



Department
of Energy &
Climate Change

How heating controls affect domestic energy demand: A Rapid Evidence Assessment

January 2014 – 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

These appendices that supplement the main report were written by Dr Tony Munton, Dr Andrew Wright, Dr Peter Mallaburn, and Dr Peter Boait. The research team comprised Tony Munton of *theRTK* Ltd; Andrew Wright, Peter Mallaburn, and Peter Boait of De Montfort University, Alan Gomersall of Kings College Information Retrieval Unit, and Collette Nurser of Southampton University. Grateful thanks also go to colleagues at the Department of Energy and Climate Change for their thoughtful responses to earlier drafts.

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How heating controls affect domestic energy demand: A Rapid Evidence Assessment

Appendices

Prepared by *the*RTK Ltd

January 2014

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Introduction

This document contains the appendices to Munton, A.G., Wright, A.J., Mallaburn, P.S, & Boait, P.J. (2014). *How heating controls affect domestic energy demand: A Rapid Evidence Assessment* main report. The RTK Ltd. conducted the research and prepared the report for the Department of Energy and Climate Change (DECC) between March and December 2013.

DECC commissioned this review with the aim of synthesising existing research evidence on how domestic heating controls affect energy demand. The objective was for the review to contribute to the Smarter Heating Control Research Programme, aimed to establish the extent to which the introduction of smarter heating controls is likely to save energy. The review was also intended to provide evidence with which to inform a subsequent design of a possible field trial that could detect any energy reductions associated with improving control technologies.

The following appendices contain supporting materials used in the study but not included in the main report.

Appendices

Appendix A: Details of the Rapid Evidence Assessment methodology

1. Identification of studies

Based on *the*RTK Ltd.'s experience of conducting reviews in this area, their publication and research experience, and further consultation with colleagues from DECC, the RTK team conducted searches using the following information sources:

1.2 Scopus

Scopus is the world's largest abstract and citation database of peer-reviewed literature. It contains over 20,500 titles from 5,000 publishers worldwide, including 5.3 million conference papers, and articles 'in press' from more than 3,000 journals.

1.3 Engineering Village

Engineering Village is a powerful search platform enabling searches of multiple databases focused on engineering literature from a range of reliable sources, including scholarly journals, trade publications, patents, government reports, reference books, and conference proceedings. Resources include:

- *Compendex* - over 7.8 million records and dating from 1969 through the present covering 175 engineering disciplines worldwide.
- *Engineering Index Backfile* - 1.7 million records for literature published from 1884-1968.
- *Inspec* - Published by the Institute of Electrical Engineers (IEE), the Inspec database provides a specialized focus on literature published in the areas of electrical engineering, computing and control, physics, and information technology. Inspec contains over 7.5 million records dating from 1969 and draws on 3,500 scientific and technical journals and 1,500 conference proceedings.
- *NTIS Database* - Over 2.1 million records dating from 1899 to the present, the NTIS database specializes in government-sponsored research. Sources include over 240 U.S. government agencies, NASA, U.S. Department of Energy, U.S. Department of Defense; plus international agencies such as the Japan Ministry of International Trade and Industry, Germany's Federal ministry of Research and Technology, and the U.K.'s Department of Trade and Industry.
- *Referex Engineering* - over 300 engineering titles from three reference collections: Mechanical and Materials, Chemical, Petrochemical and Process, and Electronics and Electrical.

1.4 The British Library (BL) direct

The British Library direct provides the capacity to search across 20,000 of the most popular journals in the British Library collection, covering almost every subject, as well as access to a five year archive from every journal. It also provides the facility to search for the titles across an additional database of over 67,000 journals and conference proceedings.

1.5 Web of Knowledge

Web of Knowledge is an academic citation indexing and search service, which is combined with web linking. It covers the sciences, social sciences, arts and humanities. The database includes 23,000 academic and scientific journals, 110,000 conference proceedings and 9,000 websites.

1.6 WorldCat Dissertations

WorldCat Dissertations and Theses includes millions of records for all dissertations, theses, and published material based on theses cataloged by members of OCLC, a worldwide library cooperative.

2. Search criteria

The review conducted searches to include studies from the UK, France, Holland, Germany, Scandinavia, the US, and Japan, but limited our search to publications produced in English. The years of publication were limited to 2006-2013, reflecting the aim of assessing the impact of recent technological developments in heating controls, and the fact that earlier reviews have covered the period prior to 2006.

The review searched for papers across the full range of the Centre for Reviews and Dissemination (CRD)¹ hierarchy of evidence – from well-designed RCTs to opinions of respected authorities, descriptive studies and reports of expert committees.

The major strategies we used for our preliminary searches were:

((heating or gas or electric) and (control or controls or thermostat or efficien* or practice* or storage or TRV* or (boiler and (timer* or programmer*)) and (dwelling* or residential or occup* or home owner* or domestic or apartment or hous*) and ((user* or customer*) and (behavior or behaviour or interaction* or practice or reaction*)) Not (china* or Chinese or stove*))*

((heating or gas or electric) and (control or controls or thermostat or efficien* or practice* or storage or TRV* or (boiler and (timer* or programmer*)) and (dwelling* or residential or occup* or home owner* or domestic or apartment or hous*) and (user* or customer*) and (behavior or behaviour or interaction* or reaction* or practice*)) and Not (china* or Chinese or stove*))*

(heating OR gas OR electric) AND (control OR controls OR thermostat OR efficien* OR practice* OR storage OR trv* OR (boiler AND (timer* OR programmer*)) AND (dwelling* OR residential OR occup* OR home owner* OR domestic OR apartment OR hous*) AND (user* OR customer*) AND (behavior OR*

¹ Centre for Reviews and Dissemination (2009). Systematic Reviews: CRD's guidance for undertaking reviews in health care. University of York. Available at - http://www.york.ac.uk/inst/crd/pdf/Systematic_Reviews.pdf (27/01/2014).

behaviour OR interaction OR reaction* OR practice*)) AND NOT (china* OR chinese OR stove*)*

After conducting preliminary searches to assess the efficacy of different search terms, the research team agreed the following string with colleagues from DECC:

((heating or gas or electric) and (control or controls or thermostat or efficien* or practice* or storage or TRV* or (boiler and (timer* or programmer*)) and (dwelling* or residential or occup* or home owner* or domestic or apartment or hous*) and ((user* or customer*) and (behaviour or behavior or interaction or reaction or practice*)) Not (china* or Chinese or stove* or wind)*

3. Inclusion and exclusion criteria

The RTK team used the DECC evaluation template, found below in Appendix B, to develop criteria to select or exclude papers on the basis of abstracts. Abstracts for further consideration were included if, on the basis of the information available, it was established that all of the following were true:

- The paper considered at least a policy/ programme/ intervention targeting energy using behaviours in the home;
- The paper considered habitual behavioural change or potential spillover/spin-off effects, i.e. not just one-off decisions that had only an immediate impact;
- The paper discussed interventions that went beyond smart metering, presentation of better or more complete data on energy bills, or demand side response (i.e. using price signals to shift demand);

In addition, for papers that reported empirical studies, the team included abstracts if the paper did all of the following:

- Described the study design;
- Described the form of original data (whether it was qualitative or quantitative);
- Examined behaviour in a real-world setting, i.e. not just theories, anticipated behaviours, or experiments in laboratories.

4. Data abstraction strategy

The team at Kings College Information Retrieval Unit passed on all abstracts identified by the searches described to two members of the review team. The review team² then selected, using the criteria described in the above section 3. *Inclusion and exclusion criteria*, from the abstracts supplied the articles for which they required full texts. Data were abstracted from each of the full text articles using an assessment template provided by DECC (see Appendix B).

² The review team comprised Dr Andrew Wright and Dr Peter Mallaburn of De Montfort University, and Dr Collette Robertson of Southampton University.

5. Critical appraisal strategy

The review team evaluated the quality of the research using a data extraction template provided by DECC (see Appendix B). The tool summarises the quality of the methodology of each study based on how adequately this was reported, as well as the applicability of each study to the five REA research questions. This approach ensures that decisions based on findings of the REA will be based on the highest quality and most relevant research.

The DECC data extraction template is organised under five main headings:

- 1) **Bibliographical information:** paper identification number, full bibliographical reference and publication type;
- 2) **Eligibility screening:** checks to establish the paper meets the inclusion/exclusion criteria described in the above session 3. *Inclusion and exclusion criteria*;
- 3) **Data extraction:** country of origin, aim of the study, types of energy service analysed, types of policy/programme, types of treatment assessed, categorisation of behaviours, study design, data analysis methods, scale of the intervention, scale of the analysis, timing of field work, aims of the intervention, evidence for the success/failure of the intervention, factors contributing to the outcome, evidence on how different groups of consumers react, effectiveness of measures or outcomes under investigation, other relevant findings, factors affecting transferability to the UK;
- 4) **Quality appraisal:** design, sampling (recruitment), sampling (profile and applicability), sampling (attrition and non-participation), data collection, analysis, findings (reliability), findings (value, depth and breadth), reporting, reflexivity and neutrality, ethics, auditability;
- 5) **Quality appraisal of analytic studies (experimental design):** randomization, presence of a control group, assignment to treatment and control groups, blinding of participants and personnel, blinding of outcome assessment, attrition, sensitivity analysis, reporting, other bias;

Full texts were randomly allocated between three reviewers. After each reviewer had extracted information from the first full text using the DECC template (Appendix B), the results were checked by another of the reviewers to establish the assessment criteria were being applied consistently.

Once any inconsistencies had been addressed, the three reviewers each assessed their allocated papers independently, entering information as appropriate on to the data extraction template.

6. Grey literature

The REA's starting point for searches of grey literature was the list of sources agreed with DECC colleagues and supplemented by conversations with sector experts in a virtual panel³. The list of references in the project ITT was also treated as a source.

³ The expert review panel consisted of: Colin Timmins of The Association of Controls Manufacturers TACMA (UK trade association); Colin Chapman of Alertme (device manufacturer); Trevor Sweetnam of PassivSystems (device manufacturer); Derek Roddy of Climote (device manufacturer); Garry Felgate of ChopCloc (device manufacturer); Thomas Muller of the European Building Automation and Controls Association EUBAC (EU trade association); and Nils Borg of the European Council for an Energy Efficient Economy ECEEE (EU energy efficiency NGO)

The review accessed source organisations through their websites and publications library, searching manually using site search engines and started searches using different combinations of the terms "heating+control+domestic". The searches tended to go back as far as the mid 1990's, when digitising of archives began.

The results varied widely across the various organisations with the larger ones (the European Union, the International Energy Agency, Intergovernmental Panel on Climate Change) returning no hits. The review searched these websites for a second time, but without success. Because none of these sources were specifically recommended to us by panel members, they were removed from the review's list at this point.

The review included the following organizations in our final searches:

- The American Council for Energy Efficient Economy (ACEEE)
- The European Council for Energy Efficient Economy (ECEEE)
- The US Department of Energy and Environmental Protection Agency
- The Carbon Trust and Energy Saving Trust archives
- The Defra/Market Transformation Programme archive
- The Association for the Conservation of Energy website

Some of these sources (the ACEEE and ECEEE) produced a large number of hits on first wave searching, so were searched again using more specific terms. Due to the assumed different characteristics of website search engines, different strategies across sites to refine the review's list were used. For example some sources produced a manageable list using the additional term "thermostat" whereas some filtered best to "setback" or "comfort".

7. Inclusion and exclusion criteria of the grey literature

Initial searches produced a long list of 44 publications. They ranged in content from short blog posts through conference papers to large scale meta-reviews. The team read all 44 papers in full and assessed their merit against two criteria:

- 1) How well they addressed the five questions set out in the ITT, with publications covering two or more questions being considered; and
- 2) Whether the publication had been specifically recommended to us by a panel member and/or was included in the DECC ITT reference list.

17 publications passed these criteria. Of the 17, ten duplicated or overlapped other publications on the list. Two needed further clarification from the author on aspects of the methodology or results; the team received information requested on only one. This left six publications that were read in full and entered into the DECC data extraction template.

Where details required to complete individual sections of the DECC template were not available, the team used best estimates of the credibility of the source, the applicability of the material to the five questions in the ITT and the rigor of the methodology.

