if they want and tell them we will be discussing it in the session. They can circle the things they really relate to, and cross out the things that don't.

Hello and thank you all for coming. This is a workshop in which we will be discussing your heating system and how that might differ from your ideal system. We have some exercises designed to get at those things.

The purpose of today's session is to discuss your heating controls. We will start by discussing heating in a general sense, in order to help get you thinking about the subject. We will then look at a few new ideas – or 'concepts' – which could help control heating in the future. We will then get you to get into pairs and design how your heating system might be controlled, ideally. These ideas could well be developed; you have a unique opportunity to input into the future of heating!

Just before we get going:

- We'd like you to be as open and honest as possible. We're an independent research company and you won't offend us with anything you have to say.
- Please allow others the courtesy you would expect yourself by listening to other people when they are talking and not interrupting.
- We are recording the session, which is mainly for research purposes. It will not be released into the public.
- **London only:** You may have noticed the mirror; I have a colleague in another room taking some notes; please try to not let this bother you. Most people tend to forget about it after a few minutes.
- The session should last two and a half hours.
- With that in mind, please don't be offended if we have to move the discussion on a bit at times. It's just to make sure we get through everything we need to.

Any questions?

Section 1 – General discussion. 40 minutes

Goal: To engage participants in regards to heating controls, and get them thinking about their current set up and the limitations of their system. We will ask them to score the user types based on how much they feel they represent them and their situation. This will be followed by a wide-ranging discussion including details on how they use the system, why they use it as they do, and limitations/ frustrations with their heating system. We will bring in and discuss common requirements unearthed during the in-home sessions.

Things needed:

- Blank flip-chart paper

You've all been specially chosen to take part in this group, because of the things you do and who you are. Some of you I've met before but you've obviously not met each other. You're probably wondering who everyone else is.

We'll go round the room, and I'd like you to tell us:

- your name
- what group you fall into on the form you filled in when you came in, and why you feel you are in that group. If none of the groups fit, why that is.

Researchers and note-takers start first; go round table in order.

To prompt round the group:

- Why are you doing it differently?
- What is the most efficient way of using the heating? What is the best way?
- Is there anyone here that has any conflict with their partners or people they live with?
- What are the frustrations, if any, that you have with your heating system?

As frustrations/ requirements come up, write them down on the blank flip chart paper on the wall.

Prompts on **how** people use their heating:

- Manual on/ off versus timer
- Timer settings: once/ twice
- Radiator valves
- Adjustment of thermostat: on/off; up/down
- Ancillary heaters/ methods
- Open windows

Discuss **why** they do it that way:

- Habit/ what know/ how told
- Household routines, variability, predictability
- Beliefs: maintaining constant temperature versus warming up and cooling home down; unbalancing system by turning off radiators, preventing damp
- Limitations in relation to controls functionality
- Limitations in relation to controls usability
- Convenience of location to where they are
- Physical constraints e.g. valves won't turn, out of reach. Can't turn them (dexterity), can't see them

Section 2 – Concept discussion. 40 minutes

Goal: To evaluate and explore up to three new concepts that are currently on the market. As part of this participants will explore how these concepts address the frustrations outlined in the previous section. They will have sheets with summaries of each concept on each, so they can capture the key benefits/ dislikes, before discussing as a group.

The order the concepts are described will vary across groups to control for order effects.

Things needed:

- Prompt sheet of common frustrations/ requirements
- Capture sheet and pens for each person

We now have a few different ideas – or ‘concepts’ – to explain to you. We will explain them to you one at a time, and then get you to rank them in order of preference on the paper we will give out to you. So the concept that you think would be most suitable for you, rank 1, and the concept you think is least suitable, rank 3.

Once we have read them out, we will give you a sheet for you to record the order you would rank them. We will then discuss why you’ve made the choices that you have.

