



Domestic energy use study: to understand why comparable households use different amounts of energy

APPENDICES

Produced by Brook Lyndhurst

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).

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Introduction

This document contains the appendices to the “Domestic energy use study: to understand why comparable households use different amounts of energy” main report. Brook Lyndhurst conducted the research and prepared the report for the Department of Energy and Climate Change (DECC) between February and October 2012.

The overall purpose of the research was to build up a rich ‘people-centred’ picture of how and why households use energy in the ways that they do, with a focus on high and low use. In particular, the research aimed to understand better why apparently comparable homes consume such different amounts of gas.

The research programme had the following phases:

- **Phase 1 - initial programme of two hour in-depth interviews:** These interviews used a mix of carefully designed prompts, including diagrams and activities; took place in interviewees’ homes; and included a ‘guided tour’ of each home. These interviews were centred around lifestyles, comfort and use of the home, and participants were not explicitly informed about the focus on energy consumption.
- **Phase 2 - diaries and energy monitoring:** Households kept diaries for eight weeks, writing once a week online¹ about what had been happening in their home. The diary was used to collect a gas meter reading each week, though this was collected amongst other information in order to disguise the focus on household energy use. This other information included: an overview of things that happened in the household that week; how many baths were taken in the week; how many hours of TV were watched each week; and a number of other questions (that varied each week) to garner information on the household. Twenty households also gave consent for consent for ThermoChron® iButtons®² to be placed in their homes. These iButtons (about the same size as a shirt button) were left in three rooms - one identified as warm, one as cool, and a third room of interest - and recorded the temperature once every hour for 10 weeks.
- **Phase 3 – final programme of one hour in-depth interviews:** Interviews took place in homes 2-3 months after the first interview, and interviewees were asked more directly about their gas use, heating, and energy consumption. Photos were taken of participants, their homes, and their boilers. Interviewees were given the option of being assessed for an Energy Performance Certificate (EPC).

These following appendices contain information on the recruitment of participants (Appendix A), some discussion of methodological issues (Appendix B) and some examples of fieldwork materials (Appendices C-E). The last two appendices display some of the data collected. Firstly the temperature data collected using the iButtons (Appendix F), and finally, a selection of photographs from the research (Appendix G).

¹ Those less comfortable using the internet (eight out of 70) were sent paper diaries to complete, along with pre-paid envelopes.

² DS1921G ThermoChron iButtons. More information on this technology:
<http://www.maximintegrated.com/datasheet/index.mvp/id/4023>

As well as the information provided in appendices DECC have been provided with:

- A spreadsheet containing a full set of qualitative responses;
- A spreadsheet with iButton data showing the temperature of three rooms in 19 households on an hourly basis throughout the 10 week monitoring period, as well as Met Office temperature data from a relevant local weather station for the corresponding period; and
- A spreadsheet containing information from the 48 Energy Performance Certificates and the boiler data collected in Phase 3³.

³ This includes Standard Assessment Procedure (SAP) ratings according to the Boiler Efficiency Database, as found at <http://www.boilers.org.uk/>

