



Department
of Energy &
Climate Change

What Works in Changing Energy-Using Behaviours in the Home?

A Rapid Evidence Assessment

Final Report

Undertaken by RAND Europe

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

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Executive Summary

RAND Europe was commissioned by the Department of Energy & Climate Change (DECC) to undertake a Rapid Evidence Assessment* to understand “What works in changing energy-using behaviours in the home?”. The main objective was to answer this question by systematically reviewing the evidence around domestic behaviour change, with a particular focus on international evidence.

In order to identify relevant studies, and avoid overlap with other previous evidence reviews, a set of search criteria was established. For inclusion, studies must:

- Target energy-using behaviours in the home.
- Consider at least one intervention.**
- Go beyond the use of direct feedback on past energy use and pricing strategies to shift or reduce demand; and consider behaviour beyond one-off purchasing decisions (such as the installation of insulation or the purchase of energy-efficient appliances).
- Measure a behaviour change in a real-world setting, either observed or self-reported.
- Make a comparison between groups (e.g. between treatment and control groups), or across different time periods.

No restrictions were applied regarding sample size; and both quantitative and qualitative studies were included.

This report draws on 48 behaviour change programmes identified and selected through a systemic search process. These programmes involve a wide range of innovative approaches (such as the provision of Home Energy Reports that compare households’ consumption with their neighbours’) as well as more traditional approaches (including advertising campaigns).

This executive summary draws out the high-level findings from the body of evidence reviewed.

In addition to the research team at RAND Europe, two academic advisors – Dr Tim Chatterton at the Institute for Sustainability, Health and Environment, University of the West of England, and Dr Charlie Wilson at Tyndall Centre, University of East Anglia – contributed to this review.

* A Rapid Evidence Assessment is a comprehensive and replicable approach to gathering, reviewing and synthesising evidence, while also delivering to tight timeframes. For more information, see: UK Civil Service. 2012. How to do a REA [Online]. Available: <http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance/rapid-evidence-assessment/how-to-do-a-rea> [Accessed July 2, 2012].

** For the purpose of this paper, an intervention is defined as an action or a set of actions undertaken with the objective to bring about changes in energy-using behaviours.

Key findings

The key findings from the review of the evidence base are:

- 1 Behaviour change programmes can be effective in encouraging people to use less energy in their home.** Behaviour change programmes based on routine reporting of comparative consumption information and energy efficiency advice have led to small, but consistent reductions in energy use in the home. The evidence suggests that provision of Home Energy Reports, which present both comparative consumption information and energy efficiency advice, can lead people to change their energy-using behaviour. In the majority of studies reported to date such reports have returned energy savings in the order of 1% to 3% per household.
- 2 Baseline consumption or pre-intervention behaviours and household characteristics have been shown to influence the levels of savings that can be achieved.** The evidence shows that households with more scope to reduce energy use (i.e. those with higher baseline energy consumption) experience larger savings in energy use within interventions.
- 3 How an intervention is structured and implemented affects the level of savings per household.** The evidence shows that interventions tend to result in higher levels of savings when including tailored instructions or comparative feedback.
- 4 Team-based approaches, which use peer support (and pressure) as a way to encourage changes in behaviour, have led to energy savings and behaviour change in a number of programmes.** The evidence includes cases where these approaches have led to energy savings amongst participating households of the order of 8–10%. However, wide scale implementation of such programmes may be limited by the requirement for highly tailored instructions and coaching to each household or team.
- 5 There is not one single motivating factor that drives individuals to take up energy-saving behaviours.** Multiple factors such as financial considerations, environmental concerns, competitiveness, cooperation, conformity and altruism come into play. There are also barriers that prevent or limit changes in behaviour (e.g. comfort, aesthetics and the physical layout of homes). Interventions need to be targeted in different ways for different groups.
- 6 Some, but not all, behaviour change programmes lead to durable energy reductions.** The evidence from well-designed evaluations of Home Energy Reports and team-based interventions shows that energy reductions can be sustained over periods of two years or more. Whilst competitions can raise awareness and lead to large (sometimes radical) short-term changes, evidence of their durability is significantly weaker than that of Home Energy Reports and team-based interventions.

- 7 **The evidence shows that education programmes provided at the same time as the adoption of new technology and one-off modifications can act as a stimulus for changing habitual* behaviours.** A well-designed study looking at those insulating and draft-proofing their properties showed that significant increases in energy savings were attainable by providing education at such moments of change. The additional savings that were attributable to the provision of education were comparable with those from community-based interventions undertaken in other studies.

Gaps in the existing evidence base

The review has identified evidence that can support future policy development in changing energy-using behaviours in the home. However to date not all possible mechanisms or interventions that might be considered in this area have been robustly evaluated. For example, the review has identified little evidence around the effectiveness of interventions seeking to address issues of convenience or messaging being applied to encouraging behavioural change in household energy-using behaviours.

The review has also identified some specific gaps in the existing evidence base:

- 1 **There is little evidence linking specific changes in behaviour to quantified energy savings.** As a result, whilst this review provides evidence on the overall effectiveness of some interventions, it cannot provide robust indication of the scale of impact from changing individual areas of behaviour. More evidence linking behaviours to usage would allow better targeting of future interventions.
- 2 **There is little evidence on how different socio-demographic groups respond to different interventions.** Typically studies have not been designed in a way that gives insight into this. They have either had small sample sizes that would not allow judgements to be made on whether differences are statistically significant, or have not collected the data necessary to undertake the analysis.
- 3 **There is limited evidence on the differences in effectiveness of interventions in gas versus electricity use.** Many studies have not reported gas and electricity savings separately. The few that did have observed larger percentage saving in gas consumption than in electricity consumption; however, there will be different contextual issues in studies drawn from different countries. There is a need to recognise the distinction and for greater precision in the reporting of future studies.
- 4 **None of the studies has explicitly tested the effect of messengers on the effectiveness of interventions.** However, the contrast between studies that have used messages communicated by peers and those where the information has been provided by a government body or utility company

* For the purpose of this study, habitual behaviour is defined as behaviour that is frequently repeated.

suggests that the messenger employed within a programme could have an important role. The evidence to date is not sufficient to establish whether it is the credibility of the messenger, the messages themselves, or some other aspect of the interventions that is leading to the differences observed. To answer this question would require further investigation.

- 5 **There is little information available on the cost effectiveness of interventions, and that which exists is based upon a range of very broad assumptions.** Future programmes should be encouraged to collect the data necessary to evaluate their cost effectiveness.

Recommendations for further research

Some of the identified knowledge gaps could be addressed through further research, e.g. the role of messengers in influencing the success of programmes. However, other areas, such as the collection of data to explore the impacts on different socio-demographic groups, should be considered when an intervention is designed. By thinking about these issues during programme design one can put in place some simple steps to support future evaluation.

It should also be noted that existing evidence from other policy areas provides some useful pointers about what can work in changing people's behaviour. Whilst beyond the remit of this review, a growing body of evidence from other sectors highlights the circumstances in which behavioural change measures appear to work and where they have been less successful. Rather than investing in large amounts of additional basic research, a case could be made for setting up pilot programmes with basic, but well-designed, evaluation arms to assess the transferability of the evidence identified from other geographic or sector contexts.

Some of the areas that a well-designed evaluation should consider are:

1. **How to demonstrate that observed changes in energy use can be attributed to the intervention rather than some other change that has not been monitored – and would not have occurred in the absence of the intervention?** The use of well designed experimental trials with control groups is powerful in showing how energy use has changed independent of the intervention, be that through seasonal fluctuation, responses to changes in energy prices or some other external influences.
2. **Who is targeted by the intervention?** Many previous studies have relied on self-selecting samples, which introduces selection bias and makes it hard to generalise findings. This can be overcome by putting in place some simple sampling strategies that seek to obtain samples that are representative of the populations that the policy or intervention is ultimately seeking to influence. The nature of these will differ between interventions and depend on what they are seeking to achieve, but the issue of who will be included in the evaluation is important and needs careful consideration.
3. **What was the level and variability of energy use prior to the intervention?** In order to calculate changes without resorting to employing

strong and challengeable assumptions, it is desirable to measure baseline use for those individuals that will be subject to the intervention.

4. **How to measure the change in energy use?** Some of the studies reviewed have relied on self-reported consumption; this is far from ideal. It is preferable to have independent measurement of actual use.
5. **Are there differences in effectiveness or impact for different socio-economic groups?** Energy reduction in and of itself cannot be the only consideration in developing policy instruments; it is also necessary to consider whether there are equity impacts. It is therefore desirable to design studies that allow the response of different socio-economic groups to be contrasted. Even if equity is not a direct consideration, tailoring approaches to the characteristics of specific groups can improve the overall response. This requires sufficient participants from the groups of interest and the recording of information that allows the participants to be classified for analysis in any datasets produced.
6. **Are the energy reductions observed durable?** Evaluations should run beyond the time period of the direct intervention to allow an assessment of whether the changes that individuals make are sustained over periods of time, or whether energy use reverts back to pre-intervention levels.
7. **What was the cost effectiveness of the intervention?** A key input to this calculation is the estimation of the costs of designing and implementing the intervention. This is typically not recorded, which makes it hard to produce a compelling argument that the intervention should be rolled out further. Programmes should therefore seek to record this information as standard.

Emerging implications for UK energy policy

The interventions studied in the evidence base are diverse, involving different combinations of mechanisms to encourage change and often implemented in very different contexts. This diversity means that there is no single model for the “best” intervention to encourage behaviour change in energy-using behaviours in the home.

What is clear from the evidence is that two broad classes of interventions have been evaluated to date: small scale targeted community-based programmes, and broad universal initiatives, such as Home Energy Reports, which have been rolled out across large segments of the population. As discussed earlier, Home Energy Reports tend to save between 1 and 3% of energy consumption per household. However, in the contexts that they have been applied to date they have proved to be relatively cost effective.

Interventions that operate at the community or neighbourhood level do seem to be effective in influencing domestic energy use. But there are challenges to in the extent to which these might be scaled, as by design they assist households and neighbourhoods in a tailored manner. The studies to date typically involve those who are already motivated to look for ways to reduce their energy use, so the gains

from extending them to less susceptible populations are likely to diminish. It would seem that the key to maximising returns could be to better target the programmes at groups that have scope for making the greatest savings. Although evidence is limited, it suggests that one of these target groups should be those that currently have the highest levels of energy usage (but only if achieving reductions in carbon emissions is the focus of the intervention, rather than reducing fuel poverty, and care must be taken to take any potential equity issues in to account,).

From the evidence included in this review, interventions designed to change habitual energy use have been shown to deliver relatively small savings on a per household basis. However, there is evidence that suggests that there is potential for larger energy savings if technical/infrastructural and behavioural interventions are applied in combination.

Finally, reflecting on the evidence collected, it is worth noting that the majority of evidence in this review comes from grey literature*, and in many cases the evaluation is not truly independent (being undertaken or funded by the programme implementers or funders themselves). This in turn suggests that more publicly funded evaluations within this area or more independent privately funded evaluations of programmes might improve the evidence base and sharpen the conclusions.

There is a strong case for the government or programme funders to put in place well-designed evaluation streams of any new programmes that may be developed to assist in strengthening the evidence base. Both qualitative research to help shape programme design and evaluations utilising the principles of the randomised controlled trial** to evaluate impact and effectiveness would provide useful new evidence to help develop more effective interventions.

* Typically studies that have not been published in peer reviewed journals and which are documented in publicly accessible reports.

** This method is discussed in detailed in the UK Cabinet Office paper "Test, Learn, Adapt". See: Haynes, L., Service, O., Goldacre, B. & Torgerson, D. 2012. *Developing Public Policy with Randomised Controlled Trials* [Online]. Available: <https://update.cabinetoffice.gov.uk/sites/default/files/resources/TLA-1906126.pdf> [Accessed July 2, 2012].

Chapter 1 – Introduction

RAND Europe was commissioned by the Department of Energy & Climate Change (DECC) to undertake a Rapid Evidence Assessment* ¹ to understand “What works in changing energy-using behaviours in the home?”.

This introductory chapter provides a brief discussion on the policy background, the research scope, the approach to systematically understanding what works, and finally the structure of this report.

1.1 Policy background

The application of behavioural insights to public policy

In recent years there has been an increasing recognition that behaviour change can be triggered by making minor alterations to the choices and the environment in which people act. In their 2008 book, *Nudge: Improving Decisions About Health, Wealth, and Happiness*, Richard Thaler and Cass Sunstein introduce the concept of a “nudge”.² They define it as:

“...any aspect of the choice architecture [the environment in which an individual makes choices] that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting the fruit at eye level counts as a nudge. Banning junk food does not.”

An example from the book concerning energy-using behaviour is described in Box 1.²

Box 1: “Smiles, Frowns and Saving Energy” in *Nudge*

One example in *Nudge* addresses how the power of social norms can be harnessed to change energy-using behaviour. In an experiment involving nearly 300 households in San Marcos, California, participants were given information on how their energy consumption compared to that of other households in the neighbourhood. One important lesson from this example is that people’s behaviours tend to converge towards the norm. This led households with above average energy consumption to significantly reduce their energy consumption, while those households with consumption below the average significantly *increased* their consumption. Therefore, informing people who do better than average may result in a negative outcome (this is known as the “boomerang effect”). To address this, the experiment also tested the effect of presenting subjects with a happy/frowny face emoticon along with information on energy use, to convey social approval/disapproval. This was found to counterbalance the boomerang effect.

* A Rapid Evidence Assessment is a comprehensive and replicable approach to gathering, reviewing and synthesising evidence, while also delivering to tight timeframes.

Many of the core theories contained in the book were developed into a practical guide for policymakers, *MINDSPACE: Influencing behaviour through public policy*, by the Institute for Government and the Cabinet Office.³ The MINDSPACE report also suggests that nudging “appears to offer similar or better outcomes at less cost,” which has helped the approach to gain further traction in Government.

However, the use of behaviour change programmes in Government is not new. There is a wide range of existing policy tools that have been used in the energy sector. These include:

- **Energy efficiency information and advice:** information provision targeted at households/individuals, based on the information deficit principle. If people actually understand where and how they are wasting energy then they will act to reduce this wastage.
- **Education or marketing campaigns:** information provision aimed at raising awareness and understanding of the wider scope of the problem. This could include energy efficiency information and advice, but builds on this by focusing on why it is important to save energy and the wider impacts that can be achieved through energy behaviour change.
- **Consumer/community engagement:** detailed interactive processes with individuals/households to provide energy efficiency information, advice or education, or to motivate pro-environmental actions. These build on the above through interactively engaging with the target audience.

An example of a UK community engagement programme is Transition Streets (see Box 2).⁴

Box 2: Engaging communities: Transition Streets in Totnes

The programme: The Transition Streets project ran in Totnes from January 2010 to July 2011. Small social groups of neighbours worked together to use a workbook full of practical actions to reduce their energy use and other household bills. Providing they made some basic energy efficiency improvements to their home, the household would become eligible to apply for a grant towards a domestic solar photovoltaic (PV) system.

The outcomes: By July 2011, nearly 500 households had participated. It was estimated (from self-reported data) that participating households saved, on average, about £570 per year on their household bills, equivalent to around 1.3 tonnes of CO₂. As for the PV grants, 44% were given to low-income homes, which then also had access to a low-interest loan scheme.

The policy implications: The Transition Streets final project report, prepared by the project team (Ward and colleagues), suggested four key lessons for similar projects: (i) encouraging people to recruit their own neighbours, (ii) setting up the groups to be self-managing from the start, (iii) monitoring results early and often, and (iv) using professional marketing experts.

The team-based approach described here is further discussed later in this report.

This review examines the evidence from the published literature on the effectiveness of both nudges as well as more traditional approaches to encouraging behaviour change in the reduction of home energy use.

The systematic nature of this review seeks to provide the full range of available evidence on the effectiveness of behaviour change interventions* in encouraging reductions in energy use. However, it should be noted that the explicit exclusion of studies looking at the impact of one-off purchases (such as the installation of insulation or the purchase of energy-efficient appliances) limits the degree to which interventions involving technological or infrastructural changes have been considered. This brings the benefit that the findings reported here focus primarily on the effectiveness of programmes addressing habitual** behaviours alone. However, it does mean that whilst the review has identified some promising findings from cases where there were reductions in energy consumption after the adoption of new technologies, it cannot provide a full assessment of the extent to which technology and/or infrastructure could impact on existing habitual behaviours.

* For the purpose of this paper, an intervention is defined as an action or a set of actions undertaken with the objective to bring about changes in energy-using behaviours.

** For the purpose of this paper, habitual behaviour is defined as behaviour that is frequently repeated.

The need for understanding what works

Sometimes, a well-intentioned policy intervention aiming to reduce energy use could turn out to be ineffective or even produce an adverse effect. One example is the boomerang effect, described earlier in Box 1, where an intervention leads to an undesirable increase in consumption towards the norm. Another potential problem is the “rebound effect”, where monetary savings from reduced energy consumption are spent on additional carbon/energy intensive activities, thereby eliminating any gain from the intervention. It is therefore necessary to review the evidence available from evaluations of behaviour change interventions to understand whether they have achieved what they set out to do, to quantify (where possible) the impact that they have had and why, and to identify any unintended consequences.

Against this backdrop, and to ensure that policy decisions on influencing energy using behaviour in the domestic sector are based on a solid understanding of the existing evidence base, the Department of Energy & Climate Change (DECC) commissioned this Rapid Evidence Assessment (REA).

1.2 Research question and scope

This review addresses the overarching question:

“What works in changing energy-using behaviours in the home?”

It focuses on domestic energy use within the home and excludes travel to and from the home. Comprehensive reviews on the use of direct feedback (e.g. provision of information on real-time household energy consumption through real-time displays) and historic feedback (e.g. the provision of extra information about energy usage on energy bills) have already been published.⁵ DECC has also commissioned a review of demand-side responses (i.e. strategies that use price signals to shift or reduce demand). This review complements these other studies by focusing on interventions that affect habitual behaviours (such as energy use for heating space, heating water, lighting, and electrical appliances).

Responses to interventions are likely to have changed over the last couple of decades due to changing social contexts, especially the increasing public profile of energy security and climate change issues. Therefore, this review focuses on a comprehensive search of the literature since 2000. Key lessons from earlier research in the 1980s and 1990s are covered by drawing on existing “meta-studies” (see Chapter 2).

1.3 Our approach to understanding what works

Our approach to Rapid Evidence Assessment (REA) follows Government Social Research Service Guidance.¹ This is particularly suited to responding to the “what works” question as it delivers a systematic and comprehensive overview of the evidence on a subject, while allowing such an assessment to be undertaken within tight timelines (four and a half months for the current study). Although it is not a full Systematic Review, it abides by the same principles (see Box 3) in that it follows a transparent and systematic research approach.

Box 3: The problem with non-systematic reviews

The science writer Ben Goldacre has commented that:⁶

Huge amounts of effort now are about making sure that we do systematic reviews of the evidence that's available to us, so that we see all of the studies, the positive and the negative ones.

What's surprising, in some respects, is that this is a fairly recent phenomenon, only about 25 years old. It used to be that if you were writing a review – on treating diabetes, for example – you would stroke your chin and you'd say, "Well, I quite like this paper and I like that paper, and this one's written by my friend, and this one validates my pre-existing prejudices. So I'll just put those into a chapter and write about it." And that was a bizarre state of affairs....

Through a systematic search process, over 4,000 potentially relevant articles were identified from academic and grey literature databases. The research team scanned through the titles and abstracts, selected over 80 for full text review, and finally arrived at 45 relevant articles (covering 48 trials or evaluations). Short summaries of these 48 trials or evaluations are presented in Appendix A; and the systematic search process is set out in the "search protocol" in Appendix B.

The chosen articles all:

- Target energy-using behaviours in the home.
- Consider at least one intervention.
- Go beyond the use of direct feedback on past energy use; or pricing strategies to shift or reduce demand (known as demand side responses); or one-off purchasing decisions (such as the installation of insulation or the purchase of energy-efficient appliances).
- Have measured a behaviour in a real-world setting, either observed or self-reported. Qualitative as well as quantitative studies were included. However, research that relied on behavioural intentions or staged laboratory behaviours was excluded.
- Have made a comparison between groups (e.g. between treatment and control groups), or across different time periods.