Centralised remote control

Summary

Simple heating control panel that allows you to easily programme different times and temperatures to best suit your routines. In addition to the control panel you can also control your heating using an app on your smartphone, tablet or PC – whether from in the home or from anywhere else in the world

Key features

- Set times and temperatures for heating your home
- You tell it when you want your home to be that temperature and it works out how long ahead to turn the heating on
- Check temperatures and control heating from your smartphone, tablet or PC
- You can also text changes to the system
- If you leave home and forgot to turn off your heating, you still can
- If you’re coming home and the heating won’t be on, you can turn it on
- Simple to install and use. *Probe what they think simple to install means; how long and by whom (themselves vs plumber)*

Localised control

Summary

‘Zonal’ controls allowing you to programme different times and temperatures for each room in your home

Key features

- Set different temperatures for each room independently to have each room just the way you want it
- Set different times so you don't need to heat rooms as much when you're not using them
- View detailed analyses of how you've been heating your home
- See information on energy used per hour and how much that energy costs
- See if you're spending more than usual

Automation

Summary

Automated system which learns from your use and also uses sensors to control the temperature in your house

Key features

- Learns when you make adjustments so is fully automated after about a week
- Senses when people are at home and adjusts the heating automatically
- Avoids the heating being on unnecessarily. *Probe on what this means to them: empty rooms, empty homes?*
- Indicates when the heating is set at an energy efficient temperature
- Incorporates external temperatures (perhaps by using the weather forecast) so it can learn and understand how your use of heating is affected by the weather outside
- An energy saving setting that always tries to reduce the heat to save energy, learning how far it can reduce it without you noticing

Read out each concept (order varied across groups), then hand out the sheets so they can rank them.

- After a few minutes: Starting with the first concept I read out (reiterate): who ranked this one first?
- Why did you rank it first?
- Why does it work for you?
- Is there anything about it you would change?

Then move to the second concept, with the same questions. Then third concept.

If time: explore reaction to more minimal controls: for instance no temperature and just one button to boost the heat for a bit (like those lights that go off after a short period)

Section 3 – Design exercise. 40 minutes

Goal: To design their ideal heating controls. This will involve analysing the products/ concepts explored in the previous section to see if it (or parts of it) would make the grade for an ideal version. They will also be able to draw on analogous areas such as iPods and Smart TVs. They will do the exercise in pairs so they are forced to argue for the included features, and they once completed each of the pairs will present to the group and explain their choices.

Things needed:

- Flip chart paper and pens for each person

We have so far discussed some of your frustrations with heating controls and looked at a few concepts and got your thoughts on them.

Firstly, we have a list of requirements that we have put together from previous research. We want you to read through them now. If any of them are unclear then please do ask – there will probably be others who aren't clear as well – and tick those you feel resonate with your situation.

Hand out the list of requirements and ensure everyone reads and ticks those applicable.

Now we are going to give you an opportunity to address these frustrations, by getting you into pairs and asking you to create your **ideal** heating system. What would your ideal system be? What would it look like? What would it do, or enable you to do that you can't do now? How would it change the way you use your heating?

- Certainly be thinking about the things we have been discussing so far, but don't limit yourself to just those things. Feel free to be creative: use your imagination. For example, you can bring ideas in from other areas, like iPads, Smart TVs, mobile phones, cars etc. There really are no stupid ideas.
- It may be that as a pair you disagree on a few things. This is ok! Try to find compromises and when we discuss your design at the end you can tell us where you had to make compromises, and how you resolved your differences.
- Specifically we want you to take a minute to think about your ideas, and then spend the rest of the time outlining your ideas on this paper. You can draw your ideas out – what they might look like, or you can create a storyboard of a day in your life – how would you use these ideal controls.
- Don't be limited by what you do already. It may be that your ideal is a panel on the wall, it may be that it works automatically, or it's something attached to your watch or something you swallow!
- Don't worry about the standard of your drawing, stick men will do. And you can annotate your pictures with lots of words and descriptions if that helps.
- We will give you 20 minutes to get your thoughts down and then we will ask you to get up and present your ideas.
- I'm aware I've given you a lot of information here, so there are sheets in front of you reiterating the exercise, and we will be around to help if you need it.