Appendices

Appendix A – Recruitment targets

ID	Gender	Age	Lifestage	Typology	Quota	Date
1	Good mix of gender	Aged 59 or under	Single and have no children	High gas energy users	Owner occupiers Live in 3 bedroom semi-detached houses At least X12 have houses built in 1920 or earlier At least X12 have houses built since 1980 At least X12 have an annual household income of up to £14,999 At least X12 have an annual household income of £60,000 or more Have a gas boiler At least X6 have an electric (power) shower At least X6 have a conservatory At least X8 have had a new boiler fitted in the last 5 years At least X8 have had new insulation measures installed in the last 5 years Good spread of electricity usage At least X6 agree that they can remember at least one occasion when they have run out of hot water when they needed it At least X6 have experienced a change in the family circumstances in the last year At least X10 have someone in the household with a long-term limiting medical condition At least X12 have a cat and/ or a dog	Starting w/c 19 th March
2				Low gas energy users		
3			Married/ cohabiting and have no children	High gas energy users		
4				Low gas energy users		
5			Have at least one child 18 years or younger living at home At least X4 have at least one child aged 5 years or younger living at home	High gas energy users		
6				Low gas energy users		
7			Have at least one child 18 years or younger living at home At least X4 have at least one child aged 5 years or younger living at home	High gas energy users		
8				Low gas energy users		
9			Single	High gas energy users		
10				Low gas energy users		
11			Empty Nesters/ have no children	High gas energy users		
12				Low gas energy users		
13			Married/cohabiting	High gas energy users		
14				Low gas energy users		
15			Empty Nesters/ have no children	High gas energy users		
16				Low gas energy users		
17			Single	High gas energy users		
18				Low gas energy users		
19			Empty Nesters/ have no children	High gas energy users		
20				Low gas energy users		
21			Married/cohabiting	High gas energy users		
22				Low gas energy users		
23			Empty Nesters/ have no children	High gas energy users		
24				Low gas energy users		
25			Single	High gas energy users		
26				Low gas energy users		
27			Empty Nesters/ have no children	High gas energy users		
28				Low gas energy users		
29			Married/cohabiting	High gas energy users		
30				Low gas energy users		
31			Empty Nesters/ have no children	High gas energy users		
32				Low gas energy users		
33			Single	High gas energy users		
34				Low gas energy users		
35			Empty Nesters/ have no children	High gas energy users		
36				Low gas energy users		
37		Married/cohabiting	High gas energy users			
38			Low gas energy users			
39		Empty Nesters/ have no children	High gas energy users			
40			Low gas energy users			
41		Single	High gas energy users			
42			Low gas energy users			
43		Empty Nesters/ have no children	High gas energy users			
44			Low gas energy users			
45		Married/cohabiting	High gas energy users			
46			Low gas energy users			
47		Empty Nesters/ have no children	High gas energy users			
48			Low gas energy users			
49		Single	High gas energy users			
50			Low gas energy users			
51		Empty Nesters/ have no children	High gas energy users			
52			Low gas energy users			
53		Married/cohabiting	High gas energy users			
54			Low gas energy users			
55		Empty Nesters/ have no children	High gas energy users			
56			Low gas energy users			
57		Single	High gas energy users			
58			Low gas energy users			
59		Empty Nesters/ have no children	High gas energy users			
60			Low gas energy users			
61		Married/cohabiting	High gas energy users			
62			Low gas energy users			
63		Empty Nesters/ have no children	High gas energy users			
64			Low gas energy users			
65		Single	High gas energy users			
66			Low gas energy users			
67		Empty Nesters/ have no children	High gas energy users			
68			Low gas energy users			
69		Married/cohabiting	High gas energy users			
70			Low gas energy users			

The above 'Recruitment targets' table is what was submitted to the recruitment consultants to recruit participants for this study.

As discussed in more detail in Appendix B, neither the recruitment, nor the classification of high and low gas users, were straightforward tasks. As a result, the criteria matched by those recruited to the project deviated slightly from those detailed in the table above. The 'Achieved recruitment' table below displays in brackets how many from each subgroup took part in the research.

Achieved recruitment

ID	Gender	Age	Lifestage	Typology ⁴	Quota		
1	Good mix of gender (55 female, 15 male)	Aged 59 or under (54)	Single and have no children (5)	High gas energy users (2)	Owner occupiers (70) Live in 3 bedroom semi-detached houses (70) At least X12 have houses built in 1920 or earlier (12) At least X12 have houses built since 1980 (10) At least X12 have an annual household income of up to £14,999 (16) At least X12 have an annual household income of £60,000 or more (17) Have a gas boiler (70) At least X6 have an electric (power) shower (24) At least X6 have a conservatory (12) At least X8 have had a new boiler fitted in the last 5 years (19) At least X8 have had new insulation measures installed in the last 5 years (34) Good spread of electricity usage At least X6 agree that they can remember at least one occasion when they have run out of hot water when they needed it (28) At least X6 have experienced a change in the family circumstances in the last year (20) At least X10 have someone in the household with a long-term limiting medical condition (10) At least X12 have a cat and/ or a dog (29)		
2				Low gas energy users (2)			
3			Married/ cohabiting and have no children (13)	High gas energy users (5)			
4				Have at least one child 18 years or younger living at home (28) [At least X8 have at least one child aged 5 years or younger living at home (12)]		Low gas energy users (7)	
5						High gas energy users (11)	
6							Low gas energy users (11)
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⁴ The 'Typology' column totals 53 due to the reallocation of some users away from 'High' or 'Low' (see Appendix B).

⁵ The discrepancy between the '16 aged 60 or over' in the 'Age' column, and the 24 'empty nesters' in the 'Lifestage' column is explained by the fact that some of the 'empty nesters' recruited were aged 59 or under.