These criteria were designed to enable the research team to review the range of relevant evidence on interventions to change energy-using behaviours. While the wealth of cross-sectional and/or self-reported studies may provide important insights into theories, models, behaviours, or practice, they were considered out of the scope of this review if they did not provide primary evidence on the effectiveness of interventions.

1.4 Structure of this report

This report draws on 48 behaviour change interventions identified and selected through the systematic search process. The range of evidence assessed is described in detail in Chapter 2. Chapter 3 presents a cross-analysis of the

evidence provided by each of the interventions studied, focusing on their effectiveness in changing energy-using behaviours in the home. Finally, conclusions are discussed in Chapter 4.

Throughout the report, references to published work are numbered consecutively with superscript numbers. The full list of works cited can be found on page 63.

Chapter 2 – Categorising, mapping and assessing the interventions

This chapter first introduces a typology of interventions. The 48 interventions identified through our systematic search are then mapped onto this typology to provide an overview of the evidence base.

2.1 Categorising the interventions

A useful typology, of four major categories and ten sub-types, has been developed by two academics, Richard Osbaldiston and John Paul Schott, in a recent meta-analysis of pro-environmental behaviour.⁷ The scope of Osbaldiston & Schott's meta-analysis was different from the current review in two ways. First, their meta-analysis was broader in scope: it covered all kinds of pro-environmental behaviours, including recycling, water conservation and travel behaviour, whereas the current review focuses on energy-using behaviour only. Second, their meta-analysis had a focus on quantitative studies, whereas the current review seeks to draw out findings from well-design qualitative studies as well. Despite the differences, Osbaldiston & Schott's typology provides a useful way of categorising the studies collected in the current review.

Osbaldiston & Schott developed their typology of interventions through a systematic analysis of the categorisation used in six other earlier reviews,⁸⁻¹³ resulting in a system that is up-to-date and comprehensive. The four major categories are: convenience, information, monitoring, and social-psychological processes, and the ten sub-types fall into each of the four major categories as set out below.

Two sub-types of interventions are classified under the major category of **convenience**:

Making it easy are interventions which change situational conditions to make behaviours easier to do, such as installing programmers or time switches to control heating, or providing low-flow shower heads to conserve water.

Prompts are reminders that focus only on *when* to perform a specific action, such as "turn off lights when leaving room".

A further two sub-types fall under the major category of **information**:

Justifications are interventions giving the *reasons* for performing a specific behaviour (also called declarative or "why-to" information), such as data about how much of the rubbish dumped in landfills could be recycled.

Instructions indicate *how* to perform a specific behaviour (also called procedural information). For example, in order to achieve the result of keeping a room cooler, a suggested procedure is to use blinds to reflect the sun.

Two sub-types of interventions are relevant to **monitoring**:

Feedback provides information about the extent of (and potentially the consequence of) a behaviour that was performed by participants in an earlier time frame. Typically, feedback treatments are administered over a course of time with distinct periods, such as monthly electricity billing, so that participants can learn how they performed last month and adjust their behaviour accordingly over the coming month.

Rewards or incentives are any kind of monetary gain that people receive as a result of participating in the intervention. These gains can include not only cash but also coupons, rebates, bus passes, gifts, prizes and so on. Monetary savings from reduced energy bills are excluded here.

Finally, four sub-types focus on **social-psychological processes**:

Social modelling includes any kind of knowledge transfer via demonstration or discussion in which the initiators indicated that they personally engaged in the behaviour. In psychology, terms to describe this passing of information include “modelling”, “norms” and “diffusion.”

Cognitive dissonance interventions access pre-existing beliefs or attitudes and attempt to make participants behave in ways that are consistent with those beliefs to reduce the gap between their current behaviour and their beliefs or attitudes.

Commitment is operationalised by asking participants to make some sort of verbal or written commitment to engage in a behaviour, most frequently by making a pledge. Box 4 describes a programme in which participants can make a pledge online and broadcast it to their social networks.¹⁴

Goal setting is the process of asking participants to aim for a predetermined goal, such as reducing their electricity consumption by 20%.

A summary of the Osbaldiston & Schott typology is presented in Table 1.

Table 1: The Osbaldiston & Schott typology

Convenience	Information	Monitoring	Social-Psychological Processes*
Making it easy	Justifications	Feedback	Social modelling
Prompts	Instructions	Rewards	Cognitive dissonance
			Commitment
			Goal setting

Box 4: An online “applet” linked to social networking sites

The programme: StepGreen.org is an online “applet” that can be linked to an individual’s profile page on MySpace or Facebook. Through this applet, users can view and commit to suggested energy saving actions and report on having fulfilled an action. The applet keeps track of the amount of CO₂ the user saves. Reminders of unfulfilled commitments, progress made and further actions are sent as “news feed”. A cartoon of a polar bear population on the user’s profile page will thrive or collapse depending on the user’s actions or inactions.

The applet is designed to encourage environmental actions through public commitment. A user’s commitments and progress can be viewed by friends of the user (those who can see the user’s profile page).

The outcome: A small-scale deployment of this applet, in which 32 participants were observed for three weeks, was reported in Mankoff et al. (2010). The participants viewed detailed information for “about 16 actions”, committed to “about 16” and reported completing 88% of their commitments one or more times.

The policy implications: The scale of the study was small, so it is not possible to draw generalised policy lessons from it. In particular, one of the most powerful features of online social applets – the potential for viral spread – could not be evaluated.

2.2 Mapping the interventions

Table 2 below provides an overview of the type of interventions identified in the studies reviewed, the outcome indicators measured, and the timescales considered. Most often, the interventions examined relied on multiple mechanisms to encourage behaviour change.

Type of interventions

The most common intervention was **information** provision (employed in 40 out of 48 interventions), followed by those focusing on **social-psychological processes** (34 interventions) and **monitoring** (31 interventions). Only four interventions focused on improving **convenience** – the low representation of this last category is largely due to the exclusion of studies looking solely at the impact of one-off purchases from the current review.

Some 20 of the programmes combined information, monitoring and social-psychological processes. More specifically, at the lower-level classification, 17 combined **instructions**, **feedback** and **social modelling** mechanisms to motivate behaviour change.

Outcome indicators

The studies reviewed used one of two indicators to examine changes in behaviour: changes in aggregated energy usage (e.g. change in kilowatt-hours of gas or electricity consumed) or specific behaviour change (e.g. turning lights off when

leaving a room). Just 10 studies looked at both measures, while 17 only examined changes in energy consumption, and the remaining 22 only considered specific behaviour change.

Countries

The majority of the studies were undertaken in the US (n=20). In second place is the UK (n=8), followed by the Netherlands (n=4), Sweden (n=3) and Australia (n=3). Canada, Denmark, France, Spain and Malaysia are among the other countries that had either one or two interventions analysed.

Table 2. Mapping of intervention types

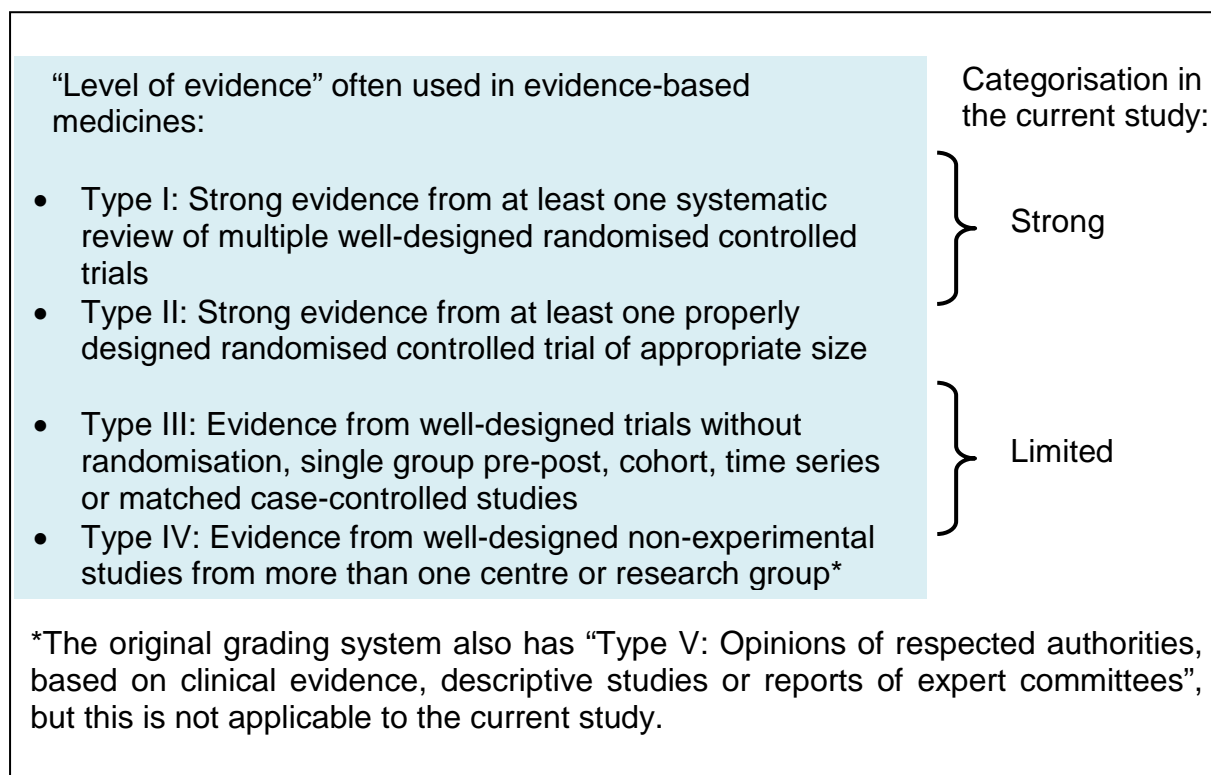
	Intervention											Indicators		Evaluation methods			Country
	Convenience		Information		Monitoring		Social-psychological processes				Other	Observed (o) or self-reported (s)		randomised controlled trial of appropriate size	well-designed trials (not randomised) or single group pre-post	non-experimental	
	Making it easy	Prompts	Justifications	Instructions	Feedback	Rewards	Social modelling	Cognitive dissonance	Commitment	Goal setting	Other	aggregate energy use	behaviour specific				
Total by 4 main category	4		40		31		34				6	27	33	9	20	12	
Total by 10 sub-type	3	3	8	38	26	6	27	4	12	6							
Abrahamse et al. (2007) Energy Analysis												s	s		✓		Netherlands
Allcott (2011) Evaluation of Opower studies												o	s	✓			US
Ayres et al. (2009) Puget Sound Energy												o		✓			US
Ayres et al. (2009) SMUD												o		✓			US
BC Hydro (2011) BC Hydro Power Smart												o			✓		Canada
Benders et al. (2006) Energy Analysis												s	s		✓		Netherlands
Bertrand et al. (2011) Lose your excuse													s		✓		US
Borrell & Lane (2009) Kildonan UnitingCare											w	o			✓		Australia
Brook Lyndhurst & Ecometrica (2011) Scottish CCF													s			✓	UK
Carlsson-Kanyama et al. (2007) Women vs. men													s			✓	Sweden
Carroll & Berger (2008) Colorado													s		✓		US
Carroll & Berger (2008) Niagara Mohawk											w	o			✓		US
Carroll & Berger (2008) Ohio Electric Partnership													s		✓		US
Carroll & Berger (2008) Ohio Weatherization											w		s		✓		US
Carroll & Berger (2008) Low Income													s				US
Cooney (2011) Opower SMUD Pilot Year 2												o		✓			US
Costa & Kahn (2010) Nudges and ideology												o		✓			US
Dolan & Metcalfe (2010) Better Neighbours												o		✓			UK
EEPH (2005) Domestic energy advice													s			✓	UK
Feenstra (2009) The Green Energy Train												s	s		✓		Netherlands
Flahaut et al. (2001) Commitment theory													s		✓		France
Fornuto (2011) Western Mass Saves												o		✓			US
GAP (2008) EcoTeams UK (I)												s	s		✓		UK
Gibb (2011) Seattle City Light												o		✓			US
Gram-Hanssen & Gudbjerg (2006) Standby													s		✓		Denmark
Gram-Hanssen et al. (2007) Energy labels													s			✓	Denmark & Belgium
Gustafsson & Bång (2009) The Power Agent											c	o			✓		Sweden
Harding & McNamara (2011) CUB Energy Saver												o			✓		US
Kurz et al. (2005) Attunement labels													s		✓		Australia
Lockwood & Platt (2009) Green Streets UK											w, c	s	s		✓		UK
Mankoff et al., (2010) StepGreen.org												s	s		✓		US
McMakin et al. (2002) Military installations												s	s		✓		US
Mendham et al. (2010) The Energymark Trial											c		s		✓		Australia
Merziger et al. (2010) Energy Neighbourhoods											c		s		✓		Europe-wide
Mustafa (2010) Energy Efficiency in Malaysia												s	s		✓		Malaysia
Navigant Consulting (2011) Massachusetts												o		✓			US
Nolan et al. (2008) The San Marco study												o		✓			US
Nye & Burgess (2008) EcoTeams UK (II)													s		✓		UK
Nyrud et al. (2008) Woodstoves											w		s		✓		Norway
Palm (2010) Energy consultants													s		✓		Sweden
Peschiera et al. (2010) The response-relapse study												o			✓		US
Robinson, S. (2009) Manchester Is My Planet													s		✓		UK
Staats et al. (2004) EcoTeams Netherlands												s	s		✓		Netherlands
Union Fenosa (2007) Energy Efficiency Index													s		✓		Spain
Valuntiené (2009) Taupukas residential awareness													s		✓		Lithuania
Ward et al. (2011) Transition Streets													s		✓		UK
Schultz et al. (2007) San Marco experiment												o		✓			US
Wortmann et al. (2003) Off. Really off?													s		✓		Germany

Note: Other interventions included: insulation and draught-proofing, or other major one-off purchases, indicated by the letter “w”; and competitions, indicated by the letter “c”.

2.3 Assessing the evidence

The findings presented in this report must be interpreted with respect to the strength of the evidence base. The quantity of studies that support the finding as well as the quality of the evaluation methods have both been taken into account. In doing so, a strategy was used that broadly follows the guidelines for conducting systematic reviews, which originated in evidence-based medicine¹⁵ but which have become increasingly common in environmental conservation (see Figure 1).¹⁶

Figure 1: Assessing the evidence: strong vs. limited¹⁶



This framework places an emphasis on robust randomised controlled trials. These are often considered the “gold standard” in evaluation methods, and there has been an increasing interest in their application to assess the impact of policy interventions. The Cabinet Office Behavioural Insights Team recently published a paper “Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials” that advocates their wider use.¹⁷

Nevertheless, there are also important insights to be gained from what is categorised within the framework as more limited evidence: for example, qualitative research can provide useful insights into how and why certain approaches are successful or not successful. Qualitative research aims to provide an in-depth understanding of people’s experiences, perspectives and histories in the context of their personal circumstances or settings. However, qualitative research methods tend to be sensitive to the social context and the researcher’s perspective¹⁸⁻¹⁹ and therefore the robustness and generalisability of their findings can be particularly difficult to substantiate. For this review, qualitative studies have been included in the analysis, and the strength of evidence from them has been discussed clearly and transparently.

The evaluation designs of included studies are summarised in Table 2 (on page 21). It indicates whether the evaluations were undertaken through randomised controlled trials, trials with comparison groups, or were non-experimental studies. For example, in the review paper by Allcott in 2011,²⁰ the author undertook a meta-analysis of seven Home Energy Report programmes implemented across the US by a company named Opower, all of which were evaluated using randomised controlled trials (RCTs) and had large sample sizes. The findings were drawn from 600,000 treatment and control households, and therefore evidence based on this study is considered “strong”.

Eight further interventions included in Table 2 were evaluated through RCTs.²¹⁻²⁷ They are the same type of Home Energy Report studies that were covered in Allcott’s review.* The findings based on these studies are also considered “strong”.

About half the studies reviewed (n=24) were not RCTs, but are considered to be well-designed trials, i.e. non-randomised studies with treatment and control groups or single group pre-post studies. A further 13 were qualitative, non-experimental studies.

All 49 interventions are analysed in detail by theme in the next chapter. Descriptions of each of the programmes reviewed are provided in Appendix A.

* Allcott (2011) did not disclose the names or locations of the programmes examined and potentially these could overlap with these eight individual RCT studies. Nonetheless, our interpretations would not be affected. The findings based on these studies will still be considered strong according to the strong vs. limited categorisation described in Figure 1.

Chapter 3 – What does the evidence say?

This chapter provides a detailed analysis of how the interventions introduced in Chapter 2 inform the question “What works in changing energy-using behaviours in the home?”. A number of sub-questions are examined:

- To what extent were energy savings achieved through the interventions?
- What kinds of behaviour change underlie the energy savings?
- How do behaviour change outcomes vary between different groups?
- Which of these interventions led to durable behaviour change?
- What were the contextual factors that contributed to the outcomes of the interventions?
- What is the evidence on the cost effectiveness of the different types of interventions?

Throughout the chapter, the evidence from the reviewed literature is identified as strong, limited or weak, using the principles previously described in Section 2.3.

3.1 To what extent were energy savings achieved through the interventions?

Key points:

A series of well-designed studies provide strong evidence that:

Large population-level programmes such as Home Energy Reports typically generate relatively small, but consistent, savings in the region of 1–3% of household energy use.

Slightly larger savings can be achieved through the use of online rather than postal energy reports; however, it is unclear whether this is a result of the difference in messaging medium or the self-selection of those opting to receive online reports.

Larger household savings, in the region of 8–10%, are achievable with more intensive community based interventions.

The studies reporting the largest energy reductions of over 20% incorporated investments in new technology as part of the package of interventions. This is not to say that the savings were wholly attributable to these investments, as additional reductions in energy usage were observed when education or feedback were provided alongside such investments. In one programme, the scale of savings from changes in habitual behaviour was observed to be 10%, similar to those achieved in community-based interventions.

Table 3: Energy saved by intervention

Short name	Intervention											Percent of energy saved, on average			notes		
	Convenience		Information		Monitoring		Sociopsychological processes					electricity	natural gas	mixed fuels			
	Making it easy	Prompts	Justifications	Instructions	Feedback	Rewards	Social modelling	Cognitive dissonance	Commitment	Goal setting	Other						
Abrahamse et al. (2007) Energy Analysis														8.3%			
Allcott (2011) Evaluation of Opower studies														2.0%			ranges from 1.4–3.3%
Ayres et al. (2009) Puget Sound Energy														1.2%			electricity and gas
Ayres et al. (2009) SMUD														2.1%			
BC Hydro (2011) BC Hydro Power Smart																	reduced 208 kWh per household on average
Benders et al. (2006) Energy Analysis														6.0%			gas, electricity and other fuels
Bertrand et al. (2011) Lose your excuse																	% unknown
Borrell & Lane (2009) Kildonan UnitingCare												w		26%			savings on other fuels not captured
Brook Lyndhurst & Econometrica (2011) Scottish CCF																	advice was found not to be effective ¹
Carlsson-Kanyama et al. (2007) Women vs. men																	% unknown
Carroll and Berger (2008) Colorado																	% unknown
Carroll and Berger (2008) Niagara Mohawk												w		26%			maximum via weatherproofing and education ²
Carroll and Berger (2008) Ohio Electric Partnership																	% unknown
Carroll and Berger (2008) Ohio Weatherization												w		21%			maximum via weatherproofing and education ³
Carroll and Berger (2008) Low Income																	% unknown
Cooney (2011) Opower SMUD Pilot Year 2														2.9%			
Costa & Kahn (2010) Nudges and ideology														2.1%			
Dolan & Metcalfe (2010) Better Neighbours														9%			
EEPH (2005) Domestic energy advice																	1,971 kWh energy saved per household
Feenstra (2009) The Green Energy Train																	% unknown
Flahaut et al. (2001) Commitment theory																	% unknown
Fornuto (2011) Western Mass Saves														4%			for customers engaging online ⁴
GAP (2008) EcoTeams UK (I)														7%			in electricity, primarily in heating
Gibb (2011) Seattle City Light														4%			after 3 years, initial reduction was 2–3%
Gram-Hanssen & Gudbjerg (2006) Standby																	% unknown
Gram-Hanssen et al. (2007) Energy labels																	% unknown
Gustafsson & Bång (2009) The Power Agent												c		0%			34% during the game, but 0% change in the following 8 months
Harding & McNamara (2011) CUB Energy Saver														6%			for customers engaging online ⁴
Kurz et al. (2005) Attunement labels																	% unknown
Lockwood and Platt (2009) Green Streets UK												w, c		15%	25%		
Mankoff et al., (2010) SepGreen.org																	% unknown
McMakin et al. (2002) Military installations														7%	3%		for one of the sites (Fort Lewis)
Mendham et al. (2010) The Energymark Trial												c					% unknown
Merziger et al. (2010) Energy Neighbourhoods												c		11%			
Mustafa (2010) Energy Efficiency in Malaysia																	% unknown
Navigant Consulting (2011) Massachusetts																	% unknown
Nolan et al. (2008) The San Marco study														0%			non-significant difference between treatment and control after 3 months
Nye & Burgess (2008) EcoTeams UK (II)														7%			
Nyrud et al. (2008) Woodstoves												w					% unknown
Palm (2010) Energy consultants														10%			average for 10 households
Peschiera et al. (2010) The response-relapse study																	% unknown
Robinson, S. (2009) Manchester Is My Planet																	95.2% of pledgers said that they took actions
Staats et al. (2004) EcoTeams Netherlands														8%	17%		
Union Fenosa (2007) Energy Efficiency Index																	% unknown
Valuniené (2009) Taupukas residential awareness																	% unknown
Ward et al. (2011) Transition Streets																	% unknown
Schultz et al. (2007) San Marco experiment																	% unknown
Wortmann et al. (2003) Off. Really off?																	% unknown

Note 1: Brook Lyndhurst & Econometrica found effective energy use interventions were linked to the use of energy monitors with clear instructions, by showing where energy could be saved and the amount of savings.