Any questions?

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While they are doing the exercise go round the table and ensure everyone can make a start and is able to start putting down their ideas. Remind them of the brief and prompt some thinking for them based on what they've said thus far if they appear to be very stuck.

After they have done the exercise, get them to come up to the front, one pair at a time and present their ideas to everyone else in the group.

Probe:

- why they did it this way
- the key benefits
- how this design meets their needs
- any drawbacks that they or others can see
- any compromises that were made by either pair
- any other feedback from the rest of the group

Add any requirements to the list that have presented themselves during the exercise.

Section 4 – Voting exercise. 10 minutes

Goal: To prioritise the requirements participants would like to see in future heating systems – whether that's control features or more fundamental aspects. Specifically, they will have a number of dots, which they will use to vote for features – should they particularly like one feature they can place all their dots next to it; or they could place one dot next to several features. Clear patterns of preference will become quickly apparent.

Things needed:

- Coloured dots/ stars for voting
- Flip chart paper/ A3 paper featuring entire list of requirements to vote on

Now we are going to do one final exercise. Over the course of the session we have discussed a number of requirements and frustrations that you all have with your heating system. We have them listed up here on the wall.

The idea is that you prioritise those requirements that you think are most important by putting sticky dots next to the requirements **you** think are most important.

There are a number of requirements. You have 10 dots.

The idea is to come up to the front and put dots next to the requirements that you think are most important.

You can put the dots where you like, and put more than one dot on a requirement. So if you think one of these requirements is really important, you could put all your dots next to it. Or you could spread your dots out next to all the requirements. It's up to you.

We'll give you 5-7 minutes, and then we'll talk about your choices.

Any questions?

If time: after the dots are on the wall, quickly scan for patterns. Discuss requirements that seem to have significant (mainly high) numbers of dots.

If time, look at who put dots on each one and discuss why, and why others did not vote for it.

Section 5 – Thoughts on getting new controls. 10 minutes

Goal: To explore how users might actually go about getting new controls; how they would prefer to pay for them, and what the cost-benefit might need to be; how they think new controls might save them money/ energy.

We have discussed a number of thoughts and ideas on heating system controls. I'd like you now to imagine these things existed (as some of them do); imagine your ideal system was available tomorrow.

1. How would you go about getting the new controls?
 - Who would you contact?
 - Who would you want to contact?
 - Where would you expect to find them?
2. How would you feel if you were *made* to get them?
3. How would you prefer to pay for them? *Direct Debit, included in energy bill.*
4. How long would you be prepared to wait in order to recoup the initial outlay?
5. Do you think the controls you have described would actually save you money in the long run?
 - In what ways?
 - Is that enough to encourage you to purchase them (hypothetically)?

Section 6 – Close

Goal: To say goodbye and hand out incentives, and get receipts signed.

That is all we have for you, so thank you for your time, it is really appreciated.

This research is for the Department of Energy and Climate change (DECC).

Has anyone got any final questions for me?

Appendix F: Requirements overall prioritisation list

Rank	Requirement	Priority based on votes
1	See how much heating is costing you	High
2	Ability to set different temperatures at different times for different rooms – all from one central panel	High
3	Understand savings that can be made by making adjustments to settings on the heating controls	High
4	Ability to remotely turn on heating before returning home	High
5	Clear and permanent display of times and temperatures set	High
5	Simple way to switch heating on/ off	High
5	Rapid warming when turning heating on	High
8	Quick-and-easy to adjust time settings for heating coming on and going off	Medium
8	Easy access to heating controls in the home	Medium
10	Automatic frost protection to guard against pipe freezing	Medium
10	Feel confident that temperature will always be right for babies and young children	Medium
10	Ability to use controls without needing to use instructions	Medium
13	Understand the cost of heating by the hour	Medium
14	Heating system automatically adjusts to take into account outside temperature	Medium
14	Ability to remotely turn off heating after leaving home	Medium
16	Knowing you can use your heating on cold days because your system works out you'll spend less on predicted upcoming warmer days	Medium