Appendix B: DECC data extraction template

Data extraction template

Note to reviewers: please use square brackets [] to indicate your personal interpretations

Bibliographical information	Paper#	for internal reference
	Full bibliographical reference	e.g. Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of Environmental Psychology, 25, 273-291.
	Publication type	Please use one of the following: (i) peer-reviewed journal article, (ii) institution working paper, or (iii) books [If there are reasons to add new categories, please email the review team.]
Eligibility screening [Any answer of 'no' in the eligibility screening the paper should be excluded and not reviewed any further.]	Does the paper describes the study design?	Yes/No/Unclear
	Does the paper describes the form of original data? [note: data can be qualitative or quantitative]	Yes/No/Unclear
	Does the paper consider at least a policy/ programme/ intervention targeting energy using behaviours in the home?	Yes/No/Unclear

	<p>The current review excludes interventions that cover solely:</p> <ul style="list-style-type: none"> - smart metering, - presentation of better or more complete data on energy bills, or - demand side response (i.e. using price signals to shift demand)? <p>Does this paper discuss interventions that go beyond these?</p>	Yes/No/Unclear
	Does this paper examine habitual behavioural change or potential spillover/spin-off effects? i.e. not just one-off decisions	Yes/No/Unclear
	Does this paper examine behaviour in a real-world setting, i.e. not just theories, anticipated behaviours, or experiments in labs.	Yes/No/Unclear
<p>Data extraction [Even if a paper passed the eligibility screening, as one gets into the quality assessment and it is looking like poor quality, it should be immediately excluded and not taken any further.]</p>	Country of the study	
	Region/State, if relevant	
	City, if relevant	
	Aim of the study	Write in authors' description if there is one. Elaborate if necessary, but use a square bracket, [], to indicate aspects that the reviewers' interpretation.
	Types of energy services analysed	Space heating
		Space cooling
		Water heating
		Lighting
		Electrical appliances
		Other [if a new category is warranted, please discuss with the team.]
		Further information about the types of energy service analysed - elaborate as necessary

	Types of policy/programmes	energy efficiency information and advice social marketing consumer engagement community engagement education campaign regulation Other [if a new category is warranted, please discuss with the team.]
	Types of treatments assessed This typology was used in Osbaldiston and Schott (2012).	<div>Making it easy [Yes/No]</div> <div>Prompts [Yes/No]</div> <div>Justifications [Yes/No]</div> <div>Instructions [Yes/No]</div> <div>Feedback [Yes/No]</div> <div>Rewards [Yes/No]</div> <div>Social modelling [Yes/No]</div> <div>Cognitive dissonance [Yes/No]</div> <div>Commitment [Yes/No]</div> <div>Goal setting [Yes/No]</div> <div>Other [if a new category is warranted, please discuss with the team.]</div> <div>Further information about the treatment assessed - elaborate as necessary</div>
	Categorisation of behaviours(developed from Wilson and Chatterton, 2011)	<div>Actor(individuals, households, community, segment, population)</div> <div>Scope (isolated, foundational, interrelations, modes, lifestyles)</div> <div>Durability (repeated (reinforced, self-supported, or self-promoting), or externally promoting)</div>

		Domain (psychological, physical, technological, institutional, infrastructural)
	Study design	For example, - randomised controlled trial - observational studies [We will develop standardised code for study design at a later stage.]
	Data analysis methods	For example, - comparing a treatment group and a control group - comparing a post-test group and a pre-test group - etc [we will develop standardised code for study design at a later stage.]
	Scale of the intervention(s)	Please use one of the following: Neighbourhood, City, Region, National, Internet/virtual communities [If there are reasons to add new categories, please email the review team.]
	Scale of the analysis	Please use one of the following: Neighbourhood, City, Region, National, Internet/virtual communities [If there are reasons to add new categories, please email the review team.]
	Sample size, if applicable	This is a numeric field
	Response rate, if applicable	
	Coverage and characteristics of the sample, if applicable	This is a qualitative text field
	Timing of field work	When did the field work take place? Duration of field work Other information about timing, e.g. were there follow-ups?

	Aims of the intervention(s)	<p>Which barrier was the intervention designed to overcome, or what opportunities was the policy aimed to enable?</p> <p>This is a qualitative text field.</p>
	Evidence for the success/failure of the intervention(s)	<p>Is there evidence of behaviour change?</p> <p>If so, which behaviour have changed?</p> <p>What evidence is there of how successful or unsuccessful it was in overcoming this barrier or enabling this opportunity?</p> <p>What evidence is there of the success of the intervention on reducing energy consumption and emissions immediately after the implementation of the intervention?</p> <p>What evidence is there of the success of the intervention on reducing energy consumption and emissions in the medium/long term?</p> <p>Evidence on 'rebound' effect</p> <p>Evidence on cost effectiveness</p> <p>Evidence on what made the intervention salient (where it was not previously)</p> <p>Where there other unintended consequences/</p> <p>Other comments - elaborate as necessary</p>
	Factors contributed to the outcome of the intervention(s)	<p>internal influences (e.g. attitudes)</p> <p>external influences (e.g. regulation and cultural practices)</p> <p>environmental and economic conditions</p> <p>Other - elaborate as necessary</p> <p>Any caveats that are highlighted by the authors</p>
	Evidence on how different group of consumers react	<p>e.g. vulnerable group, high energy using group, etc</p>

	Effectiveness measures or outcome(s) under investigation	Measurement/indication of the amount of energy saved Elaborate as necessary
	Other relevant findings	Elaborate as necessary
	Factors affecting transferability to the UK	Use square brackets [] to indicate reviewers' personal interpretations
<p>Quality appraisal</p> <p>Studies are assessed according to 12 categories:</p> <p>1. Design</p> <p>2. Sampling: recruitment strategy</p> <p>3. Sampling: profile and applicability</p> <p>4. Sampling: attrition and nonparticipation</p> <p>5. Data collection</p> <p>6. Analysis</p> <p>7. Findings: reliability</p> <p>8. Findings: value, breadth and depth of findings</p> <p>9. Reporting</p> <p>10. Reflexivity and neutrality</p> <p>11. Ethics</p> <p>12. Auditability</p>	<p>1. Design</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	<p>study design and its specific features are justified - yes/no/unclear/n.a.</p> <p>limitations are discussed and their implications addressed - yes/no/unclear/n.a.</p> <p>any changes to study design are discussed, justified and implications addressed - yes/no/unclear/n.a.</p> <p>Quality score - Strong/Medium/Weak</p> <p>A brief justification for the quality score assigned</p>
	<p>2. Sampling: recruitment strategy</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	<p>there is evidence of maximising inclusion - yes/no/unclear/n.a.</p> <p>access and recruitment strategy is clearly explained - yes/no/unclear/n.a.</p> <p>the appropriateness of the recruitment strategy and selection to the study is clearly justified - yes/no/unclear/n.a.</p> <p>explains and reflects on how approach might have affected participation and coverage - yes/no/unclear/n.a.</p> <p>Quality score - Strong/Medium/Weak</p> <p>A brief justification for quality score assigned</p>
	<p>3. Sampling: profile and applicability</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or</p>	<p>target sample is appropriate to the study question - yes/no/unclear/n.a.</p> <p>discusses relation to the population of interest and how the sample allows for comparisons to be made - yes/no/unclear/n.a.</p>

	applicable to all studies.	the actual sample profile is detailed (location, characteristics, missing coverage) - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	4. Sampling: attrition and nonparticipation The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.	outlines and addresses if some people chose not to participate - yes/no/unclear/n.a.
		outlines and addresses the reasons for non-participation and exclusion - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	5. Data collection The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.	discusses and justifies who conducted data collection and where it took place - yes/no/unclear/n.a.
		describes and justifies data collection procedures and documents used - yes/no/unclear/n.a.
		any modifications to the data collection taken are clearly explained and justified - yes/no/unclear/n.a.
		discusses checks on origins, status and authorship - yes/no/unclear/n.a.
		the form of data is clear, and appropriate (e.g. details audio or video recording of interviews, discussions and conversations, (or justifies why not used)) - yes/no/unclear/n.a.
		discusses saturation of data, and how the collection methods achieved depth, detail and richness of data - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned

	<p>6. Analysis</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	analysis process is described in-depth, including who and how it was conducted - yes/no/unclear/n.a.
		a clear rationale provided for method of analysis - yes/no/unclear/n.a.
		if used, analytic categories are clearly described and justified - yes/no/unclear/n.a.
		discusses and justifies the original form of the data and how data were selected to demonstrate the analysis process - yes/no/unclear/n.a.
		Analysis is balanced, data is considered in context, and explores a diversity of perspectives - yes/no/unclear/n.a.
		Analysis explores alternative explanations or displays negative cases - yes/no/unclear/n.a.
		Use of statistical analysis - yes/no/unclear/n.a.
		Power calculation/justification of numbers - yes/no/unclear/n.a. Yes = study included appropriate power calculations for the type of analysis
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	<p>7. Findings: reliability</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	findings have a coherent logic - yes/no/unclear/n.a.
		use of corroborating evidence to support/refine findings, for example, validation/triangulation - yes/no/unclear/n.a.
		findings are supported by data and evidence provided - yes/no/unclear/n.a.
		quotations are identified to demonstrate they come from more than one-two sources - yes/no/unclear/n.a.

		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	<p>8. Findings: value, breadth and depth of findings</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	findings resonate with other knowledge/experience - yes/no/unclear/n.a.
		relevance beyond the sample population is justified - yes/no/unclear/n.a.
		description provided of the context in which the study was conducted to allow for this assessment - yes/no/unclear/n.a.
		findings presented in a way that offers new insights and alternative ways of thinking - yes/no/unclear/n.a.
		discusses limitations of evidence and what remains unknown for further research/information - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	<p>9. Reporting</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	results are linked to study aims - yes/no/unclear/n.a.
		discusses the reason for particular interpretation of the evidence, and how explanations were derived - yes/no/unclear/n.a.
		discusses negative cases, and how these fit with conclusions made - yes/no/unclear/n.a.
		includes a clear narrative - yes/no/unclear/n.a.
		accessible information for the target audience - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	10. Reflexivity and neutrality	assumptions are clearly set out -

	<p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	yes/no/n.a.
		reflects on and addresses how assumptions might have affected results; including openness to new ways of viewing subjects/theories/assumptions - yes/no/unclear/n.a.
		reflects on error or bias in study design and analysis - yes/no/unclear/n.a.
		reflects on the impact of the researcher on the research process, including response to events and changes during the study - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	<p>11. EthicsThe first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	approval obtained from an ethics committee - yes/no/unclear/n.a.
		documents presentation to participants and in the study setting - yes/no/unclear/n.a.
		documents confidentiality and anonymity with consent procedures - yes/no/unclear/n.a.
		documents measures to offer information, advice and services - yes/no/unclear/n.a.
		documents potential harm and how this was avoided - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
	<p>12. Auditability</p> <p>The first few yes/no quality indicators are provided here to aid your judgement on the overall quality score - they are not designed to be comprehensive or applicable to all studies.</p>	documentation of changes to design, reasons and implications for study coverage - yes/no/unclear/n.a.
		documentation and reasons for changes in sample coverage/data collection/analytic approach and implications - yes/no/unclear/n.a.

		reproduction of main study documents (e.g. topic guides, observation templates) - yes/no/unclear/n.a.
		Quality score - Strong/Medium/Weak
		A brief justification for the quality score assigned
The rest of the template applies to analytic studies only. e.g. randomised trials, experimental and controlled studies, prospective cohort studies, cross sectional (analytic) studies		
Quality appraisal for analytic studies	Randomisation: are there biases due to inadequate random sequence generation?	Low risk of bias/High risk/Unclear.
		Low risk = a random component in the sequence generation process is described, this could be computer random number generator, minimisation, random number table. High risk = non-random component in sequence generation process (e.g. by date of birth, allocation by judgement or preference, allocation by availability) Unclear = insufficient information for judgement OR study did not address this
		Justification (short rationale for categorisation of risk of bias)
	Presence of a control: are there biases due to the lack of a presence of a control, or inadequate definition and selection?	Low risk of bias/High risk/Unclear.
Low risk = a control is present, pre-treatment information is clearly provided, and any differences between comparison and treatment groups are either not greater than expected by chance or are controlled for High risk = lack of an adequate control, important differences between control and treatment groups Unclear = insufficient information provided on pre-treatment equivalence of groups		
		Justification (short rationale for categorisation of risk of bias)

	Assignment to treatment and control groups: are there biases due to inadequate concealment of allocations prior to assignment?	Low risk of bias/High risk/Unclear. Low risk = participants could not foresee assignment (e.g. central allocation by telephone randomisation, sequentially numbered). High risk = participants/investigators could possibly foresee assignments and this introduces a selection bias (e.g. an open random allocation schedule, date of birth). Unclear = insufficient information for judgement OR study did not address this
		Justification (short rationale for categorisation of risk of bias)
	Treatment of confounding effects: are there biases due to confounding effects between comparison groups?	Low risk of bias/High risk/Unclear. Low risk = minimal differences between groups OR differences but these are shown not to be important to the intervention and outcomes considered. High risk = confounders considered, and what researchers did about confounding. Unclear = insufficient information for judgement OR study did not address this
		Justification (short rationale for categorisation of risk of bias)
	Blinding of participants and personnel: is there a performance bias due to knowledge of the allocation interventions by participants and personnel during the study?	Low risk of bias/High risk/Unclear. Low risk = no/low blinding but authors judge the outcome is not likely to be influenced by this OR blinding of participants and personnel is ensured. High risk = no blinding or incomplete and the outcome is likely influenced by this OR blinding could have been broken and the outcome influenced by this. Unclear = insufficient information for judgement OR study did not address this outcome
		Justification (short rationale for categorisation of risk of bias)