Appendix B – Methodological issues

1. Defining high and low gas users

The recruitment of participants to the High and Low categories was an especially important element of the recruitment. NEED data were used to calculate the thresholds for High and Low gas use, for 3-bedroom semi-detached, owner occupiers in three income groups (since it is known that gas use varies with property type, tenure and household income). DECC and Brook Lyndhurst agreed that High would be defined as households in the highest decile of gas consumption; and Low as households in the lowest decile. Figures provided from NEED analysis by DECC, corrected for temperature variations between the winter they were collected and 2012 and on the basis of a common estimate of gas prices per kWh, gave thresholds as follows:

Figure A1 – Defining high and low gas users using the NEED data

Income band	Threshold for low decile (£ per annum)	Threshold for high decile (£ per annum)
<£15k/annum	343	1,095
£15k-£60k	375	1,144
>£60k	518	1,403

During the recruitment process, prospective participants were required to indicate their annual household income, and then to show a recent gas bill. If, for the relevant income band, the bill suggested an annual gas bill of below the low threshold, or above the high threshold, participants were recruited to the study as High or Low. If not, they were rejected for inclusion.

It was recognised at the beginning of the exercise, by both DECC and Brook Lyndhurst, that this was an innovative endeavour and that, as such, there were some risks in the approach. In particular, it was acknowledged that this method for identifying Highs and Lows at the beginning of the study may not prove, in light of the findings from the research, to actually have done so with precision. A recent gas bill (deemed to be the most cost-effective device for identifying households during the recruitment phase) may not accurately reflect actual gas use.

During the course of the study, a wide variety of both qualitative and quantitative data were gathered that could both help to refine the classification of any given household as High or Low, as well as help to explain any differences between High or Low households⁶. Upon completion of the fieldwork, a series of analyses was undertaken to explore the variables that could be used to classify households as either High or Low. The variables examined were:

⁶ It is important to recall that the study was presented to participants, at initial interview, as an investigation of how they lived their lives and how they used their homes, rather than as an investigation of their energy use. This was partly because our broad hypothesis was that energy use occurs indirectly as a result of how people live their lives; and partly so as to minimise the risk that participants would change their energy use behaviours whilst participating in the research (the Hawthorne effect).

- gas use during the course of the study (as recorded by householders during the diary phase)
- gas readings at the start and end of the study (readings at the end were collected by researchers during the second interview)
- evidence from an Annual Energy Statement, where available
- gas bills presented at the point of recruitment
- gas bills presented at the second interview

No single one of these indicators provided a definitive means of classifying all the households as High or Low. In most cases this was because of incomplete coverage: not all householders who completed diaries were able to complete their gas meter readings; not all householders were able to locate an Annual Energy Statement or a gas bill⁷; not all households had an Energy Performance Certificate. Furthermore, the incompleteness of coverage was non-overlapping: that is to say, a household that was able to provide a gas bill might not have had an Annual Energy Statement etc.

Only 11 of the 70 households had an Energy Performance Certificate at the start of the study. All participating households were offered a free Energy Performance Certificate at the end of the study to gather consistent data across the sample. At the time of this analysis, we had Energy Performance Certificate data for a total of 48 households.

Furthermore, gas meter readings did not definitively indicate whether a household was high or low because they were only taken between April-July, rather than during the coldest part of the winter due to the timing of the study.

Also, as discussed in the main report, a majority of participants pay their gas bills by direct debit, meaning not only is evidence of peaks and troughs in usage evened out, but also that over- or under-payments are obscured. Thus, for example, a household that had significantly overpaid for gas in a previous year might have lower gas bills this year. Gas bills are therefore not necessarily a reliable guide to usage. Variation in tariffs between providers further complicates this issue as bills do not relate simply to the amount of gas used.

Finally, variations in behaviours or lifestyles from one year (or one period) to the next may well mean that gas consumption varies considerably over time. The arrival of a new baby; the construction of a new extension; the decision to insulate a loft; all could, conceivably, have a significant impact on an individual household. This may be sufficient to move them from being in 'the middle' one year to High the next year; or from High to the middle from one year to the next, etc.

In light of these considerations, the research team reviewed the findings across a suite of variables for each participating household and made a judgment as to the most appropriate classification for each. Where all available indicators pointed in the same direction, a household was thus classified as High or Low. Where the results were more ambiguous; or where there was clear evidence of incorrect allocation at recruitment; or where there were insufficient data to make a clear allocation; households were re-classified as 'Medium'.