Rank	Requirement	Priority based on votes
17	Be able to control heating in a specific room using a wall control	Medium
17	Temperatures on radiator valves instead of just numbers	Medium
19	Be made aware of when control settings are not working as efficiently as possible for your routines and occupancy patterns	Low
19	Know whether it's more expensive to have gas central heating on or just heat the room you're in with an auxiliary heater	Low
19	Heating system takes account of when you feel cool or warm, not just the actual temperature	Low
22	System works out best compromise temperature to suit different people with different preferences in the home	Low
22	Avoid going over heating budget	Low
22	Know how far ahead you need to turn heating on to achieve a particular level of warmth at a particular time	Low
22	Be made aware of a higher spend than normal	Low
26	Be reminded to make adjustments to different zones (rooms) according to intended usage	Low
26	Aesthetic and appealing heating controls	Low
26	To set a time and temperature and be able to leave the system to work out when to turn the heating on	Low
26	Be reminded to turn heating off when not needed	Low
26	Reminder if heating left on constant	Low
26	Warning when gas meter is running low/ running out	Low
33	Avoid running out of credit unexpectedly	Low
33	Leave heating system to note changes in daily routines and occupancy and adjust itself accordingly	Low
33	Option for Celsius/ Fahrenheit on thermostat	Low
33	Voice control	Low
37	Be alerted when someone else makes changes to heating control settings	Low
37	Be alerted remotely when someone turns the heating on (e.g. by text)	Low

Appendix G: Requirements by user type

Requirements voted for by participants classified as 'Rationers'

* Requirements that don't so obviously fit with the user type

** Requirements that received few or no votes by participants allocated to the user type but were judged by the research team as likely to be important for this type

Be able to budget for cold and warmer weather.

Heating automatically adjusts to take into account outside temperature.*

Not to go over their heating budget.

To know whether it's cheaper to use gas or auxiliary electric heater.

Understand the savings that can be made by making adjustments to heating control settings.

Simple way to switch on or off.

Ability to use controls without needing to use instructions.

Rapid warming when turning heating on.

Warning when gas meter running low or running out.

See how much heating costs.**

Reminders to turn heating off.**

Avoiding running out of credit unexpectedly.**

Requirements as voted for by participants classified as 'Ego-centric'

* Requirements that don't so obviously fit with the user type

** Requirements that received few or no votes by participants allocated to the user type but were judged by the research team as likely to be important for this type

Remote control to turn on before return home.

Simple way to switch on or off.

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Easy access to heating controls in the home.

See how much heating costs.*

Ability to set different temperatures at different times for different rooms – all from one central panel.*

Understand the savings that can be made by making adjustments to heating control settings.*

Rapid warming when turning heating on.**

Reminders to turn heating off.**

Heating to take account of different personal needs and rhythms.**

Requirements as voted for by participants classified as ‘Hands off’

* Requirements that don't so obviously fit with the user type

** Requirements that received few or no votes by participants allocated to the user type but were judged by the research team as likely to be important for this type

Clear and permanent display of times and temperatures set.

Rapid warming when turning heating on.*

Feel confident that temperature will always be right for babies and young children.*

See how much heating costs.*

Ability to remotely turn heating on before returning home.*

Ability to set different temperatures at different times for different rooms – all from one central panel.

Quick-and-easy to adjust time settings for heating coming on and going off.

Understand savings that can be made by making adjustments to heating controls.

Be made aware of when control settings are not working as efficiently as possible for routines and occupancy patterns.**

Requirements as voted for by participants classified as ‘Planners’

* Requirements that don't so obviously fit with the user type

** Requirements that received few or no votes by participants allocated to the user type but were judged by the research team as likely to be important for this type

See how much heating costs.*

Ability to use controls without needing to use instructions.