	Blinding of outcome assessment: is there a detection bias due to knowledge of the allocated intervention by outcome assessors?	<p>Low risk of bias/High risk/Unclear.</p> <p>Low risk = no blinding of outcome assessment but authors judge the outcome measurement is not likely affected OR blinding ensured and unlikely to have been broken.</p> <p>High risk = no blinding and outcome measurement likely to be influenced by this OR blinding could have been broken and outcome measurement likely affected.</p> <p>Unclear = insufficient information for judgement OR study did not address this outcome</p>
		Justification (short rationale for categorisation of risk of bias)
	Attrition: is there an attrition bias due to amount, nature or handling of incomplete outcome data?	<p>Low risk of bias/High risk/Unclear.</p> <p>Low risk = no missing outcome data, reasons for missing data unlikely to be related to the true outcome, missing outcome data are balanced in numbers across intervention groups with similar reasons for missing data, missing data imputed using appropriate methods.</p> <p>High risk = reasons for missing data likely to be related to true outcome, 'as-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation, potentially inappropriate application of simple imputation.</p> <p>Unclear = insufficient reporting of attrition/exclusions to permit judgement OR the study did not address this outcome.</p>
		Justification (short rationale for categorisation of risk of bias)
	Sensitivity analysis: is there a bias due to inadequate consideration of main areas of uncertainty?	Low risk of bias/High risk/Unclear.
		Justification (short rationale for categorisation of risk of bias)
	Reporting: is there a reporting bias due to selective outcome reporting?	<p>Low risk of bias/High risk/Unclear.</p> <p>Low risk = study protocol is available and all of study's pre-specified outcomes of interest are reported in the pre-specified way OR the protocol is not available but clear that the published reports include all expected outcomes including those pre-specified.</p> <p>High risk = not all study's pre-specified</p>

		<p>outcomes reported, or outcome(s) reported using methods or subsets of data not pre-specified, or outcome(s) not pre-specified, or incomplete reporting of an outcome(s), or fails to include results for a key outcome that would have been expected for such a study.</p> <p>Unclear = insufficient information (likely most studies fall into this category)</p>
		Justification (short rationale for categorisation of risk of bias)
	Other bias: is there any other bias due to problems not covered above?	<p>Low risk of bias/High risk/Unclear.</p> <p>Low risk = study appears free of other sources of bias.</p> <p>High risk = there is at least one important risk of bias, e.g. potential related to specific study design, has been claimed to be fraudulent or some other problem.</p> <p>Unclear = possible other risk of bias but insufficient information to assess whether it exists or insufficient rationale/evidence that a problem will introduce bias.</p>
		Justification (short rationale for categorisation of risk of bias)

Appendix C - EFUS analyses technical appendix

Appendix C provides details of the frequency tables produced from our secondary data analysis of the Energy Follow-Up Survey 2010/11 (EFUS) reported in Section 3 and Section 5 of the main report. The headings correspond to the sections and subheadings in the main report

Section 3. What heating controls are installed and how do these vary across different properties and households?

3.1 What heating controls are installed?

Table 2 of the main report

EFUS question: What is the heating system that your household uses to heat the majority of your home in the winter?

Frequency table (un-weighted data)

	Frequency	Percent	Valid Percent	Cumulative Percent
Central heating	2356	90.1	90.1	90.1
Storage radiators	180	6.9	6.9	96.9
Gas fires	26	1	1	97.9
Electric heaters	39	1.5	1.5	99.4
Coal/wood/smokeless fuel fires or stoves	15	0.6	0.6	100
Total	2616	100	100	

90% (2356) of 2616 homes surveyed use central heating to heat their homes

Frequency table (weighted data)

	Frequency	Percent	Valid Percent	Cumulative Percent
Central heating	19,691,318.00	89.9	89.9	89.9
Storage radiators	1,448,230.00	6.6	6.6	96.6
Gas fires	245,401.00	1.1	1.1	97.7

Electric heaters	399,150.00	1.8	1.8	99.5
Coal/wood/smokeless fuel fires or stoves	109,881.00	0.5	0.5	100
Total	21,893,980.00	100	100	

90% (19,691,318) of homes use central heating to heat their homes

Table 3 of the main report

EFUS question: Of the 2356 homes that have central heating systems, EFUS asks householders which of nine primary heating controls they have:

Frequency Tables

1.a Primary heating controls - overall on/off (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	2305	97.8	98.1	98.1
No	44	1.9	1.9	100
Unknown	1	0	0	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

1.b Primary heating controls - overall on/off (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	19,311,475	98.1	98.3	98.3
No	339,293	1.7	1.7	100
Unknown	3,192	0	0	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318.00	100		

2.a Primary heating controls - boiler thermostat (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	2264	96.1	96.3	96.3
No	77	3.3	3.3	99.6
Unknown	9	0.4	0.4	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

2.b Primary heating controls - boiler thermostat (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	19,007,382	96.5	96.7	96.7
No	586,226	3	3	99.7
Unknown	60,352	0.3	0.3	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

3.a Primary heating controls - central timer⁴ (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	2284	96.9	97.2	97.2
No	65	2.8	2.8	100
Unknown	1	0	0	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

3. b Primary heating controls - central timer (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	19,130,260	97.2	97.3	97.3
No	520,507	2.6	2.6	100
Unknown	3,192	0	0	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

4. a Manual override (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
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⁴ It should be noted that the EFUS data contained responses to two different sets of questions relating to heating controls: Set (a) collected via EFUS interviews (Q9 – Q11 followed by several questions on timing and boost heating); and Set (b) technically more detailed questions about the heating system, believed to have been collected via survey questions completed on the basis of observations of a third party. Recorded responses from question sets (a), shown in Table 7 (Section 5) of the main report, and (b), the tables in this section (Table 3 tables), are inconsistent. Responses to set (a) suggest 10.1% of households with central heating do not have a timer; responses to set (b) indicate 2.6% of households do not have a central timer as a primary heating control. One possible explanation for the inconsistency is that question set (a) is identifying some households that do in fact have a timer, but are not aware they have one. In these cases, the timer may be disabled, set to continuous heating, or not operating timed heating; householders may be unaware of what is controlling their heating – and probably override the timer by other means. Statistics on the technical nature of the heating system reported in Section 3 (Tables 3-5) in the main report have used responses to question set (b) as this set contains responses to all nine primary heating controls which is used to calculate the subset of 'full heating controls' which contain a central timer, room thermostat and TRV.

Yes	2,272	96.4	96.7	96.7
No	77	3.3	3.3	100
Unknown	1	0	0	100
Valid Total	2,350	99.7	100	
Question Not Applicable	6	0.3		
Total	2,356	100		

4.b Manual override (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	19,024,363	96.6	96.8	96.8
No	626,404	3.2	3.2	100
Unknown	3,192	0	0	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

5.a Primary heating controls - room thermostat (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	1830	77.7	77.9	77.9
No	517	21.9	22	99.9
Unknown	3	0.1	0.1	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

5.b Primary heating controls - room thermostat (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	15,065,467	76.5	76.7	76.7
No	4,558,250	23.1	23.2	99.8
Unknown	30,243	0.2	0.2	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

6.a Primary heating controls - radiator control (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	1548	65.7	65.9	65.9

No	801	34	34.1	100
Unknown	1	0	0	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

6.b Primary heating controls - radiator control (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	13,198,768	67	67.2	67.2
No	6,452,000	32.8	32.8	100
Unknown	3,192	0	0	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

7.a Primary heating controls – thermostatic radiator valve (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	1,584	67.2	67.4	67.4
No	764	32.4	32.5	99.9
Unknown	2	0.1	0.1	100
Valid Total	2,350	99.7	100	
Question Not Applicable	6	0.3		
Total	2,356	100		

7.b Primary heating controls – thermostatic radiator valve (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	13,017,953	66.1	66.2	66.2
No	6,626,135	33.7	33.7	99.9
Unknown	9,872	0.1	0.1	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

8.a Primary heating controls - time and temp (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	26	1.1	1.1	1.1
No	2322	98.6	98.8	99.9
Unknown	2	0.1	0.1	100
Valid Total	2350	99.7	100	

Question Not Applicable	6	0.3		
Total	2356	100		

8.b Primary heating controls - time and temp (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	225,096	1.1	1.1	1.1
No	19,417,066	98.6	98.8	99.9
Unknown	11,798	0.1	0.1	100
Valid Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

9.a Primary heating controls - delayed time (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	33	1.4	1.4	1.4
No	2313	98.2	98.4	99.8
Unknown	4	0.2	0.2	100
Valid Total	2350	99.7	100	
Question Not Applicable	6	0.3		
Total	2356	100		

9. b Primary heating controls - delayed time (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	272,698	1.4	1.4	1.4
No	19,348,646	98.3	98.4	99.8
Unknown	32,616	0.2	0.2	100
Total	19,653,960	99.8	100	
Question Not Applicable	37,358	0.2		
Total	19,691,318	100		

10.a Full set of controls (derived) – central timer, room thermostat, TRVs (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Full set of controls	1,198	50.8	50.8	50.8
Less than full set	1,158	49.2	49.2	100
Total	2,356	100	100	

10.b Full set of controls (derived) – central timer, room thermostat, TRVs (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
Full set of controls	9,620,733	48.9	48.9	48.9
less than full set	10,070,585	51.1	51.1	100
Total	19,691,318	100	100	

3.2 Heating Controls by property type

Table 4 of the main report

Of the 2356 homes that have central heating systems, EFU asks householders about the type of property they live in. The tables below were used to calculate the findings in Table 4 of the main report.

Dwelling type (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
end terrace	237	10.1	10.1	10.1
mid terrace	393	16.7	16.7	26.7
semi detached	417	17.7	17.7	44.4
detached	308	13.1	13.1	57.5
bungalow	190	8.1	8.1	65.6
converted flat	162	6.9	6.9	72.5
purpose built flat, low rise	549	23.3	23.3	95.8
purpose built flat, high rise	100	4.2	4.2	100.0
Total	2356	100.0	100.0	

Dwelling type (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
end terrace	1896895	9.6	9.6	9.6
mid terrace	3252702	16.5	16.5	26.2
semi detached	3531929	17.9	17.9	44.1
detached	2730105	13.9	13.9	58.0
bungalow	1713997	8.7	8.7	66.7
converted flat	1319367	6.7	6.7	73.4
purpose built flat, low rise	4434179	22.5	22.5	95.9
purpose built flat, high rise	812146	4.1	4.1	100.0
Total	19691318	100.0	100.0	

The survey asks a similar question about age of the property and type:

Dwelling age and type (un-weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
purpose built flat, high rise	100	4.2	4.2	4.2
purpose built flat, low rise	549	23.3	23.3	27.5
converted flat	162	6.9	6.9	34.4

bungalow: all ages	190	8.1	8.1	42.5
detached house: pre 1919	45	1.9	1.9	44.4
detached house: post 1919	263	11.2	11.2	55.6
semi detached & terraced: pre 1919	294	12.5	12.5	68.0
semi detached & terraced: 1919-1944	234	9.9	9.9	78.0
semi detached & terraced: 1945-1964	170	7.2	7.2	85.2
semi detached & terraced: 1965 onwards	349	14.8	14.8	100.0
Total	2356	100.0	100.0	

Dwelling age and type (weighted)

	Frequency	Percent	Valid Percent	Cumulative Percent
purpose built flat, high rise	812146	4.1	4.1	4.1
purpose built flat, low rise	4434179	22.5	22.5	26.6
converted flat	1319367	6.7	6.7	33.3
bungalow: all ages	1713997	8.7	8.7	42.0
detached house: pre 1919	407489	2.1	2.1	44.1
detached house: post 1919	2322616	11.8	11.8	55.9
semi detached & terraced: pre 1919	2408653	12.2	12.2	68.1
semi detached & terraced: 1919-1944	1878521	9.5	9.5	77.7
semi detached & terraced: 1945-1964	1480304	7.5	7.5	85.2
semi detached & terraced: 1965 onwards	2914048	14.8	14.8	100.0
Total	19691318	100.0	100.0	

Dwelling type * Primary heating controls - room thermostat Crosstabulation (un-weighted)

	Primary heating controls - room thermostat			Total
	Yes	No	Unknown	
end terrace	182	53	1	236
	77.1%	22.5%	0.4%	100.0%
mid terrace	301	90	0	391
	77.0%	23.0%	0.0%	100.0%
semi detached	328	88	0	416
	78.8%	21.2%	0.0%	100.0%
detached	233	73	2	308
	75.6%	23.7%	0.6%	100.0%
bungalow	159	31	0	190
	83.7%	16.3%	0.0%	100.0%
converted flat	127	34	0	161
	78.9%	21.1%	0.0%	100.0%
purpose built flat, low rise	429	120	0	549
	78.1%	21.9%	0.0%	100.0%
purpose built flat, high rise	71	28	0	99
	71.7%	28.3%	0.0%	100.0%
Total	1830	517	3	2350
	77.9%	22.0%	0.1%	100.0%

Dwelling type * Primary heating controls - room thermostat
Crosstabulation (weighted)