This process revealed a total of 28 households as High; and 25 households as Low.

⁷ This is noteworthy in itself, as participants were asked to find these documents in advance of interviews.

Data for these 53 households provided a rich source of material for exploring which – if any – differences there were between High and Low gas-using households. The majority of the findings in the main report are based on an analysis of this material. Findings from the ‘medium’ households that were relevant to the more general exploration of in-home energy behaviours were still included in the overall findings from the research, while for findings of specific relevance to High/Low comparison the ‘medium’ households were excluded.

2. Recruitment

Recruitment was an extremely complex task due to the number of conditions the recruiters were asked to meet (see Appendix A). It was not only a case of finding individuals in three-bedroom semi-detached houses that had gas central heating, a gas bill that placed them in the top or bottom deciles of gas users, and were willing and able to take part in the research. Five recruiters in different locations also had to ensure that between them they recruited a certain number of people from particular lifestages, a balance of high and low gas users for each lifestage, and that numerous other criteria were met (see Appendix A).

All in all the recruitment was very successful, though there was some difficulty in finding three-bedroom households occupied by a single person. Though the targets for recruitment were based on the national picture of occupancy in three-bedroom semi-detached houses, perhaps because of the fieldwork locations (suburban and generally relatively affluent) these individuals were harder to find. There was also an over-recruitment of women to the study (see Appendix A). The research was, however, designed to focus on the attitudes and behaviours of all household members, not just the interviewee, and questions were specifically asked about household dynamics. This will have gone some way to overcoming any bias.

Appendix C – Phase 1 interview topic guide

Time	Instructions	Purpose of section
5 mins	Introduction	
(5mins)	<ul style="list-style-type: none"> • Interviewer to introduce themselves and Brook Lyndhurst. • Aims of project: a study about lifestyles, and home life, and the different ways different types of household spend their time at home. • Confidential: their name won't appear anywhere. • No right or wrong answers – we just want to build up a picture of the range of lifestyles of normal, busy households. • Don't have to answer anything they don't want to – free to withdraw from study at any time. • Interview will last about 2 hours. • Permission to record (if necessary); explain you'll be making notes throughout – for our memories only! • Any questions before we start? 	<p><i>Warm up.</i></p>
30 mins	Part 1a – Setting the context: ideas of home	
(35 mins)	<ul style="list-style-type: none"> • To start with, could you tell me a bit about your household? <ul style="list-style-type: none"> ○ Who lives here at the moment (may include pets)? ○ (Cross reference student movements. Prompt also on visitors and whether this affects 'home') • How long have you lived in this house? <ul style="list-style-type: none"> ○ (How does it compare to previous places you've lived - better/worse?) • (If applicable) Tell me a bit about each member of your household. If you like, you can use this template (<i>present A3 template</i>) and draw a sort of 'map' of the people in your household. • In every household, there are lots of things to be done. In your house, who does things like: cooking meals, fixing the internet, paying the bills, setting the thermostat/boiler programme, dealing with the rubbish and recycling...? Could we add these tasks to your map, to show who generally does what? <p><i>(Add roles and tasks to the map (use stickers))</i></p>	<p><i>This part of the interview will take place sitting down, ideally at a table.</i></p> <p><i>Aims: break ice, establish rapport, explore family dynamics, 'ideas of home' and lifestyles from perspective of participant.</i></p> <p><i>What does home mean? (e.g. home as Sanctuary? To-do list? Place to relax? Place to be busy?)</i></p> <p><i>What roles do hh members play in the context of home? How are tasks of the house and decisions shared?</i></p>