Advice was indicated not to be very effective. The problem appeared to be that the advice was not tailored in any useful way. Interviews with participants revealed that they were already carrying out many (if not all) of the recommended actions, and therefore dismissed the advice.

Note 2: In the Niagara Mohawk programme, Carroll & Berger suggested that households that were offered insulation and draught-proofing combined with education decreased gas usage by 26%. This was the same if feedback is also provided. Participants only given insulation and draught-proofing decreased gas usage by 16%. The control group increased gas usage by 2% (therefore maximum overall gas savings might be considered to be 28%).

Note 3: In the Ohio Weatherization Assistance Programme, Carroll & Berger found a statistically significant difference in gas savings for households with a insulation/draught-proofing and education intervention (21%) versus insulation/draught-proofing only (15%).

Note 4: Lower savings were identified for those who engaged by direct mail.

An overview on size of savings

Information on the percentage of energy saved was available from 23 programmes (see Table 3). Where possible, the savings from electricity and gas are reported separately. This distinction is important as the carbon factor for electricity is more than double that of gas in the UK.²⁸

Overall, across the studies within this review, a large range of annual energy use reduction is observed, from 0–26% in overall energy use (mix of gas and electricity). However, care must be taken when interpreting these findings.

Large savings, over 20% in overall energy use (mix of gas and electricity), were only possible when insulation and draught-proofing or replacement of appliances were part of a package (n=4) alongside an intervention designed to change habitual energy use.²⁹⁻³¹ These are discussed in more detail in a later section of this chapter looking at bundles of interventions.

The EcoTeams programme³² (presented in Box 5) was able to encourage fairly large savings (8% from electricity and 17% from gas) without providing insulation, draught-proofing or replacement of appliances. It achieved this through a mix of information provision, monitoring and social-psychological processes. Participants in this programme tended to be already interested in environmental issues, so it is unlikely this high level of saving would be achieved if the programme was rolled out more widely.

In a similar programme, the Energy Neighbourhoods competition (described in Box 6) was able to encourage, on average, energy savings of 11% (mix of gas and electricity) through focusing on behaviour change alone.³³

Box 5: The EcoTeams programme in the UK

The programme: EcoTeams has been run by the not-for-profit organisation Global Action Plan internationally since the 1990s. The initiative reached the United Kingdom in 2000. It aims to promote durable change in household waste and energy use behaviour.

The programme uses a team-based approach. It brings together small groups of about four to ten neighbours and friends to engage in facilitated discussions about environmental behaviour in the household, covering topics relating to energy and water consumption as well as waste management and transport.

Small groups are led by a group leader, and meet once a month for about eight months to discuss the six themes introduced in the workbook they use as a basis for action and discussion. The group setting enables members to discuss personal experiences and receive feedback and advice.

Participants weigh their rubbish and recycling and monitor their energy use over the course of the programme.

The outcomes: By 2012, over 4,000 UK households had participated in this programme. In an evaluation of the programme by Nye & Burgess, 49 in-depth interviews were undertaken with current and former EcoTeams participants from the South East and Midlands regions in the UK. Interview data were supplemented by data collected in four workshops with approximately 40 EcoTeams participants and quantitative data from a survey of EcoTeams participants conducted by Global Action Plan. The average change in electricity usage, for a sample of 58 EcoTeams participants across the UK, was 7%. Interviewees reported a range of changed behaviours that came about directly from the group discussions and the process of weighing and measuring. They also reported an increased willingness to “do more green things” or undertake current routines in greener ways.

The policy implications: Nye & Burgess’s analysis suggests that two important behavioural mechanisms operate within the programme: (i) group dynamics: social support and pressure, and the diffusion of new green knowledge through team members; and (ii) feedback: weighing and measuring household rubbish, recycling, and energy use.

Box 6: Energy Neighbourhoods in nine European countries

The programme: The Energy Neighbourhoods programme aimed to encourage communities to achieve energy savings through changes in behaviour. The programme was marketed as “a bet between the municipality and the community”. To win the “bet”, participants had to reduce their energy consumption by 8% over a six-month period. Participants were coached by national project coordinators, municipality officials and trained volunteers (the “Energy Masters”) throughout the programme. Winners were awarded with energy saving packages (including fleece blankets, light bulbs, or vouchers for organic stores), with the best savers from each participating country offered a trip to an International Award Ceremony in Brussels.

The Energy Neighbourhood programme grew from an initiative in Belgium to an international competition involving eight other European countries (Bulgaria, France, Germany, Ireland, Italy, Spain, Sweden and the United Kingdom).

The outcomes: About 600 “Energy Neighbourhoods” of 8 to 12 households each participated. Of these, about 60% of the participants were able to achieve 8% or more energy savings in six months. Overall, the participants achieved an average energy saving of 11% (mix of gas and electricity).

The policy implications: In the Energy Neighbourhoods report, the authors suggest that simple and cost-effective measures such as using energy saving bulbs, disabling standby devices or switching off the lights when not needed can make a difference. The experience is consistent with that from other team-based programmes such as EcoTeams.

A fairly large overall energy saving of 10% was achieved through the Energy Hunt Programme in Sweden, in which detailed home energy audits were provided by energy consultants.³⁴ Most of this 10% was due to behavioural changes, as all of the major home improvement measures suggested in the project were seen as expensive by the households and they either rejected or postponed the investment to later. However, since this finding is based on a sample of 10 households, caution should be exercised in placing too high an emphasis on it.

A significant number of the studies reviewed looked at the provision of Home Energy Reports (which use a combination of information provision, monitoring and social-psychological processes, see Box 7).²⁰ These typically produced only small energy reductions, approximately 1–3% of electricity use; however, there were some notable exceptions:

- In an energy efficiency pilot program created by the Citizen Utility Board of Illinois, Harding & McNamara observed a 1.5% electricity consumption reduction for mailer-only participants, but a 6% reduction for online participants.³⁵ Similarly, in the Western Mass Saves programme, Fornuto found a 1–2% annual reduction in electricity usage for households receiving the report by direct mail, but a 4.2% reduction for online participants.²³ The question that this evidence naturally raises is whether the higher impact of online information provision is due to the media

through which the information is communicated (online being more immediate and delivered to an electronic device rather than a letter) or whether it is due to the self-selected sample that chose to receive the online communication and engaged more actively. Whilst Harding & McNamara hypothesised a self-selection effect, the design did not allow a definitive explanation of the cause of the observed differences in energy reduction.

- In the first ever natural field experiment on the effect of social norms and information in the UK, researchers Dolan & Metcalfe observed a 9% saving in natural gas consumption.³⁶ The experiment was largely similar to the Home Energy Reports studies run by Opower in the US (see Box 7),²⁰ designed to examine the effect of social norms and information provision. Dolan & Metcalfe offered a range of hypotheses to explain the large difference between this 9% and the 2% found in the Opower studies, but the study design does not allow the hypotheses regarding the cause of this higher-than-anticipated reduction to be fully tested.

³⁶ Dolan & Metcalfe suggested five potential reasons for the difference. First, the participants were typically poor, living in social housing where the tenant rents the property from the council or a private landlord. Second, the experiment was undertaken in a new cultural context (the UK, not the US). Third, the “home energy report style” information was presented on the actual energy statement from the energy provider, while Opower’s were sent separately. Fourth, the Dolan & Metcalfe home energy report design is slightly different from the one used by Opower. For instance, they do not use the most energy efficient neighbours on the statement, and do not place any other information on the front page apart from the norm. Fifth, the households that participated did not have real-time displays of gas consumption, so they did not receive immediate feedback from any changes in behaviour. Dolan & Metcalfe suggested that it may be possible that some uncertainties in the outcome of the behaviour change encouraged more actions (rather than the optimal number of actions).

Box 7: Home Energy Reports in the US

The programme: The US company Opower, which often partners with utility companies, sends Home Energy Reports to households, to give them feedback on past energy use, compare their usage to neighbours, and provide energy saving tips.

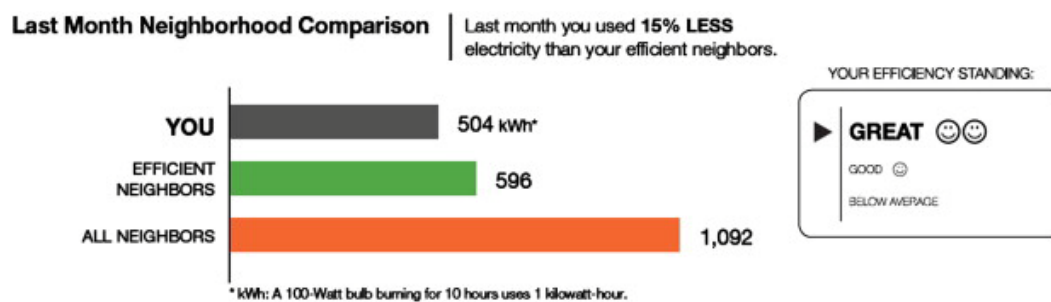
Home Energy Reports are simply multipage letters, comprising two main components: the Social Comparison Module and the Action Steps Module. The Social Comparison Module (see Figure 2) is presented at the top of the letter's first page, showing the electricity consumption of the household, alongside the average of all neighbours (approximately 100 nearby homes with similar physical characteristics) as well as efficient neighbours (those in the bottom 20th percentile of electricity usage). It also shows the “injunctive norm” by categorizing the household as “Great,” “Good,” or “Below Average”.

On a separate page it presents the Action Steps Module, providing tips for saving energy, ranked by level of effort, investment and potential monetary savings (quick fixes, smart purchases, and great investment). The tips provided are targeted to the household through an analysis of the household’s historical energy use patterns and demographic characteristics.

The outcomes: Allcott analysed data from large-scale randomised natural field experiments (with 600,000 treatment and control households across the United States), and estimated that the average programme reduces electricity consumption by 2.0%.

The policy implications: Allcott’s analysis provides strong evidence that simply sending letters to households (to give households feedback on past energy use, compare their usage to neighbours, and provide energy saving tips) can nudge them to reduce energy use in the home.

Figure 2: The Social Comparison Module in Opower’s Home Energy Reports



Source: Allcott’s 2011 review of Home Energy Reports²⁰

Understanding the effects of specific interventions within bundles of measures

Although the interventions examined in this report were almost always applied in combinations, a couple of studies tested the effect that an intervention had in isolation, or when applied as an extension to an existing bundle of measures.

The evaluation of the Niagara Mohawk programme, by Carroll & Berger, looked at the impact that behavioural interventions might have when applied in combination with a one-off purchase (in this case installation of insulation or draught-proofing).³⁰ This evaluation had an experimental design that compared a control group with:

- an insulation/draught-proofing-only group;
- an insulation/draught-proofing and education group;
- and an insulation/draught-proofing, education and gas heating feedback device group.

It was observed that insulation/draught-proofing alone could reduce average gas use by 16%. When insulation/draught-proofing was combined with education (in this case, the provision of three two-hour in-home education sessions), the average gas saving was increased to 26% (i.e. education resulted in an additional 10% saving). However, the provision of a gas heating feedback device in addition to insulation/draught-proofing and education made no additional impact over and above this 26%. It may be that the feedback in this study was ineffective in producing additional reductions in energy use because the education element had already achieved the maximum savings through changing the behaviours that might have otherwise been influenced through feedback. However the design of the study did not provide insight into this.

Peschiera and colleagues undertook a study of students in accommodation at the Columbia University campus, in which they examined the effectiveness of providing different sorts of information on electricity usage.³⁷ They found that while individual feedback alone did not result in a significant reduction in electricity use, a significant change was achieved in the groups where this individual feedback was combined with comparative information on the consumption of neighbours and peers. The approach here is similar to the Opower Home Energy Reports, where information on the usage of peers is used alongside personal consumption feedback to encourage reflection and reappraisal of personal (or more accurately, household) energy usage. Essentially, Peschiera and colleague's work reinforces Alcott's findings that social modelling in the form of comparative feedback works to reduce energy use.

3.2 What kinds of behaviour change underlie the energy savings?

Key points:

This review finds strong evidence that:

The most common behaviours taken up across the different interventions were: turning off lights or replacing traditional light bulbs with energy efficient light bulbs; reducing standby consumption and turning off

appliances; and changes in water use. This finding is consistent with research on other pro-environmental behaviours (e.g. recycling and waste food) that finds that people find it much easier to take up behaviours that do not cost much and can be done without any impact on lifestyle.³⁸

The scale of potential change can be limited by the extent to which households participating in programmes have already adopted some of the targeted behaviours prior to joining. This also points to an important issue that many programmes have issues of self-selection bias. This needs consideration if programmes are to be rolled out more widely. A self-selection bias may, on the one hand, lead to an overstatement of the behaviour changes that may be expected from a programme, because pro-environment individuals participating are more engaged than would be expected in the wider population. On the other hand, the fact that the pro-environment participants may have already adopted some of the targeted behaviours prior to joining a programme could mean that studies show a lower impact than what the programme might achieve if applied to less energy conscious individuals.

To date there seems to be weak evidence to support the attribution of savings to specific actions:

There are significant practical challenges in linking energy savings with specific behaviour changes (e.g. estimating the amount of energy saved by reducing use of standby devices). There is scope for errors in reporting levels of usage and/or compliance, and for errors in assumptions about the levels of savings that certain actions will deliver across a variety of real world contexts. Whilst the current evidence is weak, this missing link would seem to be an important area to explore further if future policies are to target specific levels of reduction from specific actions.

The interventions identified in this review target different areas of behaviour in order to achieve energy savings in the home. Of the 48 programmes or trials covered, 25 reported aggregated energy savings only and did not describe the behaviour change that led to the energy savings. Thirty programmes or trials reported changes in behaviour (see Table 2); however, only 14 of those 30 studies provided detail on the specific type of behaviour that changed as a result of the intervention.

The types of behaviour change reported in these 14 studies includes:

- the use of lighting (e.g. switching off lights or using energy efficient light bulbs) , reported in 12 studies; ^{4, 25, 30-32, 35, 39-42}
- the use of heating (e.g. turning down space heating), reported in 11 studies; ^{4, 30-32, 35, 39-43} and
- the reduction of standby consumption or switching off appliances, reported in 10 studies. ^{25, 30-32, 35, 39-42, 44-45}

Table 4 below summarises types of behaviour change by study.

Table 4: Distribution of studies looking at behaviour change, by the type of usage

	Lighting	Heating	Water use	Laundry	Dishwashing	Refrigeration	Convenience cooking	Cooking	Reducing standby, or switching off appliances	Other*
Abrahamse et al. (2007) Energy Analysis										
BC Hydro (2011) BC Hydro Power Smart										
Benders et al. (2006) Energy Analysis										
Carroll & Berger (2008) Colorado										
Carroll & Berger (2008) Low income										
Flauhaut et al. (2001) Commitment theory										
GAP (2008) EcoTeams UK (I)										
Gram-Hanssen & Gudbjerg (2006) Standby										
Harding & McNamara (2011) CUB Energy Saver										
Lockwood & Platt (2009) Green Streets UK										
Navigant Consulting (2011) Massachusetts										
Nye & Burgess (2008) EcoTeams UK (II)										
Ward et al. (2011) Transition Streets										
Wortmann et al. (2003) Off. Really off?										

*Other includes: switching off coffee machine, not filling up the kettle, putting a cover on saucepans

Seven studies reported on the relative popularity or frequency of uptake of specific behaviours. In almost all of these studies, the most popular behaviour changes reported concerned the use of lighting, standby consumption and water use:

- Turning off lights or replacing traditional light bulbs with energy efficient light bulbs^{32, 35, 39, 41-42, 46}
- Reducing standby consumption and turning off appliances^{4, 32, 35, 39, 41-42}
- Changes in water use,^{32, 39, 41-42, 46} in two cases specifically by reducing the length of showers.^{39, 46}

An intervention that used labels to prompt householders to take specific actions is discussed in more detail in Box 8.⁴⁶

Box 8: Attunement labels in Australia

The programme: A field experiment in Australia, reported by Kurz et al. (2005), tested the effect on residential water and energy consumption of three intervention strategies: information leaflets, 'attunement labels', and socially comparative feedback sheets by mail. The discussion in this box focuses on the attunement labels, since this strategy was not explored in other programmes covered in the current review and was found to be the only effective strategy out of the three evaluated.

Attunement labels were given to participants to be installed around their home and garden, e.g. for refrigerators, air conditioners, showers, washing machines, clothes dryers, dishwashers, toilets, and outdoor water taps. The labels were designed to attune residents to the environmental impact of using the appliance in question and suggest actions that could be undertaken to reduce this impact. Additionally, labels for the shower were fitted with a small waterproof digital clock to enable residents to monitor the amount of time spent showering.

Some 166 households, all of which volunteered to participate, were monitored for a period of 6 months.

The outcomes: The programme led to a 23% reduction in water consumption, but no significant reductions in energy consumption were observed. The top three actions (by all participants including the control and treatment groups) were: using less water in the garden (86%); not leaving lights on (67%); and reducing shower time (62%).

The policy implications: Intervening at the point of consumption, when householders interact with appliances or the relevant physical environment, can have an impact, at least in the case of water consumption. However, the application of attunement labels to modifying behaviours involved in energy consumption was not found to be effective. The authors make the case that this is likely to be due to a heightened awareness of water consumption at the time of the study, and the fact that water is a visible resource that can be "seen" during consumption. This would suggest that technologies that make energy consumption more visible, e.g. real-time energy consumption displays, could play an important role as enablers for other behaviour change interventions.

Heating did not emerge as a preferred area for change among the participants in the studies reviewed. However, there were a few studies indicating some changes that did take place with regards to heating: lowering the thermostat,^{39, 4} putting on an extra jumper³² and turning the air conditioning temperature setting slightly warmer.³⁵

For some behaviours, the low take-up rates can be explained by the fact that they had already been adopted by the participants before joining the programmes. For example, the evaluation of the Transition Streets programme in the UK (see Box 2) suggested this was the case for behaviours related to doing laundry (washing with

full loads and at low temperature, and wearing clothes for longer between washes).⁴

It is clear from the studies reviewed that linking energy savings to specific behaviour changes is challenging. One study, *Energy conscious behaviour saves money* by the Energy Efficiency Partnership for Homes (EEPH) in the UK, sought to do this. This study asked participants to report how their behaviour changed (whether they turned off lights, turned down heating and so on), and used this to estimate likely energy savings. This was compared to the savings from fuel bills reported by the participants themselves.⁴⁷ The results show that the calculations from stated behaviour changes *on average* aligned well with self-reported savings through fuel bills. However, the report shows that the calculations greatly underestimated the achieved savings from lighting (by approximately two and a half times) but greatly overestimated the savings from heating and cooking (by approximately two to three times).⁴⁷ It should be noted, though, that the report provides the caveat that the sample sizes were small. It is also not clear from the report whether the discrepancies are due to errors in the reporting of levels of usage and/or compliance, or whether they are due to the assumptions made about the achievable savings for given behavioural changes. Further analysis is beyond the scope of this review, but this issue should be explored more fully before strong conclusions can be drawn.