	Primary heating controls - room thermostat			
	Yes	No	Unknown	Total
end terrace	1444582	442829	3192	1890603
	76.4%	23.4%	0.2%	100.0%
mid terrace	2508161	730357	0	3238518
	77.4%	22.6%	0.0%	100.0%
semi detached	2704830	820534	0	3525364
	76.7%	23.3%	0.0%	100.0%
detached	2032105	670949	27050	2730104
	74.4%	24.6%	1.0%	100.0%
bungalow	1430236	283761	0	1713997
	83.4%	16.6%	0.0%	100.0%
converted flat	1008676	307037	0	1315713
	76.7%	23.3%	0.0%	100.0%
purpose built flat, low rise	3396945	1037233	0	4434178
	76.6%	23.4%	0.0%	100.0%
purpose built flat, high rise	539931	265549	0	805480
	67.0%	33.0%	0.0%	100.0%
Total	15065466	4558249	30242	19653957
	76.7%	23.2%	0.2%	100.0%

Dwelling type * Primary heating controls - central timer
Crosstabulation (un-weighted)

	Primary heating controls - central timer			
	Yes	No	Unknown	Total
end terrace	227	8	1	236
	96.2%	3.4%	0.4%	100.0%
mid terrace	382	9	0	391
	97.7%	2.3%	0.0%	100.0%
semi detached	404	12	0	416
	97.1%	2.9%	0.0%	100.0%
detached	297	11	0	308
	96.4%	3.6%	0.0%	100.0%
bungalow	184	6	0	190
	96.8%	3.2%	0.0%	100.0%
converted flat	158	3	0	161
	98.1%	1.9%	0.0%	100.0%
purpose built flat, low rise	535	14	0	549
	97.4%	2.6%	0.0%	100.0%
purpose built flat, high rise	97	2	0	99
	98.0%	2.0%	0.0%	100.0%
Total	2284	65	1	2350
	97.2%	2.8%	0.0%	100.0%

Dwelling type * Primary heating controls - central timer
Crosstabulation (weighted)

	Primary heating controls - central timer			
	Yes	No	Unknown	Total
end terrace	1839773	47639	3192	1890604
	97.3%	2.5%	0.2%	100.0%
mid terrace	3174900	63618	0	3238518
	98.0%	2.0%	0.0%	100.0%
semi detached	3416270	109094	0	3525364
	96.9%	3.1%	0.0%	100.0%
detached	2634080	96025	0	2730105
	96.5%	3.5%	0.0%	100.0%
bungalow	1663448	50549	0	1713997
	97.1%	2.9%	0.0%	100.0%
converted flat	1279890	35823	0	1315713
	97.3%	2.7%	0.0%	100.0%
purpose built flat, low rise	4326345	107833	0	4434178
	97.6%	2.4%	0.0%	100.0%
purpose built flat, high rise	795554	9926	0	805480
	98.8%	1.2%	0.0%	100.0%
Total	19130260	520507	3192	19653959
	97.3%	2.6%	0.0%	100.0%

Dwelling type * Primary heating controls – thermostatic radiator valve (TRV)
Crosstabulation (un-weighted)

	Primary heating controls – thermostatic radiator value (TRV)			
	Yes	No	Unknown	Total
end terrace	160	75	1	236
	67.80%	31.80%	0.40%	100.00%
mid terrace	268	123	0	391
	68.50%	31.50%	0.00%	100.00%
semi detached	264	151	1	416
	63.50%	36.30%	0.20%	100.00%
detached	194	114	0	308
	63.00%	37.00%	0.00%	100.00%
bungalow	127	63	0	190
	66.80%	33.20%	0.00%	100.00%
converted flat	111	50	0	161
	68.90%	31.10%	0.00%	100.00%
purpose built flat, low rise	380	169	0	549
	69.20%	30.80%	0.00%	100.00%
purpose built flat, high rise	80	19	0	99
	80.80%	19.20%	0.00%	100.00%

Total	1584	764	2	2350
	67.40%	32.50%	0.10%	100.00%

Dwelling type * Primary heating controls – thermostatic radiator valve (TRV)
Crosstabulation (weighted)

Primary heating controls - thermostatic radiator value				
	Yes	No	Unknown	Total
end terrace	1297040	590372	3192	1890604
	68.60%	31.20%	0.20%	100.00%
mid terrace	2219956	1018561	0	3238517
	68.50%	31.50%	0.00%	100.00%
semi detached	2184238	1334447	6680	3525365
	62.00%	37.90%	0.20%	100.00%
detached	1694468	1035637	0	2730105
	62.10%	37.90%	0.00%	100.00%
bungalow	1130835	583162	0	1713997
	66.00%	34.00%	0.00%	100.00%
converted flat	881039	434675	0	1315714
	67.00%	33.00%	0.00%	100.00%
purpose built flat, low rise	2978663	1455515	0	4434178
	67.20%	32.80%	0.00%	100.00%
purpose built flat, high rise	631714	173767	0	805481
	78.40%	21.60%	0.00%	100.00%
Total	13017953	6626136	9872	19653961
	66.20%	33.70%	0.10%	100.00%

Dwelling type * Primary heating controls – Full set controls.
Crosstabulation (un-weighted)

	Full set of controls	less than full set	Total
end terrace	120	117	237
	50.60%	49.40%	100.00%
mid terrace	203	190	393
	51.70%	48.30%	100.00%
semi detached	202	215	417
	48.40%	51.60%	100.00%
detached	138	170	308
	44.80%	55.20%	100.00%
bungalow	103	87	190
	54.20%	45.80%	100.00%
converted flat	88	74	162
	54.30%	45.70%	100.00%
purpose built flat, low rise	288	261	549
	52.50%	47.50%	100.00%
purpose built flat, high rise	56	44	100
	56.00%	44.00%	100.00%
Total	1198	1158	2356
	50.80%	49.20%	100.00%

Dwelling type * Primary heating controls – Full set controls
Crosstabulation (weighted)

	Full set of controls	less than full set	Total
end terrace	958828	938067	1896895
	50.50%	49.50%	100.00%
mid terrace	1690512	1562190	3252702
	52.00%	48.00%	100.00%
semi detached	1589332	1942597	3531929
	45.00%	55.00%	100.00%
detached	1197239	1532865	2730104
	43.90%	56.10%	100.00%
bungalow	904693	809304	1713997
	52.80%	47.20%	100.00%
converted flat	674536	644831	1319367
	51.10%	48.90%	100.00%
purpose built flat, low rise	2186793	2247385	4434178
	49.30%	50.70%	100.00%
purpose built flat, high rise	418801	393345	812146
	51.60%	48.40%	100.00%
Total	9620734	10070584	19691318
	48.90%	51.10%	100.00%

Dwelling age and type * Primary heating controls - room thermostat
Crosstabulation (un-weighted)

	Primary heating controls - room thermostat			
	Yes	No	Unknown	Total
purpose built flat, high rise	71	28	0	99
	71.70%	28.30%	0.00%	100.00%
purpose built flat, low rise	429	120	0	549
	78.10%	21.90%	0.00%	100.00%
converted flat	127	34	0	161
	78.90%	21.10%	0.00%	100.00%
bungalow: all ages	159	31	0	190
	83.70%	16.30%	0.00%	100.00%
detached house: pre 1919	37	7	1	45
	82.20%	15.60%	2.20%	100.00%
detached house: post 1919	196	66	1	263
	74.50%	25.10%	0.40%	100.00%
semi detached & terraced: pre 1919	226	67	0	293
	77.10%	22.90%	0.00%	100.00%
semi detached & terraced: 1919-1944	169	64	0	233
	72.50%	27.50%	0.00%	100.00%
semi detached & terraced: 1945-1964	139	31	0	170
	81.80%	18.20%	0.00%	100.00%
semi detached & terraced: 1965 onwards	277	69	1	347
	79.80%	19.90%	0.30%	100.00%
Total	1830	517	3	2350
	77.90%	22.00%	0.10%	100.00%

Dwelling age and type * Primary heating controls - room thermostat
Crosstabulation (weighted)

	Primary heating controls - room thermostat			
	Yes	No	Unknown	Total
purpose built flat, high rise	539931	265549	0	805480
	67.00%	33.00%	0.00%	100.00%
purpose built flat, low rise	3396945	1037233	0	4434178
	76.60%	23.40%	0.00%	100.00%
converted flat	1008676	307037	0	1315713
	76.70%	23.30%	0.00%	100.00%
bungalow: all ages	1430236	283761	0	1713997
	83.40%	16.60%	0.00%	100.00%
detached house: pre 1919	310848	78117	18524	407489
	76.30%	19.20%	4.50%	100.00%
detached house: post 1919	1721257	592832	8527	2322616
	74.10%	25.50%	0.40%	100.00%

semi detached & terraced: pre 1919	1793830	608532	0	2402362
	74.70%	25.30%	0.00%	100.00%
semi detached & terraced: 1919-1944	1326692	545264	0	1871956
	70.90%	29.10%	0.00%	100.00%
semi detached & terraced: 1945-1964	1217677	262627	0	1480304
	82.30%	17.70%	0.00%	100.00%
semi detached & terraced: 1965 onwards	2319374	577297	3192	2899863
	80.00%	19.90%	0.10%	100.00%
Total	15065466	4558249	30243	19653958
	76.70%	23.20%	0.20%	100.00%

Dwelling age and type * Primary heating controls - central timer
Crosstabulation (un-weighted)

	Primary heating controls - central timer			
	Yes	No	Unknown	Total
purpose built flat, high rise	97	2	0	99
	98.00%	2.00%	0.00%	100.00%
purpose built flat, low rise	535	14	0	549
	97.40%	2.60%	0.00%	100.00%
converted flat	158	3	0	161
	98.10%	1.90%	0.00%	100.00%
bungalow: all ages	184	6	0	190
	96.80%	3.20%	0.00%	100.00%
detached house: pre 1919	44	1	0	45
	97.80%	2.20%	0.00%	100.00%
detached house: post 1919	253	10	0	263
	96.20%	3.80%	0.00%	100.00%
semi detached & terraced: pre 1919	285	8	0	293
	97.30%	2.70%	0.00%	100.00%
semi detached & terraced: 1919-1944	228	5	0	233
	97.90%	2.10%	0.00%	100.00%
semi detached & terraced: 1945-1964	166	4	0	170
	97.60%	2.40%	0.00%	100.00%
semi detached & terraced: 1965 onwards	334	12	1	347
	96.30%	3.50%	0.30%	100.00%
Total	2284	65	1	2350
	97.20%	2.80%	0.00%	100.00%

Dwelling age and type * Primary heating controls - central timer
Crosstabulation (weighted)

Primary heating controls - central timer

	Yes	No	Unknown	Total
purpose built flat, high rise	795554	9926	0	805480
	98.80%	1.20%	0.00%	100.00%
purpose built flat, low rise	4326345	107833	0	4434178
	97.60%	2.40%	0.00%	100.00%
converted flat	1279890	35823	0	1315713
	97.30%	2.70%	0.00%	100.00%
bungalow: all ages	1663448	50549	0	1713997
	97.10%	2.90%	0.00%	100.00%
detached house: pre 1919	401093	6395	0	407488
	98.40%	1.60%	0.00%	100.00%
detached house: post 1919	2232986	89630	0	2322616
	96.10%	3.90%	0.00%	100.00%
semi detached & terraced: pre 1919	2341311	61051	0	2402362
	97.50%	2.50%	0.00%	100.00%
semi detached & terraced: 1919-1944	1831535	40422	0	1871957
	97.80%	2.20%	0.00%	100.00%
semi detached & terraced: 1945-1964	1454901	25403	0	1480304
	98.30%	1.70%	0.00%	100.00%
semi detached & terraced: 1965 onwards	2803197	93474	3192	2899863
	96.70%	3.20%	0.10%	100.00%
Total	19130260	520506	3192	19653958
	97.30%	2.60%	0.00%	100.00%

Dwelling age and type * Primary heating controls – thermostatic radiator valve (TRV)
Crosstabulation (un-weighted)

	Primary heating controls - TRV			Total
	Yes	No	Unknown	
purpose built flat, high rise	80	19	0	99
	80.80%	19.20%	0.00%	100.00%
purpose built flat, low rise	380	169	0	549
	69.20%	30.80%	0.00%	100.00%
converted flat	111	50	0	161
	68.90%	31.10%	0.00%	100.00%
bungalow: all ages	127	63	0	190
	66.80%	33.20%	0.00%	100.00%
detached house: pre 1919	30	15	0	45
	66.70%	33.30%	0.00%	100.00%
detached house: post 1919	164	99	0	263
	62.40%	37.60%	0.00%	100.00%
semi detached & terraced: pre 1919	197	96	0	293
	67.20%	32.80%	0.00%	100.00%
semi detached & terraced: 1919-1944	150	83	0	233

	64.40%	35.60%	0.00%	100.00%
semi detached & terraced: 1945-1964	111	59	0	170
	65.30%	34.70%	0.00%	100.00%
semi detached & terraced: 1965 onwards	234	111	2	347
	67.40%	32.00%	0.60%	100.00%
Total	1584	764	2	2350
	67.40%	32.50%	0.10%	100.00%