45 mins	<p>Part 1b – Setting the context: ideas of home</p>	
(80 mins)	<ul style="list-style-type: none"> • Describe a typical day (include those of other members of household too, if applicable) <ul style="list-style-type: none"> ○ A week day (Any activities geared towards making the home ‘nice’? Focus on mornings and evenings: could any – e.g. that use energy - be done at other times of day?) ○ The weekend • What are the main things you enjoy doing when you’re at home? <ul style="list-style-type: none"> ○ What about the rest of the household/family? (draw/write on map if appropriate) ○ What do you most look forward to about coming home? ○ What about holidays (Christmas, Easter)? • And tell me a bit about your actual house: what are the things you like most about it? (draw/write on map if appropriate) <ul style="list-style-type: none"> ○ Pride? Time spent on maintenance? ○ Renovations/improvements? (Give a bit of history – why have they done things?) ○ Any significant recent purchases for the home? (What, why? Replacements/additions?) ○ Are there particular rooms or areas of your house that you like most and least? 	<p><i>Look out for ‘energy behaviours’ to be used as basis for later questions</i></p> <p><i>Interviewer to (mentally) note observations about house: condition, maintenance etc.</i></p>
45 mins	<p>Part 2 – Exploring lifestyles</p>	
(125 mins)	<p>Multiple card sorting procedure of ‘activities at home’ <i>(If time, repeat. As second or third sort, use question: what do you like/dislike doing?)</i></p> <p>Walking tour of home <i>(First: check that they’d be happy to give you a ‘tour’)</i></p> <ul style="list-style-type: none"> • Can you show me the place in your house where: <ul style="list-style-type: none"> ○ You spend most time? ○ You spend least time? ○ It’s cosiest? ○ It’s coolest? ○ It’s warmest? ○ It’s draughtiest? ○ It’s loudest/quietest ○ You like to chill out/relax? • For each: Tell me about this room/this place, and what happens here: who uses this space and why? <i>Draw these places on the map (e.g. the warmest/cosiest place), and show who uses them.</i> 	<p><i>This part of the interview may involve accompanying participant to different parts of house, if appropriate (i.e. if both participant and interviewer feel comfortable).</i></p>

-	General prompts for during or after tour
-	<ul style="list-style-type: none">• Space heating/temperature<ul style="list-style-type: none">○ Would you say that you generally keep the house warm or cool?○ Would you say you all like it the same temperature? Do you all agree on how much you have the heating on?○ Do you tend to keep all the rooms the same temperature? Do you use Thermostatic Radiator Valves (TRVs)?○ When and why do you have it warm/cool?○ How do you use your central heating? What other methods of keeping warm do you have/use? Why?○ What about if you go away/out for the day/when you're at work/during the night?○ How easy/difficult do you find it keeping your house warm in winter/cool in summer?○ Do you ever worry about putting the heating on? Why?• Showers and baths<ul style="list-style-type: none">○ Do you tend to have showers or baths?○ How often?○ Why?○ Who spends longest in the bath/shower?○ Do you use hot water for anything else?• Using the boiler/thermostat (skills/knowledge) (may have been covered in Part 1)<ul style="list-style-type: none">○ Programming the heating/hot water?○ Setting the thermostat? (Ask if they know the temperature it's set to first)○ Reading the meter?○ Understanding of bills?• Energy efficiency profile of house (materials)<ul style="list-style-type: none">○ Double glazing? Insulation? Draught proofing? Energy efficient appliances? Smart meters?○ Age of white goods? (Any old enough to be 'hot fill'?)○ Why/why not? <p><i>[Can leave unanswered questions until 2nd interview]</i></p>
	Thank and close

	<p><i>We're after 'narratives' that locate these behaviours in wider structures of meaning. These points are just suggestions for prompts, if you need them. They could be covered as they arise naturally during the 'tour', or using the map later.</i></p> <p><i>Note: Is there variation in temperature by room? Or is heating on everywhere?</i></p> <p><i>Use map to cover any of the points that haven't been covered yet.</i></p>
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- **Interviewer observations**
- General observations on the household to be captured by the interviewer, after the interview is completed.


Checklist

(To be filled in afterwards with observations)

<input type="checkbox"/>	Windows:	Windows open	<input type="checkbox"/>	Windows closed	<input type="checkbox"/>
<input type="checkbox"/>	Curtains:	Curtains open	<input type="checkbox"/>	Curtains shut	<input type="checkbox"/>
<input type="checkbox"/>	Doors:	Doors open	<input type="checkbox"/>	Doors closed	<input type="checkbox"/>
<input type="checkbox"/>	Flooring:	Carpet	<input type="checkbox"/>	Wood	<input type="checkbox"/>
				Other _____	<input type="checkbox"/>
<input type="checkbox"/>	Smoker:	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
<input type="checkbox"/>	Clothing:	_____			
<input type="checkbox"/>	Use of secondary heaters:	_____			
<input type="checkbox"/>	Pets:	_____			
<input type="checkbox"/>	Welcome received:	_____			

<input type="checkbox"/>	Drying laundry:	_____			
<input type="checkbox"/>	Positioning of furniture (e.g. near radiators/fire, near windows):	_____			

Appendix D – Sample online diary

Exit this survey

Home diary - Week 6 (14th to 20th May)


Welcome

Welcome to Week 6 of the household diary.