3.3 How do behaviour change outcomes vary between different groups?

Key points:

This review finds strong evidence that:

Households that use more energy have higher potential to save. Evidence indicates that within the programmes reviewed they do save more (in both percentage and absolute terms). This suggests that targeting high energy consumption groups could make behaviour change programmes more cost effective.

To date there seems to be weak evidence on the responses of different income groups:

There is limited, and conflicting, empirical evidence on how household income level might impact on willingness and feasibility of behaviour change in energy use in the home. However, it is clear that there are barriers that need to be considered if seeking to formulate policies that target lower income groups. There is also scope for households to respond by reducing their energy usage to a level that is below minimum acceptable standards of comfort, which may be an unintended consequence of an intervention.

The scope for unintended consequences is further highlighted by the evidence that within some US interventions the provision of data relating to social norms results in some groups responding adversely and increasing

their energy consumption.

The previous sections have shown wide variations in the savings achieved by different interventions. This section assesses whether variation in household characteristics may be an explanatory factor.

Variation by level of energy consumption

The series of randomised controlled trial (RCT) evaluations conducted by Opower found that the high energy consumption group made larger reductions in energy consumption after receiving Home Energy Reports than other groups. Those in the highest decile* of pre-treatment consumption decreased usage by 6.3%, whereas those in the lowest decile of pre-treatment decreased usage by only 0.3%. The authors explained that this may be because they had more existing wasteful habits to cut back. However, this finding was confounded by the fact that in some of the trials Home Energy Reports were mailed to the high energy consumption group more frequently.²⁰ Nevertheless, the observation that the higher energy-using group saves more (both in absolute terms and in percentage terms) is important, as the implication is that targeting high energy consumption groups could make a behaviour change programme more cost effective.

However, it should be noted that this finding comes from only one series of interventions using comparative feedback and instructions. There is no evidence to prove or disprove whether the observation will hold true for other types of interventions.

Variation by household income

The literature reviewed does not provide strong evidence quantifying differences in the effectiveness of behaviour change interventions according to the income of those targeted. However, it does highlight a number of aspects that could be taken into account when targeting policies at people with low incomes.

On the behavioural response of low-income households, Carroll & Berger identified that many low-income households already practice energy saving behaviours.³⁰ They also suggested that low-income households are willing to take additional actions to save money, despite the fact that the action might reduce their level of comfort.

However, in evaluating an energy audit programme targeting those with energy-related financial hardship in Australia, Borrell & Lane identified that there are a number of specific barriers that low-income households face in changing their domestic energy consumption.²⁹ These include systemic factors (such as rental status), poor quality housing and energy inefficient appliances, household composition and characteristics (such as large families, illness, disability and the

* Allcott's model has controlled for other factors such as month-by-year effects and household characteristics.

presence of babies and the elderly), local climate and living in a rural area (especially if not connected to gas and/or needing to pump water).

Programmes that seek to influence energy consumption within lower-income groups may therefore need to consider both the barriers that may need to be overcome and the potential for unintended consequences.

Variation by household composition

There is relatively little evidence on how the effectiveness of behaviour change interventions varies by household types. One dimension that studies do identify is the challenge of achieving energy reductions amongst teenage users.

Gram-Hanssen & Gudbjerg undertook a study focusing on standby consumption.⁴⁴ They found that whilst the provision of instructions and technological solutions led to reductions in many households, the standby consumption in households with older children tended to be more resistant to change. In discussing this, the authors cited their other studies, which showed that teenagers consume more electricity than adults⁴⁸ and suggested that this is a result of the social pressure (from peers and from parents) to keep up-to-date in terms of the possession and use of electronics.⁴⁹ They identified that there were also practical issues for these groups in making reductions in standby usage, as many of the devices being used were interconnected but were often not physically located in the same location within the house. This meant that turning these devices off could be inconvenient, which acted as a deterrent to change.

One of the interventions identified in this review's literature search specifically targeted teenagers through a competition administered in the form of a mobile phone-based game (see Box 9).⁵⁰ This study found that this age group made significant changes in their consumption and were able to engage others in their households to agree to some quite extreme energy-saving tactics (described below) to win the game. The resulting behaviour changes were, however, only short-term.

Box 9: Power Agent, a mobile phone-based game in Sweden

The programme: Power Agent is a mobile phone-based game designed to encourage teenagers and their families to reduce energy consumption in the home. Each teenager is an ‘agent’ with the mission to save energy. The agent has to join forces with his/her household members as well as a few other agents/households in the same city, to compete against a team (of real people) in a different city.

The mobile phone game interface presents an animated cartoon character – Mr. Q, the agent’s boss – who announces the energy saving missions, offers clues about specific energy saving actions, and provides feedback to the players. Feedback includes actual usage information collected through the energy company’s automatic meter equipment, compared against the opposing team, as well as voice ‘encouragement and praise’ from Mr. Q.

The outcomes: The evaluation of this game involved only six teenagers and families over a 10-day period in two cities in Sweden. The evaluation reported that extreme tactics were used by the players, including: turning off all the lights in the house and using candles for illumination; using wood for heating the home and water; ordering pizza instead of cooking at home.

The players were able to reduce their electricity usage by up to 34% during the game. However, post game monitoring revealed that their average consumption in the eight weeks after the game was no different from before (a -0.2% difference was observed, which effectively meant no change).

The policy implications: Given the small number of participants (six households) and short observation period (10 days), it is not possible to draw firm policy lessons from this particular study. Nevertheless, the extreme tactics employed by the players of the game, that were clearly non-durable behavioural changes, indicate the potential problems of the short-term impacts of competitions.

Variation by political ideology

A study by two US researchers, Costa & Kahn,⁵¹ found that the effectiveness of Home Energy Reports depended on an individual’s political ideology. By linking data from Opower to voter registry data in California, they were able to identify different behavioural responses to the intervention between “liberals” and “conservatives”.^{*} Specifically, they found that:

- A liberal household that pays for electricity from renewable sources, donates to environmental groups and lives in a liberal neighbourhood reduced its electricity consumption by 3%.

^{*} The American understanding of these terms applies here. In particular, Costa & Kahn define the terms as follows: “liberals” refers to those registered voters who are affiliated with Democrat, Green, or Peace and Freedom, whereas “conservatives” refers to those who are affiliated with Republican, American Party, and Libertarian.

- A conservative household that does not pay for electricity from renewable sources, does not donate to environmental groups, and lives in a conservative neighbour *increased* its electricity consumption by 1%.

While this finding is interesting, it is unlikely that it can be transferred to the UK context. It does, however, highlight that there can be variation in the effectiveness of interventions when applied to different population groups – and that there are some groups that may respond adversely to behavioural interventions. This again highlights the need to consider the potential for unintended consequences.

3.4 Which of these interventions led to durable behaviour change?

Key points:

This review finds strong evidence that:

Home Energy Reports lead to durable energy reductions over periods of up to 29 months. The evaluations have not looked beyond this period, so it is difficult to judge whether the reductions could be sustained for longer. However, it is likely that both household composition changes and evolutions in technology would lead to the consumption patterns fundamentally changing anyway over longer periods.

Community-based interventions can also produce durable changes, with an evaluation of EcoTeams showing persisting (or improving) reductions in consumption over a period of two years. Some of the qualitative evidence suggests that the reductions in consumption can themselves become habitual.

There is weaker evidence as to which interventions do not produce durable changes:

Studies involving competitions show that whilst these can produce quite marked short-term reductions in consumption these reductions do not always prove durable. One study showed an erosion of the reductions three months after the competition, and previous reviews also identified further evidence of the short-lived effects of rewards. This calls into question the longer-term benefits of a whole segment of intervention strategies, although more evidence would be required to draw a firm conclusion on this.

A key question for this review is not only which interventions result in changed behaviour immediately, but what types of intervention contribute to changes that are durable. Five studies examined this issue specifically.

Studies that suggested durable changes

Two studies monitored energy use up to two years from the start of the intervention:

- In his evaluation of a 3-year pilot study of Opower's Home Energy Reports in Sacramento, Cooney reviewed the savings achieved by the programme over a 29-month period. The analysis indicated that for the high consumption households that were receiving monthly reports, the average percent savings in electricity levelled off at 10–12 months and remained fairly constant after that.²² In contrast, the low consumption households that were receiving quarterly reports continued to increase their electricity reductions over the 29-month period. As noted in Section 3.3, the reductions made by the high consumption households were larger (both in absolute and percentage terms), and it is possible that the lower consumption group, with less frequent reports, was taking longer to reach its saturation levels. It should be noted that the Home Energy Reports continued to be issued over the whole evaluation period. In both cases there was no evidence of a reversion to higher energy consumption over the 29-month period of the evaluation.
- In the evaluation of the EcoTeams programme in the Netherlands, Staats and colleagues found that reduction in gas and electricity consumption persisted over a two-year observation period following the end of the EcoTeams intervention.⁵² Self-reported data suggest that these reductions were associated with a range of changed behaviours. Of the 38 household behaviours monitored, 19 were changed during the programme. All of these were either sustained or improved after two years. Of the changed behaviours, 17 were habitual (e.g. setting thermostat to a lower temperature) and three were one-off (e.g. installing a low-flow showerhead). Unchanged behaviours tended to be expensive to address (e.g. having double-glazed windows or external wall insulation installed).

The sustained behaviours observed in the EcoTeams case reiterates the point made earlier in Section 3.2 that people tend to take up behaviours that are low cost; but the evidence suggests that these easier to adopt behaviours are also the ones that are most durable.

The quantitative findings from EcoTeams in the Netherlands were consistent with those from EcoTeams in the UK by Nye & Burgess.⁴² Some 49 participants were interviewed after the programme, and *all* of them indicated that in the future they intended to practice *all* of the green activities that they had taken up as a result of the programme. There has not been an evaluation to review whether the individuals carried through with their stated intentions. Below are examples of what the respondents said in the interviews:

...I found it quite, err, what's the word, not inspirational but motivating to actually try different things.... It all came together to help me find a way to help us do things in a more conservative way, in a more green way in the home.

...The point is the environment is one of the things that comes in my head when I make choices, so it's very much important so it, it goes all the way throughout my life I guess.

The quotations above illustrate the two key drivers of durable change suggested by Nye & Burgess:

- An increased willingness to try out new green activities or to perform old activities in greener ways.
- A more “joined up” way of thinking about the environmental impacts of a lifestyle and the eco-practicalities of everyday living.

Similarly, in the evaluation of Green Streets UK (see Box 10),³¹ most participants responded positively when asked whether they would sustain the greener behaviour after the competition:

I think we will actually sustain the change in habits, I think they have become, over the last four or five months, it's become almost second nature to say, 'right, we're not going to leave that on' and that has been our change in attitude, in terms that, we are energy usage aware now – Southampton

Oh yeah because you just get used to doing it, as I say, you get to where you're pointing it out to other people – Manchester

I think once you've trained yourself I don't think you can forget as much. It's everyday.... It just becomes second nature – Manchester

Another reason why the energy savings driven by Green Streets were judged to be likely to persist was that the programme involved upfront investment in improving the efficiency in the home. The core savings from such one-off investments are by definition durable, even if any behavioural changes that might be predicated upon them decline over time.

Box 10: Green Streets in the UK

The programme: Green Streets was a community- (street-) based competition, run by British Gas. It was unique in that it featured a prize of £50,000 for the winning street. Additionally, at the start of the project, £30,000 of energy savings and renewable energy measures (e.g. solar photovoltaic panels or solar heating) were offered to participating streets.

Some 63 households from 8 cities participated (London, Manchester, Southampton, Edinburgh, Cardiff, Birmingham, Plymouth and Leeds).

The outcomes: All streets significantly reduced their average energy use during the year-long competition. The energy (gas and electricity) consumption reduction varied greatly across the streets, ranging from 15% in London to almost 35% in Leeds. Most streets were in the range of 22–27%.

When examining reduction in energy use by fuel type, more savings can be observed in gas than in electricity (25% in gas compared to 15% in electricity).

The policy implications: The success in driving behaviour change was attributed to three programme elements: (i) energy advisers who not only provided 'locally available, house specific and face-to-face' advice, but also helped participants to sort out any teething problems related to new installation of appliances, insulation or other energy saving measures; (ii) hand-held electricity meters issued as part of the intervention were perceived as 'novel' by participants and had motivated behaviour change by making energy use visible; and (iii) the competition element encouraged peer pressure and mutual support to promote energy-efficient behaviours. However, it should be noted that not all of the savings would have been attributable to behavioural elements of the programme, as some would have been down to the infrastructure purchased through the initial grants.

Studies that suggested no durable changes

In contrast to the above evidence, in a study of two community programmes in Malaysia,⁵³ the effect of the intervention was eroded after three months. The intervention in this case was implemented as a competition. Winners were judged based on their electricity consumption as well as energy-efficient behaviours at home, and were rewarded with a plaque and energy-efficient appliances at the end of the programme.

This finding is similar to that of the Power Agent competition discussed earlier in Box 9. That evaluation found that some quite radical behavioural changes were adopted to bring about reductions in energy usage during the competition, but that these were not sustained beyond the conclusion of the competition.

There is also support of this finding from some earlier reviews of the evidence. Abrahamse's 2005 review of previous studies concluded that rewards are effective in encouraging energy conservation, but that the effect tends to be short-lived.⁵⁴

3.5 What were the contextual factors that contributed to the outcomes of the interventions?

Key points:

This review finds “limited” evidence regarding some of the contextual factors influencing programme success:

Motivations for participation in programmes varied, but financial considerations were reported as playing a significant role in several studies. One of the studies reviewed also suggested that there could be threshold effects and that a minimum level of saving was required before individuals would consider changing their behaviours.

Altruistic and environmental concerns play a significant role in motivating some participants. It is clear that the same motivations do not apply to all individuals and that a variety of different messages might be employed to appeal to different segments of the population.

Two studies noted that the dispersed physical location of energy-using devices within the home can create barriers to reducing consumption. This suggests that technologies that help to centralise the control of devices could reduce such barriers and lead to an increased willingness to change what may inadvertently have become habitual behaviours.

The individuals involved in implementing an intervention, their leadership skills and expertise, as well as the structure for the intervention itself, was found to have an effect on the scale of change that occurs.

There are cases where the practical constraints around implementing a programme reduced the potential impact that might have been anticipated. For example, approaches seeking to provide group feedback may encounter time-lags between the behaviour and the feedback provided, which then impacts on the scope of the feedback to lead to behavioural change. This challenge is likely to limit the number of participants that practically can be involved in each implementation of a group-based programme (although scale can clearly be achieved through multiple implementations).

There is weaker evidence around the role of socio-demographics in programme participation and energy reduction:

This is an area where future evaluations of programmes could usefully collect more data to allow a fuller analysis of differences to be undertaken. Until such evidence is available it is difficult to make judgements about whether there may be certain programme types that lead to inequitable outcomes.

The interventions designed to influence energy-saving behaviours in the home are complex: not only are different interventions often implemented in combination (e.g. social comparative feedback is often used alongside instructions), but these interventions are implemented in very different geographical areas, on varying timescales and by different actors.

A wide range of factors was considered in this section: from individual motivations and attitudes, socio-demographic, cultural and material factors to programme implementation. The evidence across these different factors is discussed in turn.

Individual motivations and attitudes

Motivations for taking up behaviours were often described as complex: most often individuals cited a combination of environmental, economic, well-being and aesthetic concerns that led them to take up (or not take up) energy-saving behaviours. Of the intervention evaluations, 15 examined how individual beliefs and motivations impacted on the nature and scale of the behaviour change outcomes.

Saving money was a common motivation to take part in an intervention or change behaviour once within a programme. For example, in the Green Streets report the authors quote two cases where participants joined the programme because of financial motivations:³¹

Both financially and environmentally and let's be honest if you're going to get people involved financial will come before the environmental, and if you can get both together you're onto a winner – Southampton

We wanted a free boiler, to be honest... We thought it'd be good for the kids to get involved and, you know, appreciate the fact that what it costs and what can be saved – Birmingham

A Swedish study that looked at the introduction of direct billing of the energy used for heating and hot water for each occupant, rather than the historic pooling of costs between tenants within a shared building, suggests that using economic instruments can be a strong motivational factor for change.⁵⁵ It was also identified that there were threshold effects and that the scale of the savings achievable had to be sufficient to motivate the change in behaviours (in this case €200–300/year).

Most often individual motivations for changing behaviour were explored through qualitative studies. These suggest participants tend to be concerned with both environmental and economic factors. Three studies indicated that most if not all respondents identified altruistic and environmental concerns to be part of the reason they took up changes in behaviour.^{4, 56-57} A well-designed trial of the Transition Streets project in Totnes arrived at a similar finding. It was found that the primary motivations for participating were building good relationships with neighbours and reducing personal environmental impact, whilst financial concerns were secondary.⁴

Qualitative studies also indicated some of the factors that might contribute to a reluctance to take up new behaviours. In particular, respondents identified that subjective views on aesthetics were reasons for not taking up or sustaining behaviour change. For example, in a study involving energy counsellors in Sweden, the authors found that many of the measures suggested were not implemented due to design or aesthetic grounds, since the participants judged that the changes would look out of place in their homes.³⁴ This finding was corroborated by an in-depth qualitative study by Crosbie & Baker* into compact fluorescent light bulbs, in which they identified that barriers to adoption included aesthetics, style and the quality of light produced by these bulbs.⁵⁸

Socio-demographic factors

A few studies attempted to explore how behaviour change might be affected by participants' socio-demographic characteristics but they do not provide robust evidence. The effect of socio-demographic characteristics on behaviour change remains unclear.

Bertrand and colleagues, in their evaluation of the "Lose Your Excuse" public service advertising campaign targeted at 8–12 year olds, used multivariate analysis to reveal correlations between self-reported energy efficiency behaviours and socio-demographic factors. They found that being older (11–12 rather than 8–10), being non-white and a having a predilection "to act rather than think" about saving energy to be positively associated with taking action to save energy.⁵⁹

A second study that attempted to investigate the impact of socio-demographic factors was an observational study of a program implemented in Provence-Alpes-Côte d'Azur, France, in which participants were asked to commit to a number of energy-saving acts. The analysis, when comparing age groups of under 30 year olds, 31-50 and those over 51, found that age had no effect on outcomes.⁴¹ The authors also report that socio-economic level had weak effects (although it seems likely that this study of 73 households was underpowered to detect statistically significant changes).

This is an area where the evidence is weaker than one might have expected. It is therefore suggested that future evaluations of programmes should seek to collect more comprehensive data on socio-demographic factors to allow a fuller understanding of differences in response between population groups. Without such analysis it is difficult to draw any conclusions on whether there may be equity implications for any behavioural change programme.

Cultural factors

Very few studies explored how cultural norms influence behaviour change. However, isolated studies drawing on a mix of survey data and data from semi-structured interviews with participants indicate that wider cultural norms, as well as local neighbourhood and family norms can influence people's willingness to take up

* This study was not included as part of the core evidence base, as it did not examine a behaviour change in the context of an intervention. However, it is mentioned here because it provides insights into the relationship between aesthetics and habitual energy use.

particular behaviours, both positively and negatively. For example, in Sweden one study consisting of semi-structured interviews with participants indicated it was common cultural practice not to close blinds or curtains at night.⁵⁵ The same study found that at the household level, men and women would negotiate energy-saving behaviours in the household. Two other studies found that people were motivated to take up behaviours to build good relationships or gain approval from their neighbours, friends or relatives.^{4, 60}

Material factors

None of the randomised controlled trials in the evidence base examined how the physical constraints of domestic properties might influence behaviour change. However, the review identified one study in which the physical layout of the home appeared to influence the behavioural response observed. In the case of EcoTeams in Sweden it was found that households were less likely to take more onerous actions. In this case many of the participants were living in apartments in shared buildings where temperature settings were controlled centrally. This necessitated individual adjustment of each radiator if an apartment's occupant wished to make daily adjustments. This was identified as too time consuming.⁵⁵ The physical layout of the energy-using technology in the home therefore acted as a barrier to reducing consumption. It is interesting to note that this may be a case where a relatively small financial investment in accessible controls might have led to an increased willingness to embrace energy-saving behaviours and change habitual patterns in usage.