Dwelling age and type * Primary heating controls – thermostatic radiator valve (TRV)
Crosstabulation (weighted)

Primary heating controls - thermostatic radiator value (TRV)				
	Yes	No	Unknown	Total
purpose built flat, high rise	631714	173767	0	805481
	78.40%	21.60%	0.00%	100.00%
purpose built flat, low rise	2998420	1578185	7740	4584345
	65.40%	34.40%	0.20%	100.00%
converted flat	881039	501301	0	1382340
	63.70%	36.30%	0.00%	100.00%
bungalow: all ages	1130835	619792	0	1750627
	64.60%	35.40%	0.00%	100.00%
detached house: pre 1919	289206	124071	0	413277
	70.00%	30.00%	0.00%	100.00%
detached house: post 1919	1410229	966635	0	2376864
	59.30%	40.70%	0.00%	100.00%
semi detached & terraced: pre 1919	1614327	851291	0	2465618
	65.50%	34.50%	0.00%	100.00%
semi detached & terraced: 1919-1944	1214089	729432	0	1943521
	62.50%	37.50%	0.00%	100.00%
semi detached & terraced: 1945-1964	940494	596907	0	1537401
	61.20%	38.80%	0.00%	100.00%
semi detached & terraced: 1965 onwards	1950389	992159	9872	2952420
	66.10%	33.60%	0.30%	100.00%
Total	13060742	7133540	17612	20211894
	64.60%	35.30%	0.10%	100.00%

Dwelling age and type * Primary heating controls – Full set controls
Crosstabulation (un-weighted)

	Full set of controls	less than full set	Total
purpose built flat, high rise	56	44	100
	56.00%	44.00%	100.00%
purpose built flat, low rise	288	261	549

	52.50%	47.50%	100.00%
converted flat	88	74	162
	54.30%	45.70%	100.00%
bungalow: all ages	103	87	190
	54.20%	45.80%	100.00%
detached house: pre 1919	23	22	45
	51.10%	48.90%	100.00%
detached house: post 1919	115	148	263
	43.70%	56.30%	100.00%
semi detached & terraced: pre 1919	151	143	294
	51.40%	48.60%	100.00%
semi detached & terraced: 1919-1944	105	129	234
	44.90%	55.10%	100.00%
semi detached & terraced: 1945-1964	86	84	170
	50.60%	49.40%	100.00%
semi detached & terraced: 1965 onwards	183	166	349
	52.40%	47.60%	100.00%
Total	1198	1158	2356
	50.80%	49.20%	100.00%

Dwelling age and type * Primary heating controls – Full set controls
Crosstabulation (weighted)

Dwelling age and type	Full set of controls	less than full set	Total
purpose built flat, high rise	418801	393345	812146
	51.60%	48.40%	100.00%
purpose built flat, low rise	2186793	2247385	4434178
	49.30%	50.70%	100.00%
converted flat	674536	644831	1319367
	51.10%	48.90%	100.00%
bungalow: all ages	904693	809304	1713997
	52.80%	47.20%	100.00%
detached house: pre 1919	211089	196400	407489
	51.80%	48.20%	100.00%
detached house: post 1919	986150	1336466	2322616
	42.50%	57.50%	100.00%

semi detached & terraced: pre 1919	1167084	1241568	2408652
	48.50%	51.50%	100.00%
semi detached & terraced: 1919-1944	812071	1066450	1878521
	43.20%	56.80%	100.00%
semi detached & terraced: 1945-1964	721975	758329	1480304
	48.80%	51.20%	100.00%
semi detached & terraced: 1965 onwards	1537541	1376507	2914048
	52.80%	47.20%	100.00%
Total	9620733	10070585	19691318
	48.90%	51.10%	100.00%

3.3 Heating Controls by household type

Table 5 of the main report

Of the 2356 homes that have central heating systems, EFU asks householders about household composition. The tables below were used to calculate the findings in Table 5 of the main report.

Primary heating controls - room thermostat * people aged under 65 or 65 and over Crosstabulation (un-weighted data)

Primary heating controls - room thermostat			
	People aged under 65	People aged 65 and over	Total
Yes	1320	510	1830
	77.10%	80.10%	77.90%
No	390	127	517
	22.80%	19.90%	22.00%
Unknown	3	0	3
	0.20%	0.00%	0.10%
Total	1713	637	2350
	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * people aged under 65 or 65 and over Crosstabulation (weighted data)

Primary heating controls - room thermostat			
	under 65	65 and over	Total
Yes	11109346	3956121	15065467
	75.60%	79.90%	76.70%
No	3560224	998026	4558250
	24.20%	20.10%	23.20%
Unknown	30243	0	30243
	0.20%	0.00%	0.20%
Total	4954147	19653960	
	100.00%	100.00%	

Primary heating controls - central timer * people aged under 65 or 65 and over Crosstabulation (un-weighted data)

Primary heating controls - central timer			
	under 65	65 and over	Total
Yes	1673	611	2284
	97.70%	95.90%	97.20%
No	39	26	65
	2.30%	4.10%	2.80%
Unknown	0.10%	0.00%	0.00%
	0.00%	0.00%	0.00%
Total	1713	637	2350

	100.00%	100.00%	100.00%
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Primary heating controls - central timer * people aged under 65 or 65 and over
Crosstabulation (weighted data)

Primary heating controls - central timer			
	under 65	65 and over	Total
Yes	14382786	4747474	19130260
	97.80%	95.80%	97.30%
No	313835	206672	520507
	2.10%	4.20%	2.60%
Unknown	3192	0	3192
	0.00%	0.00%	0.00%
Total	14699813	4954146	19653959
	100.00%	100.00%	100.00%

Primary heating controls - TRV * people aged under 65 or 65 and over
Crosstabulation (un-weighted data)

Primary heating controls - TRV			
	people aged under 65	people aged 65 and over	Total
Yes	1169	415	1584
	68.20%	65.10%	67.40%
No	543	221	764
	31.70%	34.70%	32.50%
Unknown	1	1	2
	0.10%	0.20%	0.10%
Total	1713	637	2350
	100.00%	100.00%	100.00%

Primary heating controls - TRV * people aged under 65 or 65 and over
Crosstabulation (weighted data)

Primary heating controls - TRV			
	people aged under 65	people aged 65 and over	Total
Yes	9856970	3160983	13017953
	67.10%	63.80%	66.20%
No	4839651	1786485	6626136
	32.90%	36.10%	33.70%
Unknown	3192	6680	9872
	0.00%	0.10%	0.10%
Total	14699813	4954148	19653961
	100.00%	100.00%	100.00%

Primary heating controls – Full Set Controls * people aged under 65 or 65 and over
Crosstabulation (un-weighted data)

Primary heating controls - full set of controls			
	people aged under 65	people aged 65 and over	Total
Yes	876	322	1198
	51.00%	50.50%	50.80%
No	843	315	1158
	49.00%	49.50%	49.20%
Total	1719	637	2356
	100.00%	100.00%	100.00%

Primary heating controls – Full Set Controls * people aged under 65 or 65 and over
Crosstabulation (weighted data)

Primary heating controls - full set of controls			
	people aged under 65	people aged 65 and over	Total
Yes	7190315	2430418	9620733
	48.80%	49.10%	48.90%
No	7546856	2523729	10070585
	51.20%	50.90%	51.10%
Total	14737171	4954147	19691318
	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Number in the household
Crosstabulation (un-weighted data)

Primary heating controls - room thermostat	Number in household				Total
	one person	two people	three people	four or more people	
Yes	453	656	293	419	1821
	77.00%	78.00%	75.30%	80.10%	77.80%
No	135	184	95	103	517
	23.00%	21.90%	24.40%	19.70%	22.10%
Unknown	0	1	1	1	3
	0.00%	0.10%	0.30%	0.20%	0.10%
Total	588	841	389	523	2341
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Number in the household
Crosstabulation (weighted data)

Primary heating controls - room thermostat	Number in household				Total
	one person	two people	three people	four or more people	
Yes	3656812	5506576	2464917	3437161	15065466
	76.20%	76.80%	74.20%	78.70%	76.70%
No	1140908	1658777	846856	911710	4558251
	23.80%	23.10%	25.50%	20.90%	23.20%
Unknown	0	3192	8527	18524	30243
	0.00%	0.00%	0.30%	0.40%	0.20%
Total	4797720	7168545	3320300	4367395	19653960
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - central timer * No of people in the household
Crosstabulation (un-weighted data)

Primary heating controls - room thermostat	Number in household				Total
	one person	two people	three people	four or more people	
Yes	558	818	383	525	2284
	94.90%	97.30%	98.50%	98.70%	97.20%
No	30	22	6	7	65
	5.10%	2.60%	1.50%	1.30%	2.80%
Unknown	0	1	0	0	1
% within central timer	0%	100%	0%	0%	100%
% within No of people in household	0%	0%	0%	0%	0%
Total	588	841	389	532	2350
	100%	100%	100%	100%	100%

Primary heating controls - central timer * No of people in the household
Crosstabulation (weighted data)

Primary heating controls - room thermostat	Number in household				Total
	one person	two people	three people	four or more people	
Yes	4559102	6992423	3266881	4311854	19130260
	95.00%	97.50%	98.40%	98.70%	97.30%
No	238618	172930	53418	55541	520507
	5.00%	2.40%	1.60%	1.30%	2.60%
Unknown	0	3192	0	0	3192
% within central timer	0.00%	0.00%	0.00%	0.00%	0.00%
% within No of people in	4797720	7168545	3320299	4367395	19653959

household					
Total	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - TRV * Number in the household
Crosstabulation (un-weighted data)

Primary heating controls - TRV	Number in household				Total
	one person	two people	three people	four or more people	
Yes	365	589	272	353	1579
	62.10%	70.00%	69.90%	67.50%	67.40%
No	222	251	117	170	760
	37.80%	29.80%	30.10%	32.50%	32.50%
Unknown	1	1	0	0	2
	0.20%	0.10%	0.00%	0.00%	0.10%
Total	588	841	389	523	2341
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - TRV * Number in the household
Crosstabulation (weighted data)

Primary heating controls - TRV	Number in household				Total
	one person	two people	three people	four or more people	
Yes	2848535	4971039	2306982	2891397	13017953
	59.40%	69.30%	69.50%	66.20%	66.20%
No	1942506	2194314	1013317	1475998	6626135
	40.50%	30.60%	30.50%	33.80%	33.70%
Unknown	6680	3192	0	0	9872
	0.10%	0.00%	0.00%	0.00%	0.10%
Total	4797721	7168545	3320299	4367395	19653960
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls – Full Set Of Controls * Number in the household
Crosstabulation (un-weighted data)

Full set of controls	Number in household				Total
	one person	two people	three people	four or more people	
Yes	271	443	206	278	1198
	45.80%	52.60%	53.00%	52.20%	50.80%
No	321	399	183	255	1158
	54.20%	47.40%	47.00%	47.80%	49.20%
Total	592	842	389	533	2356
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls – Full Set Of Controls * Number in the household
Crosstabulation (weighted data)

Full set of controls	Number in household				Total
	one person	two people	three people	four or more people	
Yes	2082455	3658160	1714310	2165809	9620734
	43.20%	51.00%	51.60%	49.50%	48.90%
No	2738440	3514307	1605990	2211849	10070586
	56.80%	49.00%	48.40%	50.50%	51.10%
Total	4820895	7172467	3320300	4377658	19691320
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Lives with partner
Crosstabulation (un-weighted data)

Primary heating controls - room thermostat	Lives with partner		Total
	no	yes	
Yes	890	940	1830
	75.80%	79.90%	77.90%
No	283	234	517
	24.10%	19.90%	22.00%
Unknown	1	2	3
	0.10%	0.20%	0.10%
Total	1174	1176	2350
	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Lives with partner
Crosstabulation (weighted data)

Primary heating controls - room thermostat	Lives with partner		Total
	no	yes	
Yes	7124979	7940488	15065467
	74.20%	79.00%	76.70%
No	2480172	2078078	4558250
	25.80%	20.70%	23.20%
Unknown	3192	27050	30242
	0.00%	0.30%	0.20%
Total	9608343	10045616	19653959
	100.00%	100.00%	100.00%

Primary heating controls – central timer * Lives with partner
Crosstabulation (un-weighted data)

Primary heating controls - central timer	Lives with partner		Total
	no	yes	
Yes	1132	1152	2284
	96.40%	98.00%	97.20%
No	41	24	65
	3.50%	2.00%	2.80%
Unknown	1	0	1
	0.10%	0.00%	0.00%
Total	1174	1176	2350
	100.00%	100.00%	100.00%

Primary heating controls – central timer * Lives with partner
Crosstabulation (weighted data)

Primary heating controls - central timer	Lives with partner		Total
	no	yes	
Yes	9295474	9834787	19130261
	96.70%	97.90%	97.30%
No	309678	210830	520508
	3.20%	2.10%	2.60%
Unknown	3192	0	3192
	0.00%	0.00%	0.00%
Total	9608344	10045617	19653961
	100.00%	100.00%	100.00%