As always, please fill it in towards the end of the week if possible (between Friday 18th and Sunday 20th May).

If you have any problems or questions, please give Charlotte E or Geoff a call on 020 8846 2100 or email geoff.king@brooklyndhurst.co.uk

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Exit this survey

Home diary - Week 6 (14th to 20th May)

Home life (page 1/2)

1. How has this week been overall?

***2. What's happened this week in the home?**

(For example, it could be: purchasing a new appliance; getting a new pet; staying with relatives for a night; having a big tidy; or just being far too busy to really remember much about the week. As long as it's about you or your family and stuff that has happened in your home, then we're interested! If you can remember when it happened, please tell us that too.)

1.
2.
3.
4.
5.

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Exit this survey

Home diary - Week 6 (14th to 20th May)

Home life (page 2/2)

***3. Please also tell us the following information about this week:**

Estimated hours spent watching TV (all household members)	<input type="text"/>
Your gas meter reading	<input type="text"/>
Number of baths taken in total (all household members, does not include showers)	<input type="text"/>
Number of showers taken in total (all household members)	<input type="text"/>
Approximate number of showers taken this week that lasted longer than 10 minutes	<input type="text"/>

4. Anything else you'd like to tell us?

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Exit this survey

Home diary - Week 6 (14th to 20th May)

Thank you

Thank you for completing this week's diary!

Prev

Done

Appendix E – Phase 2 interview topic guide

Time	Instructions
-	Introduction
-	<ul style="list-style-type: none"> • Thank for taking part and for completing the diary efficiently. • The interview will take around an hour. They are free to skip questions or leave the research at any point. • Reminder that all responses will be anonymised, their personal information will not appear in reports so please be as honest as possible. • Just so they are aware, there will be a walk at the start to check the gas meter reading, and mid-interview to look at the boiler. • Ask permission to take photos during the interview, and use them in the report. • Ask permission to record interview. • Any questions?
4 mins	Section A – Introductory basics
(4 mins)	<ul style="list-style-type: none"> • Number of adults • Number of children aged <5 • Number of children aged 6-17 • Family circumstances (bereavement, new baby etc) • Number of rooms (distinguish bedrooms and non-bedrooms, and exclude halls etc) • Method of gas bill payment (e.g. direct debit) • Final gas meter reading (take it with them) • (If available) note 20-digit EPC reference number (we can view the EPC details later online). • (If available) use their Annual Energy Statement to note how much energy they've used in the past 12 months (in Kwh) and the estimated cost of gas/electricity in pounds per year. If the AES is not available, ask them to show you a recent gas bill and note their spend.
8 mins	Section B - Occupancy
(12 mins)	<ul style="list-style-type: none"> • When/how often is the house unoccupied? • What are the reasons for occupants being out of the home (in a typical week)? • Any other reasons for being away? (for longer periods e.g. winter holidays) • Do they change their heating system settings when they (a) are out in the week and (b) go away? (off/cool/neighbour etc) • Is the house in use late at night (beyond 10.30)? • Is the heating on at night? Do they have any supplementary heating systems when people are asleep (blankets, windows, hot water bottles?) • Do occupants work from home? What are occupants' typical patterns of working from home? Do they use the heating system differently?

7 mins	Section C – Activities in the home
(19 mins)	<ul style="list-style-type: none"> • Do they have a gas oven/hobs? Do they do lots of cooking at home? • How do they dry laundry? What about when it's cold/warm outside? Do they turn the heating on and/or put clothes on radiators? • How often do they entertain guests? • Do any other people stay over? Who? How often? • When entertaining/having guests over, does your use of heating change? • Are there hobbies/activities that might have serious gas implications? (e.g. Industrial level cooking, potter's kiln)
7 mins	Section D – How do you feel about the home?
(26 mins)	<ul style="list-style-type: none"> • What does home mean? (Briefly, as covered in previous interview) • When are they comfortable at home, what does that mean? (Probe re temperature)
5 mins	Section E – Improving your home
(31 mins)	<ul style="list-style-type: none"> • Have they done regular and/or frequent renovations and improvements since they moved into the house? Why? How many, if any, explicitly involved temperature management/energy efficiency? • Are any rooms open plan? Which ones? (Note potential heat implications) • Have they found any rooms easier or harder to heat since making changes? • What are the reasons behind decision to/not to renovate (aesthetics, cost, 'for the kids', house value, payback periods etc)?
4 mins	Section F – Layout of the house
(35 mins)	<ul style="list-style-type: none"> • We talked in the previous interview about rooms you like or dislike. Are there any parts of the house you like or dislike because of the temperature? Draftiness? • Is there anything else related to the temperature of the house that you like/dislike? • Do they tend to spend time in rooms because they are naturally warm, or do they tend to choose the room and try and adjust the temperature? • Windows - any large, facing sun? (Note and photograph) • When do you get direct sunlight at the front of the house? What direction does the house face
20 mins	Section G – Nuts and bolts of energy management
(55 mins)	<p><i>[Visit boiler]</i></p> <ul style="list-style-type: none"> • Type of boiler (Note make and model - take photo) • How old is the boiler? When was it replaced? Why? Recently serviced? • Does the boiler work properly/any problems? • Who is responsible for setting boiler/thermostat/TRVs? • Who likes the place to be warmest? Do they agree?