As noted in Section 3.3, Gram-Hanssen and colleagues, in their study of standby consumption, also identified that the physical layout of energy-using devices (in their case information technology devices) also presented constraints on the practicality of taking energy saving actions.⁴⁴ They found that there were issues of inconvenience related to turning off interconnected devices located in different rooms within the house and that this also acted as a barrier to change.

Programme implementation

To understand the effectiveness of an intervention it is crucial to know if it was actually implemented as planned. Such detail is difficult to establish from experimental studies. However, process evaluations can be useful in explaining why interventions do or do not realise anticipated outcomes.

Very few studies were identified that focused on how implementation affected outcomes. The few studies considering this highlight how the individuals involved, and their capabilities, influence what can be achieved through an intervention. For example, neighbourhood participation in EcoTeams campaigns seemed to vary depending on the skills and qualities of the leadership.⁵⁵ Also, staff who provided active and targeted engagement with households seemed to be better able to build trust and rapport with household members, which in turn seemed to deepen the level of household engagement in the intervention.⁵⁷ Finally, other characteristics around implementation, namely, the existence of shared values, meeting structures, and individual expertise, were noted to affect the realisation of outcomes of an intervention involving community meetings and workshops.⁴

One study whose results may have been affected by implementation was described by Abrahamse and colleagues.³⁹ It involved an experiment using an Internet tool to encourage households to use less energy (see **Box 11**). The study aimed to test the hypothesis that households who received a group goal and group feedback would save more direct and indirect energy, and would adopt more energy-related behaviours, than households who only received an individual goal and individual feedback. Whilst instructions, feedback and goal setting were found to be effective in changing energy-using behaviours, there was no significant difference in the effect of group goals vs individual goals. The study concluded that might in part be explained by the fact that group feedback took longer to gather and collate, which led to delays and time-lags, which might have impacted on behaviour change.

Box 11: Abrahamse's group goals vs individual goals experiment in the Netherlands

The programme: Abrahamse's experiment involved a range of intervention types (justifications, instructions, feedback and goal setting), two different experimental groups and one control group. Households in the two experimental groups were given (i) information about energy-related problems and the need for actions (i.e. justifications), (ii) a list of energy-saving measures that was tailored to the household according to the answers they gave in the pre-intervention questionnaire (i.e. instructions) and (iii) feedback on their energy consumption through the project website. Households in one of the experimental groups were then asked to try to save 5% energy (gas or electricity) during the course of the study (5 months) as an individual participant, whereas households in the other experimental group were told the aim was to save 5% energy as a group (i.e. individual goals vs group goals). Households were free to choose which energy saving measures they would take up to achieve the goal.

The outcomes: The final sample consisted of 189 households. Those exposed to the combination of interventions used 5.1% less energy, while households in the control group used 0.7% more energy. No difference could be observed between the individual goal group and the group goal group.

The policy implications: This experiment suggested that group goals and group feedback did not offer any additional effect on energy savings. The authors explained that a major issue with group feedback was that it could only be provided after all participants had filled out the questionnaire, and that the resulting time-lag in providing feedback reduced the effectiveness of the intervention.

One study that looked in detail at how programme implementation had affected outcomes is the Green Energy Train Programme in The Hague, Netherlands.⁶¹ The Green Energy Train project took place between September 2001 and May 2003 and targeted 228 households in eight apartment blocks. It was initially intended to use the renovation of the apartment blocks as a "moment of change" to educate and inform the inhabitants about energy savings and reduce their energy use. However, during implementation, the renovation was delayed so the education

campaign was not synchronised with the moment of change. This contributed to the eventual failure of the programme. Another problem identified was that the education and information materials – which were based on the philosophy of “Leve Energie” (“Live Energy”) that builds upon the energy in the five elements (earth, water, fire, air and ether) and the four different levels of energy within these elements (individual body, in house, direct environment, rest of the world) – were regarded as “too philosophical” by the target group. While not discussed explicitly by the author of the evaluation, it is very likely that the poor landlord-renter relationship reported may have also contributed to the programme failure.

3.6 What is the evidence on the cost effectiveness of the different types of interventions?

Key points:

This review finds strong evidence that:

Measuring cost effectiveness was not considered as a primary objective for any of the evaluations of the experimental studies reviewed.

When calculated, the cost of saving a kilowatt-hour from providing Home Energy Reports and from an advertising campaign in Germany is in the same order of magnitude (approximately three US or Euro cents per kilowatt-hour).

This review finds some “limited” evidence regarding the effectiveness of competitions:

Information on cost effectiveness gathered through qualitative evaluations suggests the cost of saving a tonne of CO₂ by running a competition with cash prizes could be extremely expensive.

There are, however, complications in calculating both the costs and the benefits, especially in cases where the prize within the competition is new technology that could itself reduce energy consumption.

It should also be noted that cost effectiveness calculations will be sensitive to any assumptions that may be made about the sustainability of changes. Evidence presented earlier in this review suggests that some interventions appear to have durable effects, and calculations undertaken only over the life of a programme intervention may therefore underestimate its true cost effectiveness.

Information on cost effectiveness is only available from four studies/interventions. Among these, the way that cost-effectiveness is conceptualised and calculated varies considerably.

A few of the experimental studies attempted to provide some indication of cost effectiveness. In the series of studies that examine the use of Home Energy

Reports, the indicator used is the “administrative cost effectiveness metric” – the unit cost of the Home Energy Reports divided by kilowatt-hours saved per year (estimated to be 3.31 cents per kilowatt-hour saved per year).²⁰ Allcott examined the impact of frequency of billing on energy saving and found that more frequent mailing gives more saving, but does not offset the increased annualised cost. It was concluded that infrequent billing (e.g. every quarter) was most cost effective (for the utility company who provides the Home Energy Reports). However, it should be noted that the “administrative cost effectiveness metric” offers a rather narrow view of cost effectiveness, as it does not consider wider welfare effects (benefits from carbon emissions reduction, individuals’ “warm glow” of contributing to the public good, etc.).

Another study, also consisting of an experimentally designed evaluation, that sought to identify the energy savings and costs associated with an advertising campaign, was the “Off. Really Off?” campaign to reduce standby consumption in Schleswig-Holstein, Germany (see Box 12).⁴⁵ It was estimated that the campaign led to an energy saving of 26 million kilowatt-hours in the region, while the total costs amounted to 890,000 Euros. The division of these values gives a per kilowatt-hour cost of 3.4 cents (in Euros). To put this in context, the author of the study indicated that the per kilowatt-hour cost is in the same order of magnitude as the electricity production costs.

Box 12: Off. Really Off? An advertising campaign in Germany

The programme: The Off. Really Off? campaign in Schleswig-Holstein was an advertising campaign that aimed to reduce standby consumption by electric appliances and electronic equipment in households and offices. A range of mass communication outlets was used, including cinema and radio spots, newspaper advertisements, brochures as part of point-of-sale material and a website. Throughout the campaign, humour was used to appeal to the audience.

The evaluators of the campaign reached out to both customers and retailers, who were interviewed by phone before the launch of the campaign, at the peak of the advertising pressure and one year after.

The outcomes: Self-reported responses from consumers indicated a substantial increase in the percentage of people who used the master switch to turn off the television, from 49% before the campaign to 57% during the campaign and 58% one year after the campaign. Also, self-reported responses from retailers indicated a substantial increase in the percentage of retailers who included energy efficient devices in their assortment of goods, from 68% before the campaign to 81% during the campaign to 76% one year after the campaign. Other effects were also observed, including enhanced energy awareness and interest in standby consumption and ways to reduce it.

The policy implications: The potential benefits of an advertising campaign can be maximised when retailers (not just consumers) are involved. The effect of such campaigns on behaviours can be long lasting.

In Transition Streets, a UK study about community engagement, it was found that the cost of running and delivering the underlying project (excluding the Transition Streets funding that related just to administering the grants) was around £75 per household, while the authors estimate that 1.3 tonnes of CO₂ per household was saved (i.e. the project cost approximately £58 for each tonne of CO₂ saved). This study used both survey data and face-to-face interviews to triangulate findings.⁴

The final study to measure cost effectiveness was the Green Streets evaluation in the UK (See Box 10), which relied on information gathered through face-to-face interviews.³¹ The programme evaluation document did not report cost effectiveness. But a calculation of cost effectiveness can be undertaken based on the size of the prizes (£30,000 for each of the eight streets participating, plus a £50,000 prize for the winning team). This means the programme cost at least £290,000, excluding other costs (e.g. marketing, hiring energy advisors, infrared photographs). It was reported that the amount of CO₂ saved was 88.66 tonnes over the one-year period. Hence, the cost effectiveness can be calculated as £3270 per tonne of CO₂ saved (although this value may fall if the CO₂ savings in future years are considered). Caution is needed in interpreting this finding, as the primary aim of the evaluation was to identify behaviour change, not cost effectiveness.

To make some basic comparisons, the figures from the four studies have been converted to the same unit, pence per kWh saved per year. It should be cautioned that a number of assumptions* are used in the conversion so these figures should not be treated as precise values, but only as an indication of the order of magnitude.

Home Energy Reports:	2p/kWh saved per year
Off. Really Off?:	3p/kWh saved per year
Transition Streets:	3p/kWh saved per year
Green Streets:	162p/kWh saved (not annualised)

Based on a back-of-the-envelope calculation, the first three programmes above are similar in terms of their cost effectiveness. However, the fourth programme is comparatively expensive (over 50 times higher than the rest).

A fairer comparison would be to use an annualised value for Green Streets. However, annualising the saving would involve making many assumptions about which one-off energy efficient measures were implemented from any investment made by the Green Street participants, and their associated lifetime savings. It should, however, be noted that the difference in cost observed is so large that

* Our goal was to provide a sense of the order of magnitude. To that end, a number of simplifying assumptions were used. Since all of these programmes took place in recent years, the issue of price year is ignored. For the Home Energy Reports and the Off. Really Off? campaign, we performed only currency conversions (1 USD = 0.64 GBP and 1 EUR = 0.78 GBP, as of July 2012). For Green Streets and Transition Streets, to convert from £ per tonne CO₂ saved to p per kWh, we used a factor of 0.49677 kg CO₂ per kWh, according to Defra guidelines.

annualising the value would be unlikely to change the conclusion that the Green Streets programme is a lot less cost effective than the three other programmes for which relevant information is available.

The cost effectiveness of all of these studies will be sensitive to any assumptions made about the sustainability of changes. The values presented above are conservative in that they assume that the behaviours do not extend beyond the length of the intervention evaluation period. However, there is evidence (see Section 3.4) that some interventions appear to have durable effects (at least within the two-year window examined in studies to date). These calculations may therefore underestimate the true cost effectiveness of the programmes.

Chapter 4 – Strength of evidence and conclusions

In this chapter, key points from the Rapid Evidence Assessment are identified and their implications for policymaking in the UK are discussed. The findings are organized by the strength of underpinning evidence: the chapter first examines the key points from the most robust studies, followed by a discussion of areas where there were few studies, or where the studies relied on non-experimental methods. It concludes with some general recommendations on how to improve the evidence base to inform policymaking in the UK.

4.1 Key findings from experimental studies

While the evidence base on interventions to influence habitual energy behaviours in the home is small, several studies were found that directly considered the effectiveness of such interventions using randomised controlled trials (see Section 2.4 for a description of the relevant studies). Such studies control for a wide range of variables, compare treatment and control groups, and are able to arrive at very specific findings that assess the significance of associations between variables and outcomes. Given the robustness of these methods, and the studies' attempts to control for a wide range of individual, interventional and contextual variables, it is possible to confidently provide the following conclusions:

Key point #1: Behaviour change programmes based on routine reporting of comparative consumption information and energy efficiency advice have led to consistent reductions in energy use in the home.

The evaluations of the Opower Home Energy Reports (containing comparative consumption information and energy efficiency advice) confirm that their provision consistently leads to a reduction in energy use attributable to the reports of approximately 2%.

Given that the effect is quite small per household, for this intervention to make an impact at the country level, the key would be to engage a large number of households in making this 2% reduction.

Whilst the majority of the evidence on these reports comes from the US, there has been a recent application in the UK. In this experiment, Dolan & Metcalfe observed a 9% saving in natural gas consumption.³⁶ At this time it is not clear why this local implementation achieved significantly larger savings than Opower's reports in the US.

Key point #2: Baseline consumption or pre-intervention behaviours and household characteristics have been shown to influence the level of savings that can be achieved.

Studies specifically controlling for baseline energy consumption levels find that the largest percentage energy savings with the provision of Home Energy Reports occurs for households with above average energy consumption levels. Additionally, understanding what behaviours households have already taken up is also important for targeting the behaviours appropriately and identifying the scope for change.

This suggests that to maximise the cost effectiveness of a programme in the delivery of carbon reduction or energy efficiency goals, it could be useful to target households with high energy use who are not yet engaged in many energy saving behaviours.

Key point #3: How an intervention is structured and implemented affects the level of savings per household. The evidence shows that interventions tend to result in higher levels of savings when they include tailored instructions or comparative feedback.

Across the evidence base, the greatest savings were found to result from interventions incorporating tailored instructions and feedback.^{32, 34} Within specific studies, testing for the effect of the specific feature of the intervention showed significantly higher energy reduction if information was provided online versus through a mailout.^{23, 35} The explanation for this difference remains uncertain: is it the type of individuals more likely to engage in online interventions that results in greater savings; is it an attraction of the novelty of automated feedback; or is it the nature of the information itself? To most accurately design interventions to maximise per household savings, further well-designed qualitative research to look into the reasons why these results were achieved would be desirable. However, in the short term the evidence would seem to suggest that if a postal-based energy report programme were to be developed, it would be desirable to also offer an online option for those that wished to receive the information in this way, on the basis that the evidence shows that with some groups this can lead to greater energy savings.

4.2 Key findings from non-experimental studies

Non-randomised trials and non-experimental studies were also included in the analysis in order to be as comprehensive as possible in identifying topically relevant studies. Such studies tended not to attempt to provide evidence of impact, but rather explore the processes and outcomes of very specific interventions and communities. As such, the studies and their evaluations tended to be quite context-specific, making it difficult to extrapolate wider findings on the effectiveness of interventions more generally to contribute to change.

These studies are particularly useful in informing hypotheses about why particular interventions are effective. For example, what are the reasons that individuals might be more responsive to personalised feedback? Is it due to how the interventions are structured? Is it to do with individual motivations? Or, is it linked to

the type of people who are willing to participate? Also, what information must be included in order that recipients perceive the feedback to be suitably tailored? Here, indicative findings are presented from this more diverse, and context-specific evidence base, focusing on potential hypotheses, as well as potential fruitful avenues for further research.

Key point #4: Team-based approaches, which use peer support (and pressure) as a way to encourage changes in behaviour, have led to energy savings and behaviour change in a number of programmes.

Team-based approaches, supported by strong and engaged leadership and staff, appear to be an avenue for achieving behaviour change at community levels. Examples identified in the literature show these approaches can deliver energy savings on the order of 8–10%.

In some cases, these interventions involved competition between neighbours and neighbourhoods, and in others, the focus was more on cooperative community initiatives. A shared understanding between community group members, and strong leadership, were noted to affect the success of an intervention. While further experimental study could help identify the actual energy savings occurring as a result of these, the process evaluations undertaken to date indicate that investing in the establishment of cohesive community groups, and in the capabilities and skills of leaders, can help ensure that the intervention is implemented and taken up as anticipated.

However, it is not obvious that it is feasible to undertake a widespread implementation of programmes that by design are hard to scale up, since such programmes require trained personnel to provide tailored instructions and coaching to each individual household and/or neighbourhood. It is also not clear if the effectiveness of the intervention would hold up when most peers are also being targeted.

Taken alongside the conclusion in Key Point #2, a promising area for investigation may be whether these team-based approaches are transferable to targeting households with high existing energy usage (taking in to account any potential equity issues). This is not to say that such households should be singled out as being wasteful, since in many cases they may have intrinsically higher energy requirements. But the evidence to date suggests that on average it is possible to make larger savings when working with these households. Team-based programmes with these households would require piloting to ascertain the extent to which such programmes are transferable.

Key point #5: There is not one single motivating factor that drives individuals to take up energy-saving behaviours. Multiple motivational drivers such as financial considerations, environmental concerns, competitiveness, cooperation, conformity and altruism come into play. There are also barriers that prevent or limit changes in behaviour (e.g. comfort, aesthetics and the physical layout of homes). Interventions therefore need to be targeted in different ways for different groups.

Understanding the considerations made when individuals decide whether or not to participate in energy-saving interventions can be useful in designing effective policies and strategies for their communication and dissemination. The evidence reviewed revealed that financial considerations, environmental concerns and altruism all play a role in motivating people to participate. However, there are also cases where concerns about comfort and household aesthetics were cited as reasons not to do so.

Studies also identified that in some circumstances the physical layout of homes and the dispersed physical location of energy-using devices within the home can create barriers to reducing consumption through the lack of ease in accessing the devices. This suggests that technologies that help to centralise the control of devices (e.g. putting a thermostat in an accessible location) could reduce these barriers and lead to an increased willingness to change what may have inadvertently become habitual behaviours.

Taking into account the comforts that particular populations are accustomed to or expect, and the structure of the housing that they inhabit, seems to be an important way to maximise the likely uptake of the interventions. This, in combination with the differences in motivating factors, links back to why tailored information is crucial.

Key point #6: Some, but not all, behaviour change programmes lead to durable energy reductions. The evidence from well-designed evaluations of Home Energy Reports and team-based interventions has shown that energy reductions can be sustained over periods of two years or more. Whilst competitions can raise awareness and lead to large (sometimes radical) short-term changes, the quality of evidence on their durability is significantly weaker than that of Home Energy Reports and team-based interventions.

The evidence relating to Home Energy Reports is compelling as it derives from a long-term evaluation of a sizeable sample (20,000 to 30,000 households in both the treatment and control arms of the study). It establishes that by providing ongoing periodic reports it was possible to sustain, and in some cases increase, the level of household energy reductions over a 29-month evaluation period.

Similar results are reported from the evaluation of EcoTeams, which reported that over a two-year period there were persisting, and again in some cases increasing, reductions in consumption.

The quality of evidence for durability of changes is a lot weaker for interventions that are predicated on a competition model. There is an emerging trend across some of the studies, whose evaluations have assessed durability, that whilst they can produce quite marked short-term reductions in consumption these may not prove durable. This calls into question the benefits of a whole segment of intervention strategies, although more evidence would be required to draw firmer conclusions on this. Whilst these programmes may raise awareness, it is unclear at present whether they lead to long-term behaviour change and in several studies there are reports of behaviours and consumption reverting to pre-intervention levels at the end of the competition. This would suggest that care may be necessary in

setting up programmes utilising a competition model, and that they may be better used as awareness-raising tools rather than behavioural change interventions.

Key point #7: The evidence shows that the adoption of new technology and one-off modifications can act as a stimulus for changing habitual behaviours.

Whilst the primary focus of this review has been habitual behaviours, it is notable that it has identified literature in which changes have occurred alongside one-off purchases. The US example of insulation/draught-proofing demonstrates that the provision of education at such moments of change can lead to more significant energy savings than would be achieved through one-off investment in lower-energy technologies. In this case the scale of the additional return attributable to providing additional education at the time of insulation/draught-proofing was similar to that of the community-based interventions undertaken in other studies, and significantly higher than that obtained from Home Energy Reports.

This suggests that there may be opportunities for encouraging behavioural changes through interventions that are triggered by the adoption of new technologies or one-off investments.

One study identified that, underlying the observed energy reductions, a range of frequently repeated (as opposed to one-off) behaviours had been taken up and sustained. While this finding is encouraging, it revealed the missed opportunity that behaviours that are easy to sustain (notably, one-off home improvements) are less commonly taken up because of the high associated cost.

4.3 Gaps in the evidence base

Gap #1: There is little evidence linking specific changes in behaviour to quantified energy savings. As a result, whilst this review provides evidence on the overall effectiveness of some interventions, it cannot provide robust evidence on the scale of impact from changing individual areas of behaviour. More evidence linking behaviours to usage would allow better targeting of future interventions.

Few studies have sought to directly link savings to specific behaviour changes and have instead focused on the overall savings achieved from a bundle of changed behaviours (often in response to a bundle of interventions). This aggregation in the reporting of savings is driven largely by the instruments available to measure the changes within households participating in the programmes. There would seem to be an opportunity to improve knowledge regarding the impact that different actions may have once home instrumentation develops further, and this information could prove useful in better targeting the actions that deliver the larger returns.