**Primary heating controls - TRV* Lives with partner
Crosstabulation (un-weighted data)**

Primary heating controls - TRV	Lives with partner		Total
	no	yes	
Yes	762	822	1584
	64.90%	69.90%	67.40%
No	410	354	764
	34.90%	30.10%	32.50%
Unknown	2	0	2
	0.20%	0.00%	0.10%
Total	1174	1176	2350
	100.00%	100.00%	100.00%

**Primary heating controls - TRV* Lives with partner
Crosstabulation (weighted data)**

Primary heating controls - TRV	Lives with partner		Total
	no	yes	
Yes	6044305	6973648	13017953
	62.90%	69.40%	66.20%
No	3554167	3071969	6626136
	37.00%	30.60%	33.70%
Unknown	9872	0	9872
	0.10%	0.00%	0.10%
Total	9608344	10045617	19653961
	100.00%	100.00%	100.00%

**Primary heating controls – Full set controls * Lives with partner
Crosstabulation (un-weighted data)**

Full set of controls	Lives with partner		Total
	no	yes	
Yes	557	641	1198
	47.20%	54.50%	50.80%
No	622	536	1158
	52.80%	45.50%	49.20%
Total	1179	1177	2356
	100.00%	100.00%	100.00%

**Primary heating controls – Full set controls * Lives with partner
Crosstabulation (weighted data)**

Lives with partner			
Full set of controls	no	yes	Total
Yes	4263236	5357497	9620733
	44.20%	53.30%	48.90%
No	5372203	4698382	10070585
	55.80%	46.70%	51.10%
Total	9635439	10055879	19691318
	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * couple with dependent children
Crosstabulation (un-weighted data)

Primary heating controls - room thermostat	Couple with dependent children		
	no	yes	Total
Yes	785	154	939
	79.60%	81.50%	79.90%
No	199	35	234
	20.20%	18.50%	19.90%
Unknown	2	0	2
	0.20%	0.00%	0.20%
Total	986	189	1175
	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * couple with dependent children
Crosstabulation (weighted data)

Primary heating controls - room thermostat	Couple with dependent children		
	no	yes	Total
Yes	6650589	1279344	7929933
	78.90%	79.90%	79.00%
No	1755990	322088	2078078
	20.80%	20.10%	20.70%
Unknown	27050	0	27050
	0.30%	0.00%	0.30%
Total	8433629	1601432	10035061
	100.00%	100.00%	100.00%

Primary heating controls - central timer * couple with dependent children
Crosstabulation (un-weighted data)

Primary heating controls - central timer	Couple with dependent children		
	no	yes	Total
Yes	963	188	1151
	97.70%	99.50%	98.00%
No	23	1	24
	2.30%	0.50%	2.00%
% within - central timer	986	189	1175
	83.90%	16.10%	100.00%
Total	100.00%	100.00%	100.00%

Primary heating controls - central timer * couple with dependent children
Crosstabulation (weighted data)

Primary heating controls - central timer	Couple with dependent children		
	no	yes	Total
Yes	8231490	1592742	9824232
	97.60%	99.50%	97.90%
No	202140	8690	210830
	2.40%	0.50%	2.10%
	8433630	1601432	10035062
Total	100.00%	100.00%	100.00%

**Primary heating controls - TRV* couple with dependent children
Crosstabulation (un-weighted data)**

Primary heating controls - TRV	Couple with dependent children		
	no	yes	Total
Yes	691	131	822
	70.10%	69.30%	70.00%
No	295	58	353
	29.90%	30.70%	30.00%
Total	986	189	1175
	100.00%	100.00%	100.00%

**Primary heating controls - TRV* couple with dependent children
Crosstabulation (weighted data)**

Primary heating controls - TRV	Couple with dependent children		
	no	yes	Total
Yes	5842526	1131122	6973648
	69.30%	70.60%	69.50%
No	2591104	470309	3061413
	30.70%	29.40%	30.50%
Total	8433630	1601431	10035061
	100.00%	100.00%	100.00%

**Primary heating controls – Full set controls* couple with dependent children
Crosstabulation (un-weighted data)**

Heating Controls	Couple with dependent children		
	no	yes	Total
Full set of controls	536	105	641
	54.40%	55.30%	54.50%
Less than a full set	450	85	535
	45.60%	44.70%	45.50%
Total	986	190	1176
	100.00%	100.00%	100.00%

Primary heating controls – Full set controls* couple with dependent children
Crosstabulation (weighted data)

Heating Controls	Couple with dependent children		
	no	yes	Total
Full set of controls	4485782	871714	5357496
	53.20%	54.10%	53.30%
Less than a full set	3947848	739979	4687827
	46.80%	45.90%	46.70%
	8433630	1611693	10045323
Total	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Tenure
Crosstabulation (un-weighted data)

Primary heating controls - room thermostat	Tenure				
	owner occupied	private rented	local authority	RSL	Total
Yes	1087	225	259	259	1830
	77.90%	69.90%	82.50%	81.40%	77.90%
No	308	96	55	58	517
	22.10%	29.80%	17.50%	18.20%	22.00%
Unknown	1	1	0	1	3
	0.10%	0.30%	0.00%	0.30%	0.10%
Total	1396	322	318	318	2350
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - room thermostat * Tenure
Crosstabulation (weighted data)

Primary heating controls - room thermostat	Tenure				
	owner occupied	private rented	local authority	RSL	Total
Yes	10425286	1916606	1338069	1385506	1.5E+07
	77.60%	67.60%	78.90%	82.30%	76.70%
No	2996772	908577	357790	295111	4558250
	22.30%	32.10%	21.10%	17.50%	23.20%
Unknown	18524	8527	0	3192	30243
	0.10%	0.30%	0.00%	0.20%	0.20%
Total	13440582	2833710	1695859	1683809	2E+07
	100.00%	100.00%	100.00%	100.00%	100.00%

**Primary heating controls – central timer * Tenure
Crosstabulation (un-weighted data)**

Primary heating controls - central timer	owner occupied	Tenure private rented	local authority	RSL	Total
Yes	1375	311	297	301	2284
	98.50%	96.60%	94.60%	94.70%	97.20%
No	21	11	17	16	65
	1.50%	3.40%	5.40%	5.00%	2.80%
Unknown	0	0	0	1	1
	0.00%	0.00%	0.00%	0.30%	0.00%
Total	1396	322	314	318	2350
	100.00%	100.00%	100.00%	100.00%	100.00%

**Primary heating controls – central timer * Tenure
Crosstabulation (weighted data)**

Primary heating controls - central timer	owner occupied	Tenure private rented	local authority	RSL	Total
Yes	13233350	2735257	1561188	1600466	1.9E+07
	98.50%	96.50%	92.10%	95.10%	97.30%
No	207232	98453	134671	80151	520507
	1.50%	3.50%	7.90%	4.80%	2.60%
Unknown	0	0	0	3192	3192
	0.00%	0.00%	0.00%	0.20%	0.00%
Total	13440582	2833710	1695859	1683809	2E+07
	100.00%	100.00%	100.00%	100.00%	100.00%

**Primary heating controls - TRV * Tenure
Crosstabulation (un-weighted data)**

Primary heating controls - TRV	owner occupied	Tenure private rented	local authority	RSL	Total
Yes	937	185	224	238	1584
	67.10%	57.50%	71.30%	74.80%	67.40%
No	458	137	90	79	764
	32.80%	42.50%	28.70%	24.80%	32.50%
Unknown	1	0	0	1	2
	0.10%	0.00%	0.00%	0.30%	0.10%
Total	1396	322	314	318	2350
	100.00%	100.00%	100.00%	100.00%	100.00%

Primary heating controls - TRV * Tenure

Crosstabulation (weighted data)

Primary heating controls - TRV	owner occupied	Tenure private rented	local authority	RSL	Total
Yes	8988379	1628125	1189744	1211705	13017953
	66.90%	57.50%	70.20%	72.00%	66.20%
No	4445524	1205585	506115	468911	6626135
	33.10%	42.50%	29.80%	27.80%	33.70%
Unknown	6680	0	0	3192	9872
	0.00%	0.00%	0.00%	0.20%	0.10%
Total	13440583	2833710	1695859	1683808	19653960
	100.00%	100.00%	100.00%	100.00%	100.00%

**Primary heating controls – Full set controls * Tenure
Crosstabulation (un-weighted data)**

Primary heating controls	owner occupied	Tenure private rented	local authority	RSL	Total
Full set of controls	694	127	187	190	1198
	49.60%	39.40%	59.60%	59.20%	50.80%
Less than full set	705	195	127	131	1158
	50.40%	60.60%	40.40%	40.80%	49.20%
Total	1399	322	314	321	2356
	100.00%	100.00%	100.00%	100.00%	100.00%

**Primary heating controls – Full set controls * Tenure
Crosstabulation (weighted data)**

Primary heating controls	owner occupied	Tenure private rented	local authority	RSL	Total
Full set of controls	6632839	1062408	949065	976421	9620733
	49.30%	37.50%	56.00%	57.50%	48.90%
Less than full set	6831235	1771301	746794	721254	10070584
	50.70%	62.50%	44.00%	42.50%	51.10%
Total	13464074	2833709	1695859	1697675	19691317
	100.00%	100.00%	100.00%	100.00%	100.00%

Chi-Squared statistical tests for the main report

To investigate the extent to which the installation of heating controls varies across household type and tenure, we conducted a series of chi-square tests.

The chi-square analyses could not be run on the weighted data: where cell frequencies are greater than around 2500, the chi-square statistic gets so large, the probability of Type I errors (incorrectly rejecting the null hypothesis) is unacceptably high. Were the analyses run on the weighted data, with several million cases per cell all chi-square statistics would be highly significant.

Because the cell proportions for the weighted and un-weighted data are very similar, we conducted chi-square tests on the un-weighted data as the optimum analytical strategy.

Of 16 tests (four categories of household by four types of heating controls), five yielded statistically significant test statistics:

- i. Number of people in household by Thermostat (TRV);
- ii. Number of people in household by full set of controls;
- iii. Tenure by room thermostat;
- iv. Tenure by Thermostat (TRV);
- v. Tenure by full set of controls.

The full results are reported below:

Number of people in household by Thermostat (TRV);

Chi-Square Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.631 ^a	6	.049
Likelihood Ratio	13.165	6	.040
Linear-by-Linear Association	2.812	1	.094
N of Valid Cases	2350		

Number of people in household by full set of controls

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.198 ^a	3	.042
Likelihood Ratio	8.203	3	.042
Linear-by-Linear Association	3.893	1	.049
N of Valid Cases	2356		

Tenure by room thermostat

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.333 ^a	6	.002
Likelihood Ratio	19.816	6	.003
Linear-by-Linear Association	2.510	1	.113
N of Valid Cases	2350		

Tenure by Thermostat (TRV)

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.810 ^a	6	.000
Likelihood Ratio	27.371	6	.000
Linear-by-Linear Association	6.029	1	.014
N of Valid Cases	2350		

Tenure by full set of controls

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	36.087 ^a	3	.000
Likelihood Ratio	36.318	3	.000
Linear-by-Linear Association	13.253	1	.000
N of Valid Cases	2356		

Because we were using multiple chi-squares to test *a priori* hypotheses, we did not conduct any simultaneous-inference test such as the sequential Bonferroni correction⁵, used to adjust significance levels when conducting multiple *a posteriori* tests on the same data set.

⁵ Cabin, R. J., & Mitchell, R.J. (2000). To Bonferroni or not to Bonferroni: When and How are the Questions. *Bulletin of the Ecological Society of America*, 81(3) pp. 246-248

Section 5. How do people use their heating at present?

5.1.1 Central heating and use of a timer

As stated above, EFUS data contained responses to two different sets of questions relating to heating controls: Set (a) collected via EFUS interviews (Questions 9 – 11 which included Question: Does your household use a central timer to control the times that the central heating is switched on and off?); and Set (b) (including the Question Q6 Primary heating controls – central timer) which are technically more detailed questions about the heating system, believed to have been collected via survey questions completed on the basis of observations of a third party.

Recorded responses from question sets (a), reported in Table 3, and (b), used in this section (Section 5) are inconsistent. Responses to set (a) suggest 10.1% of households with central heating do not have a timer; responses to set (b) indicate 2.6% of households do not have a timer.

One possible explanation for the inconsistency is that question set (a) is identifying some households that do in fact have a timer, but are not aware they have one. In these cases, the timer may be disabled, set to continuous heating, or not operating timed heating; householders may be unaware of what is controlling their heating – and probably override the timer by other means.

Statistics in this section (Section 5) use responses to set (a) as this set has responses to how households use their heating controls, the subject of this section of the report on how people heat their homes. However comparisons of Question 6 (from set (a)) and of Question 10 (from set (b)) are shown below.

Central timer comparison

Question 6: Primary heating controls - central timer

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	2284	96.9	97.2	97.2
No	65	2.8	2.8	100
Unknown	1	0	0	100
Total	2350	99.7	100	
Missing / n/a	6	0.3		
Total	2356	100		

Question 10 Does your household use a central timer to control the times that the central heating is switched on and off?

Comparison: Primary heating controls - central timer * Does your household use a central timer to control the times that the central heating is switched on and off?

Valid Cases		Missing Cases		Total	
Frequency	Percent	Frequency	Percent	Frequency	Percent
1977	83.90%	379	16.10%	2356	100.00%

Crosstabulation (un-weighted data)

Primary heating controls - central timer	Does your household use a central timer to control the times that the central heating is switched on and off?		
	Yes	No	Total
Yes	1396 71.40%	559 28.60%	1955 100.00%
No	14 66.70%	7 33.30%	21 100.00%
Unknown	1 100.00%	0 0.00%	1 100.00%
Total	1411 71.40%	566 28.60%	1977 100.00%

Primary heating controls - central timer * Does your household use a central timer to control the times that the central heating is switched on and off?
Crosstabulation (weighted data)

	Q10 Does your household use a central timer to control the times that the central heating is switched on and off?		
	Yes	No	Total
Yes	12203319 73.50%	4391243 26.50%	16594562 100.00%
No	123266 73.80%	43749 26.20%	167015 100.00%
Unknown	3192 100.00%	0 0.00%	3192 100.00%
Total	12329777 73.50%	4434992 26.50%	16764769 100.00%

Of all those households with a central timer, 71% (73% for weighted data) use it to control central heating.

Of all those households with central heating (2365 scaled to 19.7 million households), 59% (1396 scaled to 12.2 million) control their central using a timer.

Table 7 of the main report

The tables below were used to calculate the findings in Table 7 of the main report.

Do you have a timer that controls your central heating? * Does your household use a central timer to control the times that the central heating is switched on and off?
Crosstabulation

	Does your household use a central timer to control the times that the central heating is switched on and off?		
	Yes	No	Total
Do you have a timer that controls your central heating?	12353269	4448858	16802127
	73.50%	26.50%	100.00%

This weighted table gives the percentages for control within the group (26.5%) who do not use a timer for central heating control.

Does your household use a central timer to control the times that the central heating is switched on and off? * How does your household switch your central heating on and off?
Crosstabulation (weighted data)

	How does your household switch your central heating on and off?			
	Switch on and off manually when needed using a switch or at the control panel	Switch on and off by turning the thermostat up and down	Other	Total
Households not using a central timer to control the times that the central heating is switched on and off?	2593218	1684970	170670	4448858
	58.30%	37.90%	3.80%	100.00%

When using the percentage of households who do not use a timer to control their central heating (26.5%), calculations can be made from the table above:

$58.3\% \times 26.5\% = 15.4\%$ of those with timer using central heating (as reported) manual on/off

$37.9\% \times 26.5\% = 10.0\%$ of those with timer using central heating (as reported) thermostat up and down

5.1.2 Heating periods

The tables below were used to calculate the findings in Table 8a and 8b of the main report.

How many times does your central heating come on, on a typical Friday?
(un-weighted data)

Times central heating comes on, on a typical Friday	Frequency	Percent	Valid Percent	Cumulative Percent
Zero	5	0.2	0.4	0.4
One	218	9.3	15.6	16
Two	1052	44.7	75.4	91.3
Three	101	4.3	7.2	98.6
Four	10	0.4	0.7	99.3
Five	5	0.2	0.4	99.6
Six	5	0.2	0.4	100
Total	1396	59.3	100	
Missing; n/a; unknown	960	40.7		
Total	2356	100		

How many times does your central heating come on, on a typical Friday?
(weighted data)

Times central heating comes on, on a typical Friday	Frequency	Percent	Valid Percent	Cumulative Percent
Zero	31860	0.1	0.3	0.3
One	1771592	8.1	14.5	14.8
Two	9366184	42.8	76.7	91.5
Three	858786	3.9	7	98.6
Four	77661	0.4	0.6	99.2
Five	44384	0.2	0.4	99.6
Six	53836	0.2	0.4	100
Total	12204303	55.7	100	
Missing; n/a; unknown	9689677	44.3		
Total	21893980	100		

How many times does your central heating come on, on a typical Weekend?
(un-weighted data)

Times central heating comes on, on a typical Weekend	Frequency	Percent	Valid Percent	Cumulative Percent
Zero	14	0.6	1	1
One	264	11.2	19.1	20.1

Two	986	41.9	71.3	91.4
Three	98	4.2	7.1	98.5
Four	10	0.4	0.7	99.2
Five	6	0.3	0.4	99.6
Six	5	0.2	0.4	100
Total	1383	58.7	100	
Missing; n/a; unknown	973	41.3		
Total	2356	100		

How many times does your central heating come on, on a typical Weekend? (weighted data)

Times central heating comes on, on a typical Weekend	Frequency	Percent	Valid Percent	Cumulative Percent
Zero	93913	0.4	0.8	0.8
One	2229721	10.2	18.4	19.2
Two	8730023	39.9	72.2	91.4
Three	843149	3.9	7	98.4
Four	82505	0.4	0.7	99.1
Five	59335	0.3	0.5	99.6
Six	53836	0.2	0.4	100
Total	12092482	55.2	100	
Missing; n/a; unknown	9801498	44.8		
Total	21893980	100		

Heating hour periods

There was very little difference between weekdays, and as these graphs show, also little difference between weekdays (using Wednesday as typical) and weekends, with a difference in average hours of only 0.192 hour (11.5 minutes).

Table shows hours on and off for two periods (1394 valid, 962 missing for homes without fixed times).

Central heating timing	Period 1			Period 2		
	on	off	hours	on	off	hours
On Monday Period 1	06:32	10:09	3.6	16:02	20:05	4.1
On Tuesday Period 1	06:32	10:09	3.6	16:03	20:03	4.0
On Wednesday Period 1	06:32	10:09	3.6	16:02	20:03	4.0
On Thursday Period 1	06:32	10:09	3.6	16:03	20:03	4.0
On Friday Period 1	06:32	10:10	3.6	16:02	20:03	4.0
On Weekend Period 1	06:49	10:52	4.1	16:02	20:07	4.1

The following table summarises the same information using weighted data.

Period 1	Period 2
----------	----------

Day	on	off	on	off
Monday	06:31	10:02	16:03	20:08
Tuesday	06:31	10:02	16:04	20:06
Wednesday	06:31	10:02	16:03	20:06
Thursday	06:32	10:03	16:04	20:06
Friday	06:32	10:03	16:04	20:06
Weekend	06:50	10:47	16:02	20:12

Note this includes the homes with only 1, or more than 2, periods. It shows remarkable consistency between days, with slightly longer periods as weekends.
For homes with one period only: very similar weekday and weekend, slightly later weekends.

	N	Minimum	Maximum	Mean	Std. Deviation
Q13 Time central heating goes on Wednesday Period 1	216	00:00	24:00	08:01	04:45
Q14 Time central heating goes off Wednesday Period 1	216	00:00	24:00	18:25	06:40
Q13 Time central heating goes on Weekend Period 1	210	00:00	24:00	07:58	04:36
Q14 Time central heating goes off Weekend Period 1	210	00:00	24:00	18:49	06:22
Valid N (listwise)	210				

For homes with exactly two periods: shows weekend mornings about 50 mins longer but evenings very similar.

	N	Minimum	Maximum	Mean	Std. Deviation
Q13 Time central heating goes on Wednesday Period 1	1053	01:30	14:00	06:17	00:55
Q14 Time central heating goes off Wednesday Period 1	1053	04:00	18:00	08:41	01:19
Q13 Time central heating goes on Weekend Period 1	1039	00:00	20:00	06:38	01:20
Q14 Time central heating goes off Weekend Period 1	1039	00:00	24:00	09:28	02:51
Q13 Time central heating goes on Wednesday Period 2	1053	08:00	22:00	16:29	01:19
Q14 Time central heating goes off Wednesday Period 2	1053	00:00	24:00	20:50	02:53

Q13 Time central heating goes on Weekend Period 2	989	08:30	22:00	16:25	01:25
Q14 Time central heating goes off Weekend Period 2	989	00:00	24:00	20:49	02:48
Valid N (listwise)	989				

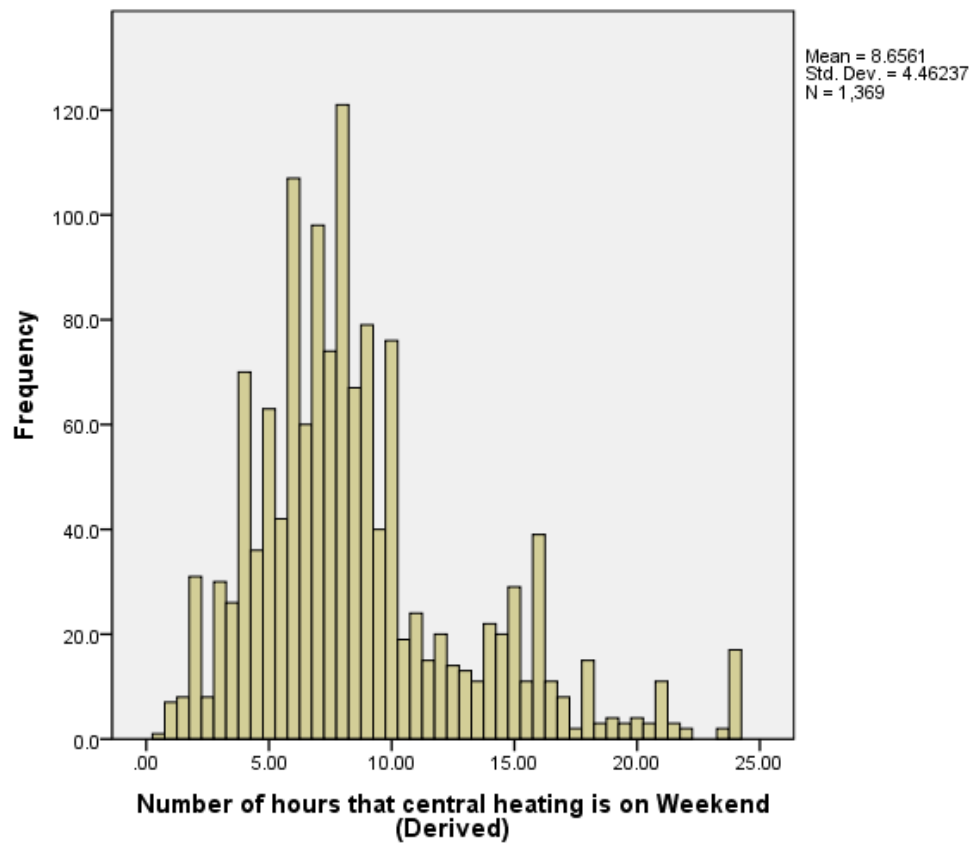
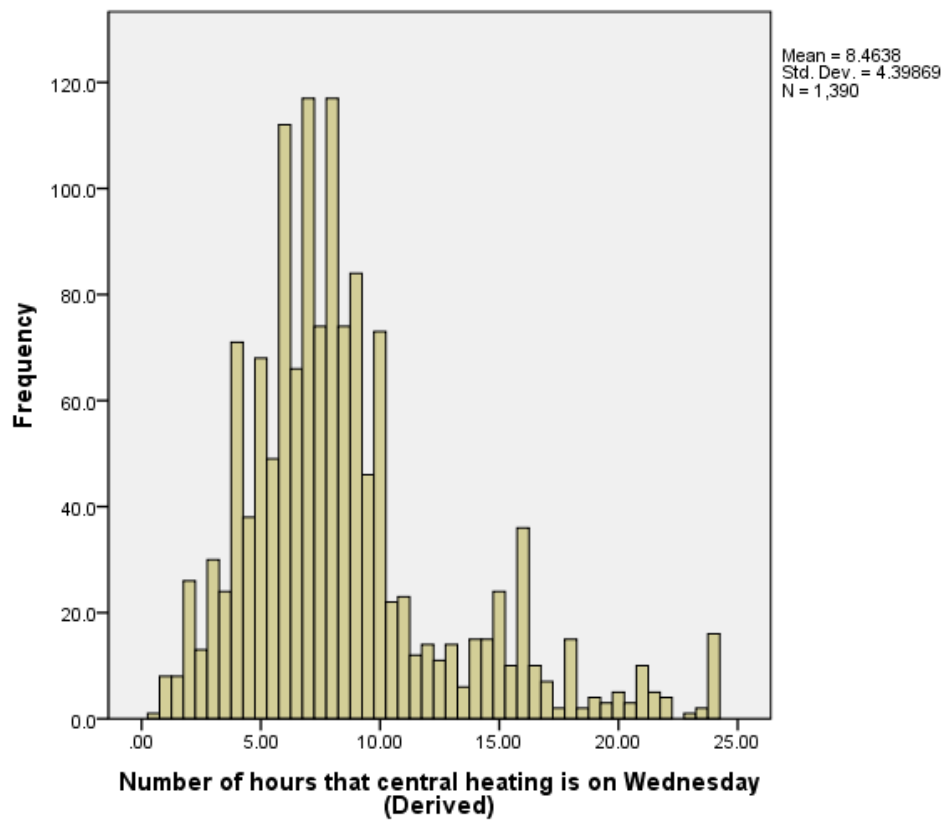
These histograms were plotted from the actual hours per day data directly using the histogram function in Excel, so using a weighted dataset has no effect. It may be possible to calculate weighted values by multiplying all the hourly values by their weights then rescaling, but this is outside the scope of the project.

Weekday histogram values, Monday to Friday data.

Bin (hours)	Frequency 5 days	Frequency/day	Cumulative %
0	14	2.80	0.20%
1	41	8.20	0.79%
2	169	33.80	3.21%
3	221	44.20	6.38%
4	478	95.60	13.24%
5	536	107.20	20.93%
6	804	160.80	32.47%
7	916	183.20	45.61%
8	950	190.00	59.24%
9	797	159.40	70.67%
10	595	119.00	79.21%
11	227	45.40	82.47%
12	126	25.20	84.28%
13	127	25.40	86.10%
14	108	21.60	87.65%
15	190	38.00	90.37%
16	230	46.00	93.67%
17	86	17.20	94.91%
18	83	16.60	96.10%
19	30	6.00	96.53%
20	39	7.80	97.09%
21	65	13.00	98.02%
22	45	9.00	98.67%
23	5	1.00	98.74%
24	88	17.60	100.00%
More	0	0.00	100.00%

Weekend histogram data.

<i>Bin</i>	<i>Frequency</i>	<i>Cumulative %</i>
0	0	0.00%
1	8	0.58%
2	39	3.43%
3	38	6.21%
4	96	13.22%
5	99	20.45%
6	149	31.34%
7	158	42.88%
8	195	57.12%
9	146	67.79%
10	116	76.26%
11	43	79.40%
12	35	81.96%
13	27	83.93%
14	33	86.34%
15	49	89.92%
16	50	93.57%
17	19	94.96%
18	17	96.20%
19	7	96.71%
20	7	97.22%
21	14	98.25%
22	5	98.61%
23	0	98.61%
24	19	100.00%
More	0	100.00%



5.1.2 Boost heating usage.

The data below was used to calculate boost heating figures such as those used in Figure 12 of the main report.

In a typical week, how many hours of boost heating does your family use?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	76280	.4	1.3	1.3
	1	597036	3.0	10.4	11.8
	2	1191823	6.1	20.8	32.6
	3	646305	3.3	11.3	43.9
	4	356490	1.8	6.2	50.1
	5	400576	2.0	7.0	57.1
	6	351048	1.8	6.1	63.3
	7	295381	1.5	5.2	68.4
	8	227802	1.2	4.0	72.4
	9	33084	.2	.6	73.0
	10	373425	1.9	6.5	79.5
	11	9276	.0	.2	79.7
	12	111775	.6	2.0	81.6
	14	257214	1.3	4.5	86.1
	15	95917	.5	1.7	87.8
	16	24916	.1	.4	88.2
	18	13653	.1	.2	88.5
	20	118752	.6	2.1	90.6
	21	90783	.5	1.6	92.2
	24	12728	.1	.2	92.4
	25	39857	.2	.7	93.1
	28	58269	.3	1.0	94.1
	30	84133	.4	1.5	95.6
	35	83018	.4	1.5	97.0
	40	33092	.2	.6	97.6
	42	12246	.1	.2	97.8
	44	8045	.0	.1	97.9
	48	15762	.1	.3	98.2
	49	26661	.1	.5	98.7
	50	38565	.2	.7	99.4
	56	16625	.1	.3	99.7
	70	8900	.0	.2	99.8
	84	7562	.0	.1	99.9
	98	3510	.0	.1	100.0
	Total	5720510	29.1	100.0	
Missing	Question not applicable	13970808	70.9		

Total	19691318	100.0		
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5.1.4 Heating density

It was not possible to include in these appendices the findings and calculations for heating density periods due to the fact that they used a large tables which could not be presented coherently in this appendices.

Appendix D – SAP and EFUS data definitions of heating periods

In the EFUS data, a heated period is the time the heating is recorded to be physically 'on', i.e. the system is 'calling for heat' and the boiler will be firing and providing heat if required (it is not quite correct to simply say 'when room temperature is below the set point' due to the effect of the dead band). If the house is well below the set point at the start of this period, the house will remain 'uncomfortable' for some time, typically 30 minutes to an hour in normal weather, so the heating system is generally set to come on earlier than the occupancy required, particularly early in the morning when the house is likely to be at its coldest. This 'warm up period' is additional to the 'occupancy period'. Conversely, if the heating goes off before the end of occupancy, the house will remain tolerably comfortable for a while (particularly if well insulated and/or with high thermal mass and a low infiltration rate). This is illustrated in Figure A4.1. Note that points B and E may or may not coincide in time.

In a well-controlled system, set point will be reached at point A, and the house will remain comfortably close to the set point between E and B; if E comes after B then energy is wasted in heating beyond occupancy.

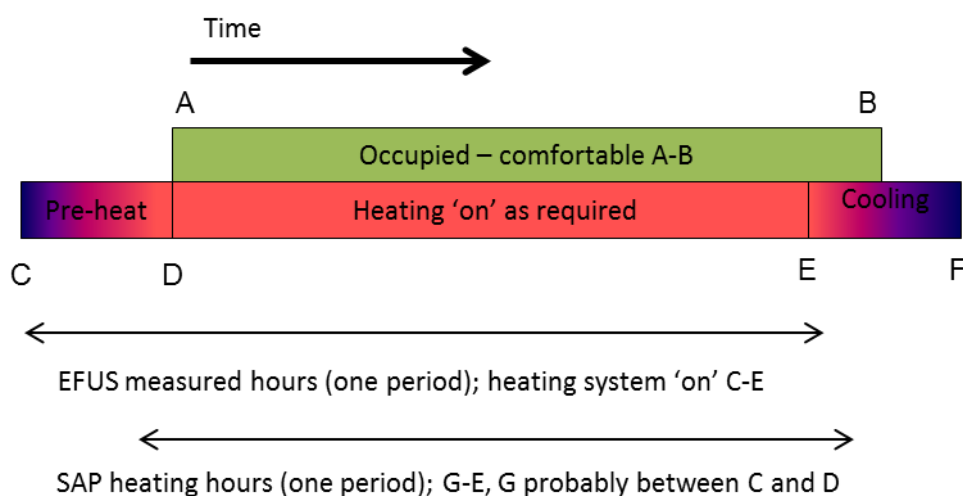


Figure A4.1. Comparison of what heated/occupied periods mean in different definitions.

In the BREDEM model which forms the basis of SAP and RD-SAP, heated period has a slightly different definition:

The heating period was taken as starting from the time where the temperature was within 2°C of the assessed demand level (taken as the mean value of the approximately flat portion to nearest 1°C), and ending at switch-off. Thus the preheat period is excluded, to some extent balanced since comfort conditions would be maintained for a time after switch-off.⁶

⁶ BREDEM — BRE Domestic Energy Model: background, philosophy and description B R Anderson, A J Clark, R Baldwin and N O Milbank, Building Research Establishment, 1985.

Thus in this definition, the start of the heating is likely to occur between points C and D before the set point is reached, and end at E, so be less than the EFUS time. Interestingly, the early work on Bredem identified three heated periods.

It is evident that there is a wide variation in demand pattern between similar houses, so that representative values will be averages over a group of houses and not necessarily applicable to a particular house. Demand schedules for living areas have been assessed from the data (with some aspects illustrated in Figures 13 to 15) as follows:

- (1) all day heating (single period)
- (2) morning and evening (two periods);
- (3) evening only 1700–2300 (single period);
- (4) evening, midday and evening heating (three periods).

However, a ‘standard’ set of hours was chosen for SAP which comprised (2) above, 0700–0900, 1600–2300 for weekdays, 9 hours, and (1) above, 0700-2300, for weekends, 16 hours, making 77 hours per week or an average of 11 hours per day; these apply to all parts of the house (zones 1, living room and 2, elsewhere, in Bredem terms). It is also important to note that while the EFUS data refers to timed periods, the SAP is for all heating; homes may extend or shorten their heated periods, or add ‘boost’ heating outside timed periods.

Figure A4.2 shows the actual hours from the EFUS data for homes with one and two heating periods on weekdays (represented by Wednesday data) and weekends (excluding boost heating at varying times) – it should be remembered the periods are not defined in quite the same way, and that the SAP periods equate to slightly longer EFUS periods for the same control setup because the former do not include all the preheat time.

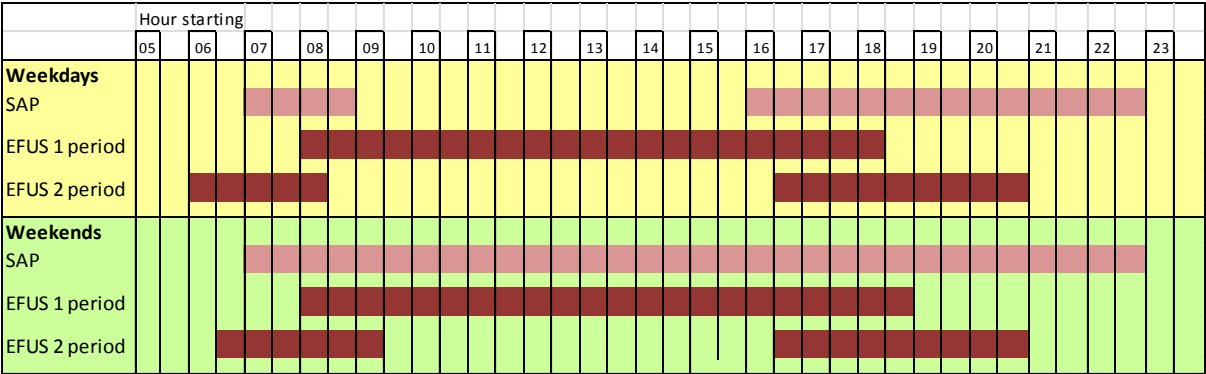


Figure A4.2. Recorded hours heating is on from EFUS data for homes with 1 and 2 periods of heating, compared with standard SAP assumptions.

Numerical data are summarised in Table A4.1. A number of interesting observations can be made. The SAP weekend ‘all day’ heating period is much longer, at both ends, than the observed EFUS single period heating. For two periods heating, the weekday SAP morning period starts later and is shorter than EFUS, but the evening period in SAP starts slightly earlier and goes on much longer than EFUS, with SAP ending at 23:00 compared to a recorded average of around 20:50 every day. Also, there is little difference in the number of homes using two periods on weekdays and weekends, which make up 75% of homes with timed heating; this is very different from the SAP assumption of all day weekend heating.

Total hrs hh:mm	Total hrs decimal	Proportion homes with timed heating
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Weekdays			
SAP	09:00	9.00	n/a
EFUS 1 period	10:24	10.40	16%
EFUS 2 periods	06:45	6.75	75%
Weekends			
SAP	16:00	16.00	n/a
EFUS 1 period	10:51	10.85	19%
EFUS 2 periods	07:14	7.23	71%

Table A4.1: Summary of hours heating 'on' for SAP and EFUS homes with timed heating.

Use of boost heating can be taken into account as follows. Although all homes with timed heating also use boost heating, only a proportion of these use it regularly and only some of these can say how much; however this is our only estimate of usage and there is no reason why they should use more or less than those who don't know usage. Thus we can use the known hours of boost (average about 1.1 hours per day) to estimate the typical hours of use across the houses with timed heating. A summary comparison of hours per week for SAP and EFUS, with and without boost for the latter, is given in Table A4.2. Including the assumed boost period, EFUS homes with one or two periods (making over 90% of those with known heating times) heat for 89% of the weekday hours assumed in SAP, and 54% of the weekend hours. In fact these numbers should probably be somewhat lower, as the SAP hours do not include all of the 'heating on' period. The large discrepancy at weekends is mainly because most homes heat for two periods rather than one at weekends, with only a small difference between weekday timings.

Overall, the EFUS heating hours are 75% of the SAP heating hours; in other words, SAP assumes heating systems are on for 1/3 more than EFUS suggests, mainly due to longer weekend hours. For households who do not use timers or have the information, q25b in the questionnaire asks 'How many hours do you think your main heating is on in a typical winter week?' The mean of the responses (from 575 household, roughly half the number who do not know times) is 47.8 hours; this equates to 6.83 hours per day which is about 83% of the timed EFUS results, but only 62% of the SAP average.

	SAP	Timed EFUS	% SAP, timed only	Boost	Total EFUS	% SAP, total
weekdays	9.00	7.37	82%	0.649	8.02	89%
weekends	16.00	8.00	50%	0.649	8.65	54%
week	11.00	7.55	69%	0.649	8.20	75%
week, estimated, not timed					6.83	62%

Table 4.2. Comparison of hours per day from EFUS homes with one and two timed periods, and SAP.