- Does the person setting the boiler understand it? Anything they don't understand/ find complicated?
- Do they have settings for the boiler? If so, what are they? What about hot water settings/controls?
- When does the heating come on/off?
- Are there any variations in heating settings for weekday/weekend etc
- Any seasonal variation?
- What is the thermostat set to? How is this used (in conjunction with the boiler)?
- Where is the thermostat (reachable? Likely to be affected by heating/windows)?
- Any relationship between levels of comprehension and ease of use? Would simpler controls or automation save energy? (Do not ask - use judgement)

22 mins

Section H – Is there an information gap? (Relevant to Smart Meters)

(77mins)

- Who is/are their energy supplier(s)?
 - Have they changed supplier in past 5 years?
 - If they changed supplier, why?
 - Do they have a smart meter/display? (probe re gas and electricity)
 - Do they know how much gas they use?
 - How much do their gas bills cost? (Ask to see if they are aware, not to collect the figure NB don't let them look)
 - Do they perceive their gas use as a lot or a little?
- Task: What do you think uses the most energy in the home? (Get them to rank 1, 2, 3). (We are referring to all forms of energy e.g. measured in Kilowatts, so it could be anything in the household that use gas, electricity, or another source of energy).*
- If you wanted to use less gas, what kind of things could you do? (Name at least three, to allow comparison with DECC study)
 - Are they conscious of not using too much gas/trying to use less gas?
 - What about water? Do you think about how much hot water you use? Would you know how to use less hot water?
 - What do they think about energy efficiency more generally?
 - Have they made an investment or changes in behaviour around energy efficiency recently? Why/why not? (Probe re cost and payback period)
 - Do they generally keep house warm or cool? (Warm/cool/N/a)
 - Is there anything that requires the house to be warm?
 - Do they use secondary heaters? If so, what, where, why?
 - Do they ever wear more clothing at home, rather than turning the heating up?
 - Do they generally have windows open/closed?
 - Why are windows open/closed? (Probe - heat related?)
 - Do they generally have doors open/closed?
 - Why are doors open/closed? (Probe - heat related?)
 - How do they use TRVs?

Task: Comparison with national: for a household like yours in a 3 bed semi where do you think your gas use sits? (e.g. top 20%, bottom 5%, about in the middle)

-	Close out
-	<ul style="list-style-type: none"> • Pay incentive. • If haven't already: Photos #1 (exterior); Photos #2 (interviewee in living room (with family (and pets) if possible)); Photos #3 (boiler – sufficient to be able to identify the boiler). • If relevant, collect iButtons and note locations. • (If they don't have an EPC) We are able to offer you the opportunity to have your property assessed by an accredited domestic energy assessor. They will provide you with an Energy Performance Certificate (EPC) which gives information on how to make your home more energy efficient and reduce your energy costs. It would usually cost £X, but as you are part of this research it can be done for free. Would you be happy for us to arrange for an energy assessor to contact you? • NEED database: "It is sometimes possible to link the data we have collected with other government surveys or datasets held by government for the purposes of statistical analysis and informing wider policy formulation. Would you be happy for your responses to be passed to DECC for this purpose?" (Your confidentiality will be maintained, and linked data will only be used for statistical purposes by researchers authorised by the Department for Energy and Climate Change). • Further research: Would you be happy if the information collected in this project (with any personal information removed) is used in future studies? • Do they want feedback? • Explain what research is for. • Any questions?
	Thank and close
-	Further notes
-	<ul style="list-style-type: none"> • Researcher to note external temperature when the interview was conducted