Quick-and-easy to adjust time settings for heating coming on and going off.

Simple way to switch heating on or off.

Understand cost of heating by the hour.

Automatic frost protection.*

Understand savings that can be made by making adjustments to settings on the heating controls.

Ability to set different temperatures at different times for different rooms – all from one central panel.**

Clear and permanent display of times and temperatures set.**

Easy access to heating controls in the home.**

Ability to remotely turn on heating before returning home.**

Requirements as voted for by participants classified as ‘Reactors’

Ability to set different temperatures at different times for different rooms – all from one central panel.

See how much heating is costing.

Understand savings that can be made by making adjustments to settings on the heating controls.

Ability to remotely turn heating on before returning home.

Ability to remotely turn off heating after leaving the home.

Easy access to heating controls in the home.**

Rapid warming when turning heating on.**

System works out best compromise temperature to suit different people with different preferences in the home.**

Know whether it's more expensive to have gas central heating on or just heat the room you're in with an auxiliary heater.**

Reminders to turn heating off.**

Appendix H: How smarter heating controls might address wasteful behaviours

The table below presents the research team’s analysis of whether smarter heating controls have the potential to mitigate the wasteful behaviours detailed in 6.4.1 to 6.4.8 of the main report.

‘Waste’ category	Automated controls	Remote controls	Zonal controls
Forgetting	Yes	No	No
Excessive ‘caution’	Yes	No	No
Over-heating home	Yes	No	No
Use of auxiliary heaters	No	No	Yes
Non communication	Yes	No	Yes
Leaving heating on when out	Yes	Yes	No
Non fine tuning of timer	Yes	Yes	Yes

Appendix I: Researchers' reflexions on smarter heating controls and comfort

Whether smarter heating controls could increase comfort did not form a research question explicitly pursued. However, comfort is often balanced against spend; with many prioritising comfort over spend (while wanting to minimise waste). As a result it is worth considering the relationship between smarter heating controls and comfort. Based on the researchers' observations and analysis of overall participant responses, this question is assessed in terms of automation, remote control and zonal control.

Automation

It's difficult to know whether automation would increase comfort without knowing exactly how it may be executed. If it predicted when occupants were returning home based on routines, then it could have the heating on for when occupants returned, which would increase comfort (assuming their system does not already do this). Many wanted the system to heat up the home faster; if automation switched on and off when people walked in and out of rooms and there was a lag, this would affect comfort negatively compared to a system that left the heating on in that room permanently.

Remote control

As reported, a key requirement was to be able to turn heating *on* before returning home. Participants also reported benefits of remote control around being able to adjust the heating from a bed or the sofa. From the context provided around these discussions, it is likely people would turn the heating on earlier than before to increase comfort. Turning the heating off could also improve comfort if the person felt too warm. Remote control would therefore probably help to increase comfort overall.

Zonal control

Zonal control, was seen by participants to be more about turning heating off or down, in 'standby' or 'dead' space. This would have no effect on comfort directly. But if participants could see the benefit of savings made elsewhere in the home, they may compensate by having the heating on more or longer in the 'live' space they occupy.

Some participants complained about having rooms in their home too warm or too cool and not being able to get the system right. Zonal control should allow people to have each room at the right temperature, when they want it.

Appendix J: Potential criteria for usability testing of smarter heating controls

General

- Turn heating up/ down
- Turn heating on/ off
- Turn heating on to constant
- Check/change times/ temperatures the heating is due to come on or off
- Setting time for temperature to be achieved rather than time coming on

Remote control

- Turn heating off/on remotely
- Check current temperature/ time settings
- Adjust the current temperature/ time settings

Zonal control

- Turn heating on/ up upstairs
- Turn heating off/ down upstairs
- Setting different temperatures/ times for different rooms/ areas
- Advance setting for temperature to go on/off up/down in a particular room
- Checking the current settings

Automation

- Override to turn on/off, higher/lower
- Ascertain how it's currently set
- Make changes to how it's currently set