Gap #2: There is little evidence on how different socio-demographic groups respond to different interventions. Typically studies have not been designed in a way that gives insight into this. They have either had small sample sizes that would not allow judgements to be made on whether differences are statistically significant, or have not collected the data necessary to undertake the analysis.

The evidence on any differences in response by different socio-demographic groups is very limited and the findings that there are on differences across income groups are conflicting. There are, however, barriers that are identified and the literature does show that in some cases there can be unintended consequences from interventions. This raises the question as to whether some interventions may impact adversely on equity. However, until evidence is available, this will remain an unanswerable question.

Gap #3: There is limited evidence on the differences in effectiveness of interventions in gas vs. electricity use.

Many studies have not reported gas and electricity savings separately. The few that did have observed larger percentage saving in gas consumption than in electricity consumption; however, there will be different contextual issues in studies drawn from different countries. There is a need to recognise the distinction and for greater precision in the reporting of future studies.

Gap #4: None of the studies has explicitly tested the effect of messengers on the effectiveness of interventions. However, the contrast between studies that have used messages communicated by peers and those where the information has been provided by a government body or utility company suggests that the messenger employed within a programme could have an important role.

Indirect evidence from the interventions analysed suggests that messages communicated by peers tend to be viewed more favourably by participating households than direct top-down interventions implemented by policymakers or utility companies and can produce larger savings. It is, of course, difficult in the evidence to separate the multiple factors that differ between the small number of programmes available for evaluation and review. It is therefore not clear whether it is the messenger that leads to the differences in savings achieved, the level of personalisation available in the advice, the peer support mechanism, or some other aspect. However, it does seem that those programmes that involve personal interactions lead to larger savings.

Gap #5: There is little information available on the cost effectiveness of interventions, and that which exists is based upon a range of very broad assumptions. Future programmes should be encouraged to collect the data necessary to evaluate their cost effectiveness.

In a small number of studies the evaluations have sought to calculate the cost effectiveness of the programme. However, the type of measurement and units vary considerably and are subjected to a number of caveats. The calculations are also sensitive to the assumptions made; for example, the period over which the behaviour changes are sustained. Programmes should be encouraged, or supported, to better report both the costs of implementation and the levels of savings achieved by those targeted by the intervention. Such data will then allow fuller and more robust cost-effectiveness calculations to help inform what works and how maximum impact can be gained from limited resources.

4.4 Final conclusions

Recommendations for further research

A number of knowledge gaps in the evidence base are set out in section 4.3 above. Some of these could be addressed through further research, e.g. the role of messengers in influencing the success of programmes.

However, other areas, such as the collection of data to explore the impacts on different socio-demographic groups or data to allow calculations of cost effectiveness, should be considered when an intervention is designed.

It should also be noted that existing evidence from other policy areas provides some useful pointers about what can work in changing people's behaviour. Whilst beyond the remit of this review, there is a growing body of evidence from a range of other sectors that highlights the circumstances in which behavioural change measures appear to work and where they have been less successful. Rather than investing in large amounts of additional basic research, a case could be made for setting up pilot programmes with basic, but well-designed, evaluation arms to assess the transferability of the evidence identified from other geographic or sector contexts.

Some of the areas that a well-designed evaluation should consider are:

1. **How to demonstrate that changes in energy use that have occurred can be attributed to the intervention rather than some other change that has not been monitored?** The use of well designed experimental trials with control groups is powerful in showing how energy use has changed independent of the intervention, be that through seasonal fluctuation, responses to changes in energy prices or some other external influence.
2. **Who is targeted by the intervention?** Many previous studies have relied on self-selecting samples, which introduces selection bias and makes it hard to generalise findings. This can be overcome by putting in place some simple sampling strategies that seek to obtain samples that are representative of the populations that the policy or intervention is ultimately seeking to influence. The nature of these will differ between interventions and depend on what they are seeking to achieve, but the issue of who will be included in the evaluation is important and needs careful consideration.
3. **What was the level and variability of energy use prior to the intervention?** In order to calculate changes without resorting to employing strong and challengeable assumptions, it is desirable to measure baseline use for those individuals that will be subject to the intervention.
4. **How to measure the change in energy use?** Some of the studies reviewed have relied on self-reported consumption, this is far from ideal. It is preferable to have independent measurement of actual use.
5. **Are there differences in effectiveness or impact for different socio-economic groups?** Energy reduction in and of itself cannot be the only

consideration in developing policy instruments; it is also necessary to consider whether there are equity impacts. It is therefore desirable to design studies that allow the response of different socio-economic groups to be contrasted. Even if equity is not a direct consideration, tailoring approaches to the characteristics of specific groups can improve the overall response. This requires sufficient participants from the groups of interest and the recording of information that allows the participants to be classified for analysis in any datasets produced.

6. **Are the energy reductions observed durable?** Evaluations should run beyond the time period of the direct intervention to allow an assessment of whether the changes that individuals make are sustained over periods of time, or whether energy use reverts back to pre-intervention levels.
7. **What was the cost effectiveness of the intervention?** A key input to this calculation is the estimation of the costs of designing and implementing the intervention. This is typically not recorded, which makes it hard to produce a compelling argument that the intervention should be rolled out further. Programmes should therefore seek to record this information as standard.

Emerging implications for UK energy policy

The interventions studied in the evidence base are diverse, involving different combinations of mechanisms to encourage change, and often implemented in very different contexts. This diversity means that there is no single model for the “best” intervention to encourage behaviour change in energy-using behaviours in the home.

What is clear from the evidence is that two broad classes of interventions have been undertaken to date: small-scale targeted community-based programmes, and broad universal initiatives, such as Home Energy Reports, which have been rolled out across large segments of the population. As discussed earlier, Home Energy Reports tend to save between 1 and 3% of energy consumption per household. However in the contexts that they have been applied to date they have proved to be relatively cost effective.

Interventions that operate at the community or neighbourhood level do seem to be effective in influencing domestic energy use. But there are challenges too in the extent to which these might be scaled, as by design, they assist households and neighbourhoods in a tailored manner. The studies to date typically involve those who are already motivated to look for ways to reduce their energy use, so the gains from extending them to less susceptible populations are likely to diminish. It would seem that the key to maximising returns could be to better target the programmes at groups that have scope for making the greatest savings. Although evidence is limited, it suggests that one of these target groups should be those that currently have the highest levels of energy usage (if achieving reductions in carbon emissions is the target, rather than reducing fuel poverty).

From the evidence included in this review, it seems that large reductions in household energy use are unlikely to be achieved from interventions designed to change habitual behaviour alone. However, there is evidence that suggests that

there is potential for larger energy savings if technical/infrastructural and behavioural interventions are applied in combination (recalling the US experience of providing education to those undertaking insulation/draught-proofing). This is an area where there may be a window of opportunity for aligning behaviour change interventions with programmes seeking to encourage investment in energy-saving infrastructure improvements.

Finally, reflecting on the evidence collected, it is worth noting that the majority of data in this review came from grey literature, and in many cases the evaluation is not truly “independent” (being undertaken or funded by the programme implementers or funders themselves). This in turn suggests that more publicly funded evaluations within this area or more independent privately funded evaluations of programmes might improve the evidence base and sharpen the conclusions.

There is a strong case for the government or programme funders to put in place well-designed evaluation streams of any new programmes that may be developed to assist in strengthening the evidence base. Both qualitative research to help shape programme design and evaluations utilising the principles of the randomised controlled trial (as discussed in the Cabinet Office paper “Test, Learn, Adapt”)¹⁷ to evaluate impact and effectiveness would provide useful new evidence to help develop more effective interventions.

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Studies that form part of the core evidence base are marked with an asterisk.

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Appendix A: Information about each of the policies/interventions

Information about each of the policies/interventions can be found in the tables below. For each intervention, the following data is provided:

- Year the pilot/evaluation took place
- Goals of the intervention
- Brief description of the study or intervention
- Intervention type
- Approach
- Number of individuals/households targeted
- Outcomes

1. Energy Analysis		Abrahamse et al. (2007)
Netherlands, Groningen		
Year of the pilot/evaluation	2002–2003	
Goals of the intervention	To provide information that is tailored to individuals, particularly about indirect energy costs.	
Description	This programme consists of an internet-based tool to encourage households (N=189) to reduce their direct (gas, electricity and fuel) and indirect energy use. A combination of tailored information, goal setting (a 5% reduction target) and tailored feedback was used. This evaluation aimed to examine whether this combination of interventions would result in (i) changes in direct and indirect energy use; (ii) changes in energy-related behaviours, and (iii) changes in behavioural antecedents (i.e. knowledge). After 5 months, households exposed to the combination of interventions had reduced their energy use by 11,951 MJ (5.1%), and households which had received a group goal and group feedback in addition to the combination of interventions had reduced their energy use by 12,550 MJ (5.3%). In contrast, households in the control group used 0.7% more energy compared to when the study began.	
Intervention type	Instructions; feedback; goal setting.	
Approach	Energy Analysis Program, a web-based tool that provides feedback and suggestions on cutting both direct and indirect household energy consumption.	
Number of individuals/ households targeted	Originally, 6,000 households were contacted. The response rate was 5%; the initial sample featured 314 individuals, and 189 used the tool.	
Outcomes	After 5 months, households in the experimental groups combined had reduced their energy use by 11,951 MJ (5.1%). On average, households who received the combination of interventions reduced their energy use by 11,411 MJ (5.0%), and households who, in addition to this combination, received a group goal and group feedback reduced their energy use by 12,550 MJ (5.3%).	

2. Evaluation of Opower studies		Allcott (2011)
United States		
Year of the pilot/evaluation	2009–2010	
Goals of the intervention	To provide consumers with information about the behaviour of other consumers, and about ways for them to decrease their energy usage.	
Description	Opower is a software company that partners with utility providers to promote energy conservation. One of their most notable non-price energy conservation products are Home Energy Reports (HERs), which Opower sends to households by mail. These compare a household's energy use to that of similar neighbours and provide energy conservation tips. The idea to compare neighbours was drawn from research showing that providing information on social norm induces people to conserve energy. This study consists of an impact evaluation of all the Opower programs launched before the end of 2009.	
Intervention type	Instructions; feedback; social modelling.	
Approach	Comparative feedback via Home Energy Reports.	
Number of individuals/ households targeted	600,000 households.	
Outcomes	A 1.4–3.3% drop in energy consumption was observed (compared to baseline usage) over a 2-year period. Households in the highest decile with regard to their energy consumption pre-treatment reduced their energy usage by 6.3%, while the energy consumption of households in the lowest decile decreased by only 0.3%.	

<h3>3. Puget Sound Energy</h3> <p style="text-align: right;">Ayres et al. (2009)</p> <p style="text-align: center;">United States, King County, Washington</p>	
Year of the pilot/evaluation	2008
Goals of the intervention	To enable lasting and significant savings in energy consumption by providing tailored and comparative information on energy use in the home by household.
Description	This study analyses data from two large-scale, random-assignment field experiments conducted by utility companies, one of which is Puget Sound Energy (PSE), an electricity and natural gas provider, in partnership with a private software company, Positive Energy/Opower, which provides monthly or quarterly mailed peer feedback reports to customers. Overall, this research illustrates that providing feedback on electricity and natural gas usage while focusing on peer comparison can enable utilities to reduce energy consumption at a relatively low cost.
Intervention type	Instructions; feedback; social modelling.
Approach	Comparative feedback, via a normative and injunctive message, accompanied by targeted energy efficiency advice.
Number of individuals/ households targeted	The sample size was 84,000 (approximately 40,000 households were randomly assigned to the treatment group).
Outcomes	On average, households in the treatment group reduced their kWh usage by 1.2%, their therm (heat energy) usage by 1.2%, and a combined price-weighted usage (taking into account energy and electricity) by 1.1% compared to the control group.

4. Sacramento Municipal Utility District study	
United States, Sacramento, California	
Ayres et al. (2009)	
Year of the pilot/evaluation	2008–2009
Goals of the intervention	Enable lasting and significant savings in energy consumption by providing tailored and comparative information on energy use in the home by household.
Description	This study analyses data from two large-scale, random-assignment field experiments conducted by utility companies, one of which is Sacramento Municipal Utility District (SMUD), an electricity provider, in partnership with a private software company, Positive Energy/Opower, which provides monthly or quarterly mailed peer feedback reports to customers. Overall, this research illustrates that providing feedback on electricity and natural gas usage while focusing on peer comparison can enable utilities to reduce energy consumption at a relatively low cost.
Intervention type	Instructions; feedback; social modelling.
Approach	Comparative feedback, via a normative and injunctive message, accompanied by targeted energy efficiency advice.
Number of individuals/ households targeted	The sample size was 85,000 (35,000 households were assigned to the treatment group).
Outcomes	On average, energy consumption by households fell by 2.1%. This was sustained over a 12-month period.

5. BC Hydro Power Smart		BC Hydro (2011)
Canada, British Columbia		
Year of the pilot/evaluation	2008–2010	
Goals of the intervention	To enable energy efficiency and savings.	
Description	<p>The BC Hydro Power Smart program gave residents of British Columbia the possibility to join an online challenge (Team Power Smart) online or at Outreach events organised throughout the province. Those who chose to participate had to commit to participate in a 12-month challenge to reduce their electricity consumption by 10% or more. They received correspondence related to the challenge and could become eligible for a \$75 reward for successfully completing their challenge. The objectives of this Residential Behaviour Program were multiple, and ranged from capturing cost-effective behavioural savings to entrenching new behaviours to create habits by engaging with customers constantly. The intervention also aimed to prevent behaviour “slide-back”.</p>	
Intervention type	Rewards; social modelling; commitment.	
Approach	Online engagement.	
Number of individuals/ households targeted	45,000 Pro-Participants (households who joined Team Power Smart and added their BC Hydro account online) took part in the challenge.	
Outcomes	<p>Total savings for the Pro-Participants group are estimated to be 5.15 GWh over the 12-month period in 2010. This is calculated by the total number of eligible accounts (24,774) multiplied by the average savings per account (207.7 kWh) as measured among the sub-set included in the matched analysis. No savings were realised by the non-challenge group.</p>	

6. Energy Analysis		Benders et al. (2006)
The Netherlands		
Year of the pilot/evaluation	2002–2003	
Goals of the intervention	To provide information to consumers about other consumers' behaviours, and about ways to decrease energy usage.	
Description	This study analysed the Energy Analysis Programme, a web-based tool that has the potential to overcome the shortcomings of energy reduction campaigns, namely that, first, such campaigns can either be personalized but time intensive or time extensive but generalized, and second, these campaigns only address direct energy requirements, and therefore only 50% of the total household energy requirement is subject to reduction (since indirect energy requirements are more difficult to calculate and address). The Energy Analysis Programme addresses both direct and indirect energy requirements. By means of a simple expert system participants can obtain personalized reduction options and feedback on the energy reduced.	
Intervention type	Instructions; feedback.	
Approach	Energy Analysis Program, a web-based tool that provides feedback and suggestions on cutting both direct and indirect household energy consumption.	
Number of individuals/ households targeted	347 individuals started the experiment, and 190 completed it.	
Outcomes	The total average energy reduction of the experimental group compared to the control group is almost 6%. However, the difference is not statistically significant. When the total reductions are split up into indirect and direct reductions, it becomes clear that a large part of the energy reduction can be ascribed to savings in direct energy. Although there is a 4% difference between experimental and control groups for indirect energy, it is not statistically significant.	

7. Lose Your Excuse		Bertrand et al. (2011)
United States		
Year of the pilot/evaluation	2008–2009	
Goals of the intervention	The Lose Your Excuse public service advertising (PSA) campaign aimed to increase knowledge, foster proactive attitudes and change energy-usage behaviours among 8–12 year olds (tweens).	
Description	The Lose Your Excuse campaign targeted 8–12 year olds and ran from 2008 to 2009. It was launched by the US Department of Energy with the Ad Council across the United States: it included TV and radio spots, web banners, billboards, and collateral materials. The campaign directed tweens to an interactive website where they could download an energy action plan.	
Intervention type	Justifications; instructions; goal setting.	
Approach	Advertising campaign.	
Number of individuals/ households targeted	Not available.	
Outcomes	There is evidence that that 47% of the tweens recognised at least one ad from the campaign (this is used as a proxy to indicate knowledge, proactive attitudes and energy-saving behaviour). Furthermore, the authors undertook a propensity score analysis and confirmed a small but measurable and statistically significant effect on energy-saving behaviour.	

8. Kildonan UnitingCare		Borrell & Lane (2009)
Victoria, Australia		
Year of the pilot/evaluation	2004–2006	
Goals of the intervention	To enable better program outcomes across energy audits.	
Description	Kildonan UnitingCare's domestic energy audit services were conducted from 2004 to 2006 throughout Victoria. This report includes data about the energy audit service (including saving and indications of associated factors, opportunities for greater energy abatement and barriers to making changes). It also contextualises research literature and government policy, the views and experiences of current team members and some recent client evaluation data.	
Intervention type	Instructions; other (insulation/draught-proofing or major one-off purchase).	
Approach	Energy audit program.	
Number of individuals/ households targeted	126 households.	
Outcomes	Across the three years the program was run, the mean saving in kilowatts was 1,637. However, savings ranged from -4,250 to 12,570, and a large standard deviation hints to a high level of dispersion in the study sample. The mean saving remains high; to put it in perspective, the average metropolitan household consumed 6,265 kWh of electricity in 2003, slightly lower than the state average of 6,398 kWh. Thus 1,637 kWh is just over a quarter of the average household electricity consumption for Victoria in 2003.	

9. Scottish CCF	
Brook Lyndhurst & Econometrica (2011)	
Scotland, United Kingdom	
Year of the pilot/evaluation	2008
Goals of the intervention	To help communities reduce carbon emissions and combat climate change.
Description	The Scottish Government's Climate Challenge Fund (CCF) was set up in 2008 to help communities combat climate change by reducing carbon emissions. It covers a broad range of areas from energy to food, transport and waste. The CCF program made 331 awards to 261 communities in a series of 7 funding rounds between 2008 and 2011; in addition, further funding was announced in March 2011 for an extra 130 projects. The interventions were designed to reduce carbon emissions through five different categories of project action: acceleration, activation, facilitation, consolidation and conversion. Evidence from qualitative feedback suggests the projects were generally more effective in the first three categories. This evaluation looked at both hard measures and habitual behaviours, but acknowledges that habitual behaviours generate more uncertainty about the scale of carbon savings.
Intervention type	Making it easy; prompts; instructions; commitment; goal setting.
Approach	Funding a range of projects to help reduce carbon emissions.
Number of individuals/ households targeted	The CCF programme made 331 awards to 261 communities in Scotland in 7 funding rounds between 2008 and 2011, further funding announced in March 2011 for 130 projects. This study consisted of qualitative research with a sample of 21 projects and a quantitative carbon assessment of 8 of these; 477 interviews of participants, staff members and volunteers were performed.
Outcomes	The evidence suggests that changes are often directly attributable to projects (e.g. a number used energy monitors).

10. Women vs men		Carlsson-Kanyama et al. (2007)
Sweden		
Year of the pilot/evaluation	Not available	
Goals of the intervention	To assess how households in Sweden respond to policy instruments encouraging changes in behaviour to reduce energy use, and how this affects the workload of men and women.	
Description	The project aimed to answer the following research question: how do households respond to policy instruments encouraging changes in energy use in the home, and to what degree may this affect the workload of women and men in Sweden? Its aim was to answer this question by finding out how the household chores of women and men are affected when saving residential energy. Three programmes were analysed: Direct billing, New Energy Habits, EcoTeams.	
Intervention type	Instructions; feedback.	
Approach	Three programs designed to foster energy saving were analysed.	
Number of individuals/ households targeted	30 households.	
Outcomes	The evidence indicates that depending on the division of household chores between members of the household, it is possible that the extra workload related to actions to save energy may fall upon women in a disproportionate fashion (for instance, when they wash clothes and dishes in the evenings and on weekends when electricity is cheaper). The research also showed that a suitable combination of policy instruments may have a significant effect on behaviour and may persist over time.	

11. Colorado		Carroll & Berger (2008)
United States, Colorado		
Year of the pilot/evaluation	2008	
Goals of the intervention	To facilitate mass distribution of energy-saving devices to favour energy-saving behaviours.	
Description	In 2007, the Governor's Energy Office in Colorado implemented a mass distribution program. To this end, it used three different service delivery models, namely direct install, one-on-one workshop, and a direct mail approach. Each of these service delivery models focused on delivery of low-cost energy efficiency measures and on encouraging participating households to adopt energy-saving actions. The models were designed to compare cost effectiveness and overall energy savings.	
Intervention type	Instructions; other (installation of energy-saving devices – CFLs, low-flow showerheads).	
Approach	Facilitating the installation of devices to help favour energy-saving behaviours.	
Number of individuals/ households targeted	Not available.	
Outcomes	More CFLs and showerheads were installed in the homes where those measures were directly installed by the Youth Corps staff (9 CFLs installed in direct install versus 3 for direct mailing and 3 for one-to-one workshops). However, the survey showed that the Workshop participants had a much higher rate of self-reported energy-saving actions than the other two groups across all measured energy-saving actions. The direct install customers were the least likely to report that they had used the thermometers to measure their hot water temperature or the temperature of their refrigerator.	

12. Niagara Mohawk		Carroll & Berger (2008)
United States		
Year of the pilot/evaluation	1996	
Goals of the intervention	Enhancing the willingness of low-income households to take further action to save energy.	
Description	The Niagara Mohawk Power Corporation (NMPC) multi-session in-home energy education program built on the idea that households can and will reduce energy consumption if properly informed and motivated. The study seeks to find out which behaviour changes are most likely to find acceptance through a review of interventions.	
Intervention type	Instructions; feedback; other (insulation/draught-proofing or other major one-off purchase).	
Approach	In-home energy education program.	
Number of individuals/ households targeted	Not available.	
Outcomes	In terms of gas usage, the control group was estimated to consume 2% more, while the group that benefited from insulation/draught-proofing measures saved 16% (304 therms). The insulation/draught-proofing and education group achieved 26% savings, and the group that received insulation/draught-proofing, education and feedback also saved 26%.	

13. Ohio Electric Partnership

Carroll & Berger (2008)

United States, Ohio

Year of the pilot/evaluation	Not available
Goals of the intervention	The program aimed to use technology to address educational and motivational issues related to changing energy behaviours.
Description	The Ohio Electric Partnership Program sought to build on the idea that households can and will reduce energy consumption if properly informed and motivated. The study seeks to find out which behaviour changes are most likely to find acceptance through a review of interventions.
Intervention type	Feedback; goal setting.
Approach	Using technology to achieve savings thanks to energy-related behaviours.
Number of individuals/ households targeted	Not available.
Outcomes	The impact evaluation for the Ohio Electric Partnership Program demonstrated that it had a significant impact on electric usage. However, because all homes were recorded in the database as receiving energy education services, there was no way to directly assess whether the energy education contributed to the level of electric savings realized by the program.

14. Ohio Weatherization

Carroll & Berger (2008)

United States, Ohio

Year of the pilot/evaluation	Not available
Goals of the intervention	To facilitate energy savings via weatherisation (insulation/draught-proofing).
Description	The Ohio Weatherization Assistance Program built on the idea that households can and will reduce energy consumption if properly informed and motivated. The study seeks to find out which behaviour changes are most likely to find acceptance through a review of interventions.
Intervention type	Instructions; feedback; other (insulation/draught-proofing).
Approach	Weatherisation (insulation/draught-proofing) and information programme.
Number of individuals/ households targeted	Not available.
Outcomes	The insulation/draught-proofing and education group made average savings of 21% (310 CCF – cubic feet – per year), while the insulation/draught-proofing only groups made average savings of 15% (215 CCF per year). The difference in savings is reported to be statistically significant.

15. Low Income		Carroll & Berger (2008)
United States		
Year of the pilot/evaluation	Not available	
Goals of the intervention	Reducing the energy usage of low-income customers.	
Description	All regulated Pennsylvania utilities furnish Low Income Usage Reduction Program (LIURP) services to customers with a low income. PECO Energy Company has operated a program of this type for many years. The program features an energy education component that provides an energy audit of qualifying homes by an energy service professional; a review of the customer's bill and discussion of the drivers of energy usage, and a commitment from the customer to take up one or more actions to save energy. Unique elements to the program include a monthly energy newsletter for 12 months after the service is delivered, and follow up with program participants whose energy usage has increased, either by phone or face to face.	
Intervention type	Instructions; commitment.	
Approach	Low-cost follow up procedures.	
Number of individuals/ households targeted	Not available.	
Outcomes	Although the combined measures implemented by the program make it difficult to measure the impact of energy education separate from the delivery of energy saving measures, a recent evaluation reported that a group of homes that were eligible only to receive CFLs achieved far greater kWh savings than would be projected from the CFL installation alone; the expected savings from CFL installations hovered around 274 kWh, yet these households saved an average of 953 kWh. Other results include statistically significant reductions for electric savings in kWh by reported reduced use of electric space heaters, as well as statistically significant reductions of the number of lights left on all night.	

16. Opower SMUD Pilot Year 2		Cooney (2011)
United States, Sacramento, California		
Year of the pilot/evaluation	2008–2010	
Goals of the intervention	Enable lasting and significant savings in energy consumption by providing tailored and comparative information on energy use in the home by household.	
Description	Opower Inc. offers an information program to help residential customers manage their electricity use. This is achieved through the provision of regular reports – Home Electricity Reports – about the customer’s electricity consumption, which feature comparative information on the electricity use of neighbours, and advice on actions the household could take to reduce its energy use. The idea underpinning the Home Energy Reports is that comparative feedback “nudges” households into reducing their energy use. This evaluation focused on the second year of the Opower program.	
Intervention type	Instructions; feedback; social modelling.	
Approach	Comparative feedback via Home Energy Reports.	
Number of individuals/ households targeted	35,000 single-family residential customers in the treatment group received regular reports on how their energy use compared to their neighbours’ energy use. The control group was composed of 50,000 single-family customers who did not receive any reports.	
Outcomes	Average savings in program Year 2 were 2.89% for high consumption (HC) households receiving monthly reports, and 1.70% for low consumption (LC) households receiving quarterly reports. The average percent savings in program Year 2 are higher than in Year 1, at 2.89% compared to 2.37%, which represents a 22% increase in savings in the second year. The increase is statistically significant. Statistical analysis reveals that the long-term trend for savings levelled off at about 10–12 months, and has remained fairly constant since then. In other words, after the first year the fundamental effectiveness of the program does not appear to have changed substantially. Statistical analysis points to a long-term savings trend of about 380 kWh per year, approximately 2.9% per year.	

17. Nudges and ideology

Costa & Kahn (2010)

United States, California

Year of the pilot/evaluation	January 2007 – October 2009
Goals of the intervention	To understand whether the effectiveness of energy conservation “nudges” depend on an individual’s political ideology.
Description	By linking data from Opower to voter registry data in California, the authors were able to identify different behavioural responses to the intervention between liberals and conservatives.
Intervention type	Instructions; feedback; social modelling.
Approach	Comparative feedback via Home Energy Reports.
Number of individuals/ households targeted	Treatment group: 35,000 households. Control group: 49,000 households.
Outcomes	<p>The authors found that:</p> <p>A liberal household that pays for electricity from renewable sources, donates to environmental groups and lives in a liberal neighbourhood reduced its electricity consumption by 3%.</p> <p>A conservative household that does not pay for electricity from renewable sources, does not donate to environmental groups, and lives in a conservative neighbour <i>increased</i> its consumption by 1%.</p>

18. Better neighbours	
Dolan & Metcalfe (2010)	
United Kingdom, London	
Year of the pilot/evaluation	October 2010 – August 2011
Goals of the intervention	To separate the impact of information from social norms.
Description	This natural field experiment took place in a large housing estate in Camden, London. Energy statements were sent out by Camden Council. The authors used 569 households and randomised them into three groups: (i) control with a basic energy statement; (ii) treatment 1 – “norms only”; (iii) treatment 2 – “norms with information”. The control group had a basic energy statement, and the “norms only” group had the basic statement with a bar graph illustrating their consumption in comparison to the average in their neighbourhood for their property size. The treatments were applied twice over the observation period of 10 months.
Intervention type	Instructions; feedback; social modelling.
Approach	Comparative feedback via energy statements.
Number of individuals/ households targeted	569 households.
Outcomes	<p>Dolan & Metcalfe (2011) observed a 9% saving in natural gas consumption. The experiment was largely similar to the Home Energy Reports studies run by Opower in the US, designed to examine the effect of social norms and information provision. Dolan & Metcalfe offered a range of hypotheses to explain the large difference between this 9% and the 2% found in the Opower studies, but the study design does not support conclusions regarding the cause of this higher than anticipated reduction.</p> <p>* Dolan and Metcalfe suggested five potential reasons for the difference. First, the participants were typically poor, living in social housing where the tenant rents the property from the council or a private landlord. Second, the experiment was undertaken in a new cultural context (the U.K., not the U.S). Third, the ‘home energy report style’ information was presented on the actual energy statement from the energy provider, while Opower’s sent theirs separately. Fourth, the Dolan and Metcalfe home energy report design is slightly different from the one used by Opower. For instance, they do not use the most energy efficient neighbours on the statement, and do not place any other information on the front page apart from the norm. Fifth, the households that participated did not have real time displays of gas consumptions, so they did not receive immediate feedback from their change in behaviour. Dolan and Metcalfe suggested it may be possible that some uncertainties in the outcome of the behaviour change encouraged more actions (rather than the optimal number of actions).</p>

19. Domestic energy advice		EEPH (2005)
United Kingdom		
Year of the pilot/evaluation	2002	
Goals of the intervention	The research aimed to: (i) evaluate the overall impact of advice and the relative effectiveness of different methods of delivering advice; and (ii) determine what actions result from advice and identify the benefits of following that advice.	
Description	The study draws on an earlier survey that was based on 1,900 interviews with people who had received energy advice 9–15 months earlier from a wide variety of sources. This study takes a step further and seeks to estimate the savings likely to be achieved by people from the survey.	
Intervention type	Instructions.	
Approach	Estimates of the energy savings likely to arise from each change in behaviour were agreed among the agencies involved in this study (Energy Inform, New Perspectives and the Energy Saving Trust). Their inputs were based on the latest research at the time. The estimated savings for each action (£, kWh and CO ₂ emissions) were then applied to the households.	
Number of individuals/ households targeted	1900 interviews with people who had received advice 9–15 months earlier from a wide variety of sources.	
Outcomes	This study showed that linking energy savings to specific behaviour changes is challenging. The author compared the estimated savings based on the reported behaviour change with the savings from fuel bills reported by the participants themselves. It was found that the calculations from stated behaviour changes on average aligned well with savings observed through meter readings. However the calculations greatly underestimated the achieved savings from lighting (by approximately 2.5 times) but greatly overestimated the savings from heating and cooking (by approximately 2 to 3 times).	

20. The Green Energy Train		Feenstra (2009)
The Netherlands, The Hague		
Year of the pilot/evaluation	2001–2003	
Goals of the intervention	To enable energy-saving behaviour in a specific group.	
Description	The Green Energy Train programme was implemented in apartment buildings in the neighbourhood of Leijenburg in The Hague, Netherlands. The project took place between September 2001 and May 2003 and targeted 228 households in 8 apartment blocks. It was managed by consultancy firm Aarde-Werk in cooperation with housing association Vestia (the owners of the apartments). The project aimed to reduce the energy, heat and water use of households by 5%, although for a range of reasons, the target was not met.	
Intervention type	Instructions; social modelling; commitment; goal setting.	
Approach	Education about energy savings.	
Number of individuals/ households targeted	228 households in 8 apartment buildings owned by the Vestia housing association.	
Outcomes	Among the households that completed both surveys to assess the program (52% completed the first, and among these, 56% completed the second enquiry), a large majority (86%) had changed their behaviour towards energy compared to the previous year. The actions they had taken up included turning the heating down an hour before going to bed, taking shorter showers, using less water for washing dishes, using energy-saving bulbs, etc. Active participants improved in 10 energy-reduction behaviours, whilst non-active households made only small behavioural changes.	

21. Commitment theory	
Flahaut et al. (2001); Beauvois et al. (2000)	
France, Provence-Alpes-Côte d'Azur	
Year of the pilot/evaluation	2000
Goals of the intervention	Gauging the extent to which the population could be mobilised to save energy.
Description	This program aimed to explore the relationship that households had with energy efficiency behaviours in a French region, and to see whether they were willing to take up extra energy efficient behaviours little by little, over the course of a few weeks. First, participants were asked whether they were willing to adopt between 1 and 5 simple actions taken from a list (which contained 35 simple habitual actions, such as using the "eco" program on the washing machine, etc.). After a few weeks had passed, researchers checked whether individuals had taken up these actions and included them in their routine; at the same time, researchers offered participants the possibility to adopt another small set of actions from a second list (which featured more costly actions such as installing CFLs, etc.).
Intervention type	Commitment.
Approach	Commitment to taking up energy-saving actions.
Number of individuals/ households targeted	75 families.
Outcomes	Three-quarters of respondents had taken up the actions they had committed to after the first interview: it is worth noting that every person committed to perform at least one of the actions during the test week, and about 80% committed to 3 actions. The most commonly chosen action (chosen 19 times) was to eliminate unnecessary night lights. About 93% of the people contacted actually took up economical behaviours during the test week, and 88% of these agreed to commit to another action after the second interview, and roughly half actually followed up on this promise. A change in attitudes to energy saving also occurred.

22. Western Mass Saves

Fornuto (2011)

United States, Massachusetts

Year of the pilot/evaluation	2010
Goals of the intervention	Creating savings by performing basic actions to save energy.
Description	The Western Mass Saves program aims to achieve more savings and decreased costs for clients. It does so by using deep customer engagement, via a multi-channel approach (direct mail, targeted emails, web experience, local community teams and prizes).
Intervention type	Instructions; feedback; social modelling.
Approach	Customer engagement.
Number of individuals/ households targeted	Reports were sent to 25,000 consumers, with a view to engage with 5,000 of them.
Outcomes	It is estimated that customers who received the report made savings of 0.98% kWh (this covers between 59,019 and 99,019 households). For the 6,142 customers engaging online, estimated savings were 4.2% kWh.

23. EcoTeams UK (I)		GAP (2008)
United Kingdom		
Year of the pilot/evaluation	2006–2007	
Goals of the intervention	To overcome the lack of awareness of environmental issues, and the low take-up of energy efficiency actions.	
Description	EcoTeams were set up by Global Action Plan and have existed in the United Kingdom since the early 2000s. This study reviews the savings that participants in the groups have made and the way their behaviour has changed. The report differentiates between three delivery models for EcoTeams, namely: Semi Facilitated, Fully Facilitated, and Stand Alone, and notes that each reached different results.	
Intervention type	Instructions; feedback; social modelling; commitment.	
Approach	Working through groups.	
Number of individuals/ households targeted	49 EcoTeams were interviewed: they had an average of 10 participants. In total, GAP estimates it has worked with 3,602 households.	
Outcomes	Analysing survey results from past participants shows that 94% reported they were doing more than before to reduce environmental impact. When it came to household energy-related behaviours, 52% of respondents reported that they now switch off appliances at the wall when not in use; 40% explained they now put on extra jumpers to lower heating, and 37% installed CFL light bulbs. In terms of water usage, 66% of respondents explained they changed their consumption by using natural alternatives to cleaning products; 43% buy environmentally friendly cleaning products, and 31% have installed a water butt. Other behaviours were reported to have changed, and findings seem to indicate that the Semi-Facilitated or Fully Facilitated delivery formats were most effective.	

24. Seattle City Light		Gibb (2011)
United States, Seattle		
Year of the pilot/evaluation	2009	
Goals of the intervention	Generating kWh savings, and engaging with consumers.	
Description	This operation was run jointly by Seattle City Light (Seattle's publicly owned electric power utility), and Opower, which distributed Home Energy Reports. The goals of the program were to generate kWh savings, to make energy relevant and interesting to consumers, and also to act as a complement to measures (thereby minimizing the take back effect), and finally to engage customers in a dialogue.	
Intervention type	Instructions; feedback; social modelling.	
Approach	Comparative feedback via Home Energy Reports.	
Number of individuals/ households targeted	20,000 single family residential customers received the report.	
Outcomes	Seattle City Light households are making 2–4% energy savings.	

25. Standby consumption		Gram-Hanssen et al. (2006)
Denmark		
Year of the pilot/evaluation	Not available	
Goals of the intervention	To consider effects on the level of standby consumption of energy by ICT technologies in the household through interventions involving communication and technical devices.	
Description	This experimental research project implemented in Denmark aimed to investigate how households' standby behaviour can be changed. The design of the project is not directly transferable as a broader program.	
Intervention type	Making it easy; instructions.	
Approach	Intervention using communication and technical devices.	
Number of individuals/ households targeted	30 families.	
Outcomes	Among the 30 families, one third of the standby consumption could be reduced through communication; another third by technical devices; the final third remained unchanged in spite of the efforts deployed.	

26. Energy labels		Gram-Hanssen et al. (2007)
Denmark and Belgium		
Year of the pilot/evaluation	Not available	
Goals of the intervention	To overcome the fact that consumers question and neglect information on sound energy practices even if it is customised for their dwelling.	
Description	A mandatory energy labelling scheme has existed in Denmark since 1997. In 2006, the application of European directive 2002/91/CE on the energy performance of buildings made a similar scheme mandatory for all EU countries. This study seeks to answer the following question: why do consumers question or neglect the plethora of information on sound energy practices even if the advice is customised for their dwelling? In order to do this, it compares two systems (Belgium and Denmark) in terms of information acceptance and trust in experts. Researchers note that the Belgian system provides the homeowner with a personal contact with the expert, which is not the case in Denmark; they also focus on the importance of the reputation of the expert, and on the level of technicality of the information provided compared to the householder's knowledge. They note the importance of a social network in overcoming the barriers studied here.	
Intervention type	Justifications.	
Approach	Expert advice and information.	
Number of individuals/ households targeted	20 households.	
Outcomes	The research found that the level of trust shown by interviewees towards the schemes differs, although trust and mistrust exist in both systems. The study also showed that the expectations towards the expert and the system are different in the two countries. This is partly because energy assessments are not common in Belgium; as a consequence, Belgian interviewees did not have precise expectations.	

27. The Power Agent		Gustafsson & Bång (2009)
Sweden		
Year of the pilot/evaluation	Not clear (around 2008): 10 days of observation and a follow-up after 8 weeks	
Goals of the intervention	To encourage teenagers and their families to reduce energy consumption in the home.	
Description	Power Agent is a mobile phone-based game designed to encourage teenagers and their families to reduce energy consumption in the home. Each teenager is an “agent” with the mission to save energy. The agent has to join forces with his/her household members as well as a few other agents/households in the same city, to compete against a team (of real people) in a different city.	
Intervention type	Instructions; feedback; social modelling; other (competition).	
Approach	A mobile phone-based persuasive game.	
Number of individuals/ households targeted	Six teenagers and their families.	
Outcomes	<p>The players were able to reduce their electricity usage by up to 34% during the game. However, it is worth noting that many extreme tactics were used by the players, including: turning off all the lights in the house and using candles for illumination; using wood for heating the home and water; ordering pizza instead of cooking at home.</p> <p>Furthermore, post-game monitoring revealed that average consumption in the 8 weeks after the game was little different from before (a -0.2% difference was observed).</p>	

28. CUB Energy Saver		Harding & McNamara (2011)
United States, Illinois		
Year of the pilot/evaluation	2010–2011	
Goals of the intervention	To test the impact of incentives, engagement and feedback across multiple channels on consumer's energy usage.	
Description	The CUB Energy Saver program engages customers with advanced energy savings recommendations, feedback and rewards. This study analyses the program over 12 months from July 2010 to July 2011. There were two types of participants in the program: those who were engaged online, and those engaged by mail only.	
Intervention type	Instructions; feedback; social modelling.	
Approach	Engagement with customers online and by mail.	
Number of individuals/ households targeted	15,000 households received the "mail" treatment. The size of the online sample is not specified.	
Outcomes	An effect of 6.01% is observed for online participants and 1.47–1.63 percent for mail-only participants.	

29. Attunement labels		Kurz et al. (2005)
Australia, Perth		
Year of the pilot/evaluation	2001–2002	
Goals of the intervention	To encourage residential water conservation and residential energy conservation behaviours.	
Description	The city of Perth in conjunction with a local council (Melville) implemented an information intervention. This study focuses on the influence of information leaflets, attunement labels and socially comparative feedback on the actual levels of energy and water consumption.	
Intervention type	Prompts; justifications; instructions; social modelling.	
Approach	Information campaign.	
Number of individuals/ households targeted	166 households.	
Outcomes	Many households that participated in the program believed their involvement had brought about behavioural changes in a variety of areas. The most commonly reported areas of change were those relating to water conservation: reducing water use in the garden (85.7%), not leaving the lights on (68.8%) and reducing showering time (62.3%). However, the list of self-reported behavioural changes includes some behaviours that were not directly targeted by the intervention, namely energy and water behaviour at work, and switching to natural power).	

30. Green Streets UK		Lockwood & Platt (2009)
United Kingdom		
Year of the pilot/evaluation	2007–2008	
Goals of the intervention	To help communities become greener by showing individuals how to reduce energy consumption.	
Description	British Gas ran the Green Streets experiment to help 14 communities across Britain save energy by investing in micro-generation and energy efficiency measures. This evaluation by IPPR validates and analyses energy data and results from interviews with participants, and draws out policy lessons.	
Intervention type	Instructions; feedback; rewards; social modelling; commitment; other (competition, insulation/draught-proofing and other major one-off purchase).	
Approach	Competition and investment.	
Number of individuals/ households targeted	63 households.	
Outcomes	Evidence indicates that there was an initial conscious changing of habits, which was easy for some individuals and more difficult for others. Quantitative results hint that in most cases, reductions towards the end of the year were as high as the ones realised at the start of the project. Reported changes in energy use behaviour include turning lights off, not leaving appliances on standby, not using a tumble dryer, washing clothes at lower temperatures, not overfilling kettles, using and turning down thermostats, and several others.	

31. StepGreen.org		Mankoff et al. (2010)
United States		
Year of the pilot/evaluation	Not available	
Goals of the intervention	To encourage people to take up actions to lower energy consumption and therefore, greenhouse emissions.	
Description	StepGreen.org is a website that aims to motivate people to make energy-reducing changes to their behaviours: the website uses a range of features including commitment and reporting on actions, and delivering information to a person's social network profile page. This study partly aims to assess which design features are successful by describing the development and evaluation of StepGreen.org.	
Intervention type	Justifications; instructions; feedback; social modelling; commitment.	
Approach	Online engagement.	
Number of individuals/ households targeted	An online survey to map out behaviours included 122 respondents; the service may have been deployed to 32 members of the local community and students.	
Outcomes	Participants viewed detailed information on about 16 actions and committed to taking up about 16 of these. In addition, they reported completing 88% of the actions they had committed to once or more. Most of the actions could be undertaken daily given their repetitive nature. Participants reported fulfilling almost 300 actions in total (including repetitions).	

32. Energy conservation at two US military installations

McMakin et al. (2002)

United States, Washington and Arizona

Year of the pilot/evaluation	1998–1999
Goals of the intervention	To help increase energy efficiency, although the sample group have no financial incentive to limit energy-related expenses (houses on military bases do not pay their own bills).
Description	This study describes applied energy conservation campaigns which took place in two U.S. military installations where residents do not pay their own utility bills. For each installation, a customized approach was designed based on a broad social-psychological model. Before-and-after energy use was measured, and residents were surveyed about end use behaviours. Residents said they were motivated by the desire to do the right thing, to set good examples for their children, and to have comfortable homes. For sustained change, respondents recommended continued awareness and education, disincentives, and incentives. The aim of the study was to understand what drives individuals' energy use behaviour and the way it may be influenced. Findings from this study may have implications for situations where residents are not billed for individual energy use (this includes government-subsidized facilities, master-metered apartments, and university dormitories).
Intervention type	Making it easy; prompts; justifications; instructions; social modelling.
Approach	Energy conservation campaigns.
Number of individuals/ households targeted	The evaluation focused on the military base, hence the data was aggregated. For each base respectively, the surveys were completed by 1,231 and 175 people.
Outcomes	Aggregate usage was lower, and there is evidence of savings. One of the bases saved 10%, while the other saw energy usage increase, except during the final months of the evaluation.

33. The Energymark Trial

Mendham et al. (2010)

Australia, South Australia

Year of the pilot/evaluation	2009–2010
Goals of the intervention	To develop momentum around the issue of climate change and energy use.
Description	The South Australian Energymark Trial began in August 2009, following a successful national trial of the Energymark process. The trial was launched by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), in partnership with South Australian Local Government Association. The trial focused on the following question: how to create national momentum around the topic of climate change and its relation to energy that will change the way Australians think and act about energy and climate change mitigation? This final report provides SALGA with an evaluation of the Energymark trial. The Energymark process consisted of bringing people together in small groups to learn about energy and climate change and to explore which actions individuals could take to reduce their carbon footprint, save on their bills, and lower their energy usage.
Intervention type	Justifications; social modelling; commitment; other (competition).
Approach	Working through groups.
Number of individuals/ households targeted	394 participants, corresponding to 20 groups.
Outcomes	Over the duration of the Energymark program, participants reduced their carbon footprint by an average of three tonnes (from 20.8 to 17.7 tonnes). Although there were significant emissions reductions in each sector, the greatest reduction in greenhouse gas emissions was made in the spending sector. Household energy emissions decreased from 2.4 to 2.0 tonnes.

34. Energy Neighbourhoods		Merziger et al. (2010)
Europe		
Year of the pilot/evaluation	2008	
Goals of the intervention	To overcome the lack of awareness and incentives to decrease energy usage.	
Description	The Energy Neighbourhoods competition focused on raising awareness of behavioural change and how it can be harnessed to save energy around the home. The goal was for participants to try and save as much household energy as possible for themselves and for their neighbourhood: this was to be achieved by using simple and cost-effective measures such as changes in user behaviour, using energy saving lamps and disabling standby. All participants of the project were supported by national project coordinators, the municipalities and last but not least by the Energy Master appointed by each neighbourhood	
Intervention type	Rewards; social modelling; other (competition).	
Approach	Pan-European competition.	
Number of individuals/ households targeted	600 "neighbourhoods" of 8–12 households each.	
Outcomes	Evidence indicates that about 60% of the participants were able to win the bet with their municipalities and realised energy savings of 8% or more in 6 months. 80% of the neighbourhoods saved energy (compared to their energy consumption in the previous year). The full group of participants achieved an average energy saving of 11%. The energy saved compared to the previous year amounted to 3,320 tons of CO ₂ and 9,149,756 kWh.	

35. Energy efficiency in Malaysia		Mustafa (2010)
Malaysia		
Year of the pilot/evaluation	2007–2008	
Goals of the intervention	To combat two misconceptions about energy efficiency (that it will impact negatively on lifestyle and that people don't need to be concerned about saving electricity so long as they can afford it) and low take-up of six specific energy efficient practices (such as turning appliances off fully, and using energy efficient light bulbs).	
Description	This study provides a comprehensive evaluation of the impact of two community projects on energy efficiency that took place in Malaysia in January 2008. The study specifically sought to compare attitudes and energy efficiency practices between a baseline and a post-campaign survey, but also to compare electricity consumptions before, one month after, and three months after the campaign. Finally, the report aims to gain a richer understanding of the process of attitudinal and behavioural change among residents during the duration of the campaign.	
Intervention type	Rewards; social modelling.	
Approach	Community engagement.	
Number of individuals/ households targeted	113 of 120 residents completed the survey forms (they were chosen from the 1,800 residents of the apartments). 5 residents gave in-depth interviews.	
Outcomes	The evaluation carried out after the campaign found that attitudes towards energy efficiency had become more positive. More participants disagreed with the statements that energy efficiency practice would reduce the comfort associated with their lifestyle and as they could afford it, they would not try to save electricity.	

36. The Massachusetts study		Navigant Consulting (2011)
United States, Massachusetts		
Year of the pilot/evaluation	2010	
Goals of the intervention	To enable people to make lasting and significant savings in energy consumption by providing comparative information about each consumer's behaviour, as well as targeted energy advice.	
Description	Four different behavioural programs were in place in the state of Massachusetts. They were administered by the National Grid, WMECO, NSTAR, and Cape Light Compact; each of the programs leveraged an experimental design to enable comparison of actions and behaviours taken by Home Energy Reports participants who were exposed to the program (treatment group) and customers who were not exposed to the program (control group). The study compares the effect of these programs on people treated compared to the control group. The program implementer for these 4 programs was OPOWER. This paper by Navigant Consulting reviews Program Year 1 of the intervention. Two pilots were in place: one for gas, and one electric.	
Intervention type	Instructions; feedback; social modelling.	
Approach	Comparative feedback through Home Energy Reports.	
Number of individuals/ households targeted	The electric pilot featured 23,515 treatment households and 23,487 control households. The gas pilot had 23,898 treatment households and 23,972 control households.	
Outcomes	The initial study of self-reported measure uptake and behavioural change among cohorts of participants in the National Grid electricity and gas pilot showed that participants were taking more energy-saving efficiency actions than control group members. Yet, Home Energy Report participants did not report changing any more of their conservation behaviours than the control group. Also, Home Energy Reports participants were no more likely to report starting or increasing energy-saving behaviours in the past year compared with the control group. The absolute and relative number of behaviours that treatment group members changed was no different than the control group. There are no groups of behaviours for which the treatment group was more likely to start or increase the behaviour in the last year compared with the control group.	

37. The San Marco study		Nolan et al. (2008)
United States, California		
Year of the pilot/evaluation	2003–2004	
Goals of the intervention	To overcome the lack of engagement in household energy conservation.	
Description	This experimental research project implemented in California by academics aimed to investigate participants' awareness of the causal relationship between descriptive social norms and their behaviour. The study also provides a direct test of the accuracy of the causal explanations elicited from participants.	
Intervention type	Social modelling.	
Approach	Comparative feedback and normative messages.	
Number of individuals/ households targeted	810 individual respondents.	
Outcomes	Participants in the descriptive norm condition (e.g. those who received a message informing them that the majority of their neighbours conserved energy) used significantly less energy in the short term than did participants in the combined other conditions (e.g. participants who received a message containing appeals that are traditionally recognised to motivate people to save energy – social responsibility, the environment, etc.).	

38. EcoTeams UK (II)		Nye & Burgess (2008)
United Kingdom		
Year of the pilot/evaluation	2007	
Goals of the intervention	To overcome the lack of awareness of environmental issues, and the low take-up of energy efficiency actions.	
Description	This study was funded by DEFRA's Waste and Resources Research and Development Programme, and seeks to better understand the drivers for long-term (durable) change in regards to domestic waste and recycling behaviour by studying EcoTeams, set up by the Global Action Plan, which have existed since the early 2000s in the UK. The study focuses on two core research questions; first, how can individuals or households be encouraged to change their behaviour in order to reduce their level of waste production, to recycle more of their remaining waste, and to reduce their energy consumption?; second, how can such changes in domestic routines be sustained beyond the life of an action project?	
Intervention type	Instructions; feedback; social modelling; commitment.	
Approach	Working through groups.	
Number of individuals/households targeted	49 in-depth interviews were performed, as well as 4 focus groups, although the total sample size was larger.	
Outcomes	Behavioural outputs of the EcoTeams programme include several habits that respondents claim to have taken up after participating in the program, across different areas (energy saving and water saving, among others). The most commonly adopted behaviours included switching off lights and appliances, switching to a green energy tariff, buying efficient appliances, and others. When it comes to energy use behaviour, the most commonly adopted behaviours were switching to CFL light bulbs, increasingly turning appliances off when they were not being used, and making a general effort to use less energy. These behaviours represent a characterisation of the range of activities that the interviewees adopted (some individuals may have adopted these behaviours but omitted to report it in the interviews, for instance). This study found that the behaviours most commonly taken up were waste-related (recycling, composting, and buying local products), although changes in water consumption behaviour proved to be an important area of behaviour change through participation in EcoTeams.	

39. Woodstoves		Nyrud et al. (2008)
Norway, Oslo		
Year of the pilot/evaluation	Not available	
Goals of the intervention	To encourage families to replace old woodstoves with new, improved energy-efficient woodstoves.	
Description	In 1998, the city of Oslo initiated a campaign using financial incentives to speed up the shift from old woodstoves to new improved woodstoves. Since 2004, it granted NOK 3000 (about £320) for households in the inner city, and NOK 1500 (about £160) for households in the remainder of the city (up to 30% of the total cost of installing a new stove). This report focuses on bioenergy and heating: the authors seek to measure customer satisfaction (defined as a combined effect of perceived product benefits, perceived personal benefits and sacrifices). The theoretical framework used is that of the Theory of Planned Behaviour, to examine how customers' intentions are formed.	
Intervention type	Other (major one-off purchase – woodstoves).	
Approach	Campaign to encourage.	
Number of individuals/ households targeted	1,200 surveys were mailed, and 808 were completed and returned.	
Outcomes	In the 7 years since the campaign began, 2,241 households have changed their old, inefficient woodstoves: in this respect, the campaign has contributed to decreasing pollution and energy consumption. Furthermore, households have installed new stoves without direct assistance from the government, and, in most cases, have also paid part of the costs related to changing their stove. However, about 10% of the respondents are not using their new stove and are dissatisfied with it. Statistical results seem to indicate that the reported importance of subsidy as a reason to acquire the new stove had a clearly negative impact on the subsequent satisfaction. Moreover, about 12% of respondents were reluctant to continue using bioenergy for heating. The element that had the largest impact on customer satisfaction was the heating effect (taking into account both efficiency and comfort).	

40. Energy consultants		Palm (2010)
Sweden		
Year of the pilot/evaluation	Not specified	
Goals of the intervention	To provide energy-saving advice and tips in response to requests.	
Description	The study reviews the effect of municipal energy guidance directed towards households, and also analyses a specific program, Energy Hunt, which was implemented in the town of Linköping. The guidance was delivered through energy consultants who were employed by the municipalities but financed via state subsidies.	
Intervention type	Instructions.	
Approach	Specific advice on energy use.	
Number of individuals/ households targeted	Two case studies are analysed. The first was evaluated through interviews with 12 energy consultants, 18 homeowners, and 3 tenants. The second case study involved interviews with 10 homeowners who had been part of the Energy Hunt project to reduce energy use.	
Outcomes	A decrease in overall domestic energy use in the homes participating in the Energy Hunt project was reported. The author reports that the Energy Hunt project was successful in such a way that the 10 householders on average reduced their energy consumption by around 10%. It is suggested that this was mainly due to behavioural changes, because most households had not made any major investments at the time of the evaluation, which was when the project had been running for one year.	

41. The response-relapse study		Peschiera et al. (2010)
United States, New York		
Year of the pilot/evaluation	2009	
Goals of the intervention	To explore how sharing energy use information with building residents can increase energy efficiency, especially when there are no (financial) rewards for participants to conserve energy.	
Description	The purpose of this study is to assess the behavioural impact of providing building occupants with personal electricity utilization data contextualized with different social frames of reference (i.e. with their own electricity use; their own electricity use plus the average building occupant's utilization; own electricity use plus average building occupant utilization plus the electricity use of peer networks in building).	
Intervention type	Feedback; social modelling; goal setting.	
Approach	Comparative feedback.	
Number of individuals/ households targeted	37 participants were in the experimental group and 46 participants formed the control group.	
Outcomes	Participants in Group C (those who received information on their own electricity use plus the average building occupant's utilization plus the electricity use of peer networks in the building) showed statistically significant improvement (relative to the period before the experiment) after each of the first two email notifications (20 and 28% reductions).	

42. Manchester Is My Planet		Robinson (2009)
United Kingdom, Manchester		
Year of the pilot/evaluation	2007	
Goals of the intervention	To change the attitudes of the target group of Greater Manchester citizens, by providing them with the information and encouragement necessary to make changes in their energy use behaviour at home and at work.	
Description	The Manchester Is My Planet Pledge Campaign is an attitude and behaviour change programme that formed part of the wider Manchester Is My Planet Climate Change Programme which had operated across the city-region of Greater Manchester since 2005. The goal of the program was to make Greater Manchester a “shining light on sustainable energy living and working”, thereby putting Manchester at the forefront of action on climate change in the UK. The program consists of people taking a pledge: “I pledge to play my part in reducing the city’s greenhouse gas emissions by 20% by 2010, to help the UK meet its international commitment on climate change”.	
Intervention type	Instructions; rewards; commitment.	
Approach	Campaign to engage the community.	
Number of individuals/ households targeted	10,000 people took the pledge in the first 2 months; 20,000 individuals took the pledge during the first two-and-a-half years. The sample size for the phase 1 survey was 350, compared to 3,030 for the phase 2 survey.	
Outcomes	Around 70% of respondents to the phase 1 poll said they would consider taking a pledge to reduce their greenhouse gas emissions. Eight out of ten respondents claimed they felt that they could make a difference to climate change (the figure hovers around 9% in national surveys). About 88.1% of respondents to the phase 2 survey felt that they could limit the effects of climate change through their actions at home and work. As of 2009, 95.2% of pledgers (in a survey of 3,000 people) said that they took actions listed in the top ten tips for saving energy (these included simple actions such as boiling the kettle with the water you need and turning appliances off rather than using standby). 78.5% of respondents said taking the pledge had resulted in actions that had saved them money. Furthermore, 71.6% of pledgers said they were keen to encourage others to reduce home energy use.	

43. EcoTeams Netherlands		Staats et al. (2004)
The Netherlands		
Year of the pilot/evaluation	1994–1996	
Goals of the intervention	To change the participants' behaviour with regard to energy behaviour and environmental resources, to be more efficient.	
Description	This study examined the effects of participation in the EcoTeams program – which was set up in the Netherlands by Global Action Plan – on changes in household behaviour and environmental resources (i.e., the consumption of natural gas, electricity, and water). The EcoTeam Program (ETP) consists of a combination of information, feedback, and social interaction in a group – the EcoTeam. This enables participants to focus on the environmental consequences of their household behaviour. The study tests the hypothesis that the information, feedback, and social influence from the EcoTeams program increased the strength of intentions that can explain behaviour change.	
Intervention type	Justifications; instructions; feedback; social modelling; commitment.	
Approach	Working through groups.	
Number of individuals/ households targeted	445 people were ready to start the EcoTeams Program in Jan/Feb 1994 and were asked to be part of the study. 289 accepted, 205 completed the first questionnaire, but only 150 completed both surveys.	
Outcomes	The 3-year longitudinal study found that participants in the EcoTeams program (n=150) changed half of the 38 household behaviours examined: this corresponded with reductions on four physical measures of resource use. These improvements were maintained or enlarged 2 years after completion of the program, amounting to savings from 7% on water consumption to 32% on solid waste deposition	

44. Energy Efficiency Index		Union Fenosa (2007)
Spain		
Year of the pilot/evaluation	2004–2007	
Goals of the intervention	To boost awareness and dissemination of best practices in this sector.	
Description	Given the difficulty of controlling energy efficiency measures in the domestic sector in Spain, Unión Fenosa (UF) decided to develop an Energy Efficiency Index in this sector. This enabled them to obtain comprehensive data on efficiency in Spanish homes (through 1–10 scores), and their energy-saving potential (electrical and thermal). This has also enabled UF to offer all the participants in the study and subsequently everybody, via the UF website, both the results of the study and their level of energy efficiency and hints for improving it. In order to achieve this, a specific questionnaire and a mass campaign were designed, that reached 8,200 domestic users (2004 and 2005 total). The energy efficiency pattern of the Spanish homes has now been studied since 2004.	
Intervention type	Instructions; feedback.	
Approach	Community engagement.	
Number of individuals/ households targeted	4,100 homes were reached in 2004; 4,100 homes were also reached in 2005; 3,800 homes were reached in 2007. About 51,595 reports and guides were sent in 2006. In total, about 22,500 users have entered details into the Domestic Index website.	
Outcomes	In 2004–2005, a Repetition Group was established, to which the same questionnaire was applied for a second time, thereby showing that those completing the survey questionnaire had improved their Energy Efficiency Index by 4%, which represents a real saving equivalent to 1.25%. The improvement of the Energy Efficiency Index in the Action Group is 4%. Learning therefore takes place through the mere fact of filling out the questionnaire. The improvement in the Index is reflected in a saving of 1.5% of energy consumption. In Spain this saving is equivalent to 60 kWh/year per household that completed the questionnaire