Appendix F – iButton data

Figure A2 - iButton temperature data for high and low gas use households

	ID	Room 1	Room 1 average temp (°C)	Min. temp (°C)	Max. temp (°C)	St. Dev	Room 2	Room 2 average temp (°C)	Min. temp (°C)	Max. temp (°C)	St. Dev	Room 3	Room 3 average temp (°C)	Min. temp (°C)	Max. temp (°C)	St. Dev	Total average temp (°C)
High	31	Bed 2 ⁸	20.95	14.50	27.00	1.95	Bedroom	20.13	16.50	26.50	1.78	Playroom (back ⁹)	19.51	11.00	29.00	3.05	20.05
	42	Sitting (back)	20.85	17.00	25.00	1.31	Cloakroom	19.52	12.50	25.50	1.73	Front	20.21	16.50	24.00	1.25	20.19
	48	Bedroom ¹¹	22.37	19.00	27.50	1.34	TV room	20.65	15.50	32.50	2.33	Kitchen	20.74	17.50	25.50	1.21	21.25
	59	Lounge	19.46	15.00	28.00	1.91	Kitchen	17.90	13.50	24.50	1.86	Bedroom	20.02	15.00	30.50	2.57	19.12
	62	Ironing	23.12	17.00	46.00	3.78	Living	20.70	17.50	31.00	1.55	Toilet	19.65	14.00	40.00	3.63	21.16
																High ave:	20.35
Low	14	Bedroom	21.49	18.50	26.50	1.65	Kitchen	20.73	17.00	27.50	1.85	Lounge	19.59	16.50	28.00	1.64	20.61
	15	Bedroom	21.65	14.00	36.50	2.48	Dining	22.60	19.00	27.00	1.59	Lounge	22.72	18.00	29.00	2.28	22.32
	43	Kitchen	18.36	14.50	24.00	2.28	Bedroom	17.98	13.00	25.00	2.84	Sitting	17.65	13.50	23.50	2.42	18.00
	44	Sitting	18.48	12.50	26.00	2.54	Kitchen	19.88	13.50	27.50	2.68	Bedroom	19.28	13.50	26.50	2.58	19.22
	60	Bedroom	18.02	11.00	24.00	2.48	Game room	17.79	12.00	22.50	2.11	Kitchen	17.74	11.00	24.50	2.50	17.85
	63	Bed 2	21.28	15.50	26.50	2.18	Dining	19.53	14.00	25.00	2.03	Living	19.36	14.50	24.00	1.86	20.06
	65	Bed spare ¹¹	19.70	15.50	25.00	2.00	Bedroom	20.46	15.50	27.00	2.54	Living	19.99	14.00	27.00	2.82	20.05
																Low ave:	19.73

This table and the graph below display temperature data for each room in which iButtons were placed as part of the research¹⁰. The temperature of each room was recorded each hour between late April and early July 2012, though exact start and end dates varied by as much as two weeks. Full iButton data has been presented to DECC in a separate document.

⁸ Rooms listed as Bedroom refer to the 'main' bedroom in the house. Bed 2 refers to a second bedroom (in use). Bed spare denotes a largely unused bedroom.

⁹ Back and front rooms refer to a room's position on the ground floor in relation to the front door. Unless specified, these rooms were not explicitly referred to as a lounge or sitting room by the householder.

¹⁰ Only households which could be categorised as 'high' or 'low' gas users are included.

Figure A3 – Temperature data, by room – all households

Room	Average temperature (°C)	Average Standard dev.	Average min. temp. (°C)	Average max. temp. (°C)
Lounge, living, sitting ¹¹ (n=16)	20.32	1.98	15.69	26.72
Main bedroom (n=11)	20.26	2.22	15.23	27.77
Kitchen (n=8)	19.16	2.28	14.19	26.75
Other rooms ¹² (n=9)	20.02	2.64	13.94	31.56

The table above includes all 19 households in which iButtons were positioned. Front or back rooms not explicitly described as the 'lounge', 'living room' or 'sitting room', and dining rooms not included in the table.

¹¹ This does not include front or back rooms that were not explicitly described as the 'lounge', 'living room' or 'sitting room'.

¹² This 'other' category specifically includes one each of a: Cloakroom, Game room, Ironing room, Playroom, Office, TV room, Toilet, Upstairs hairdressing salon (semi-commercial), and Utility room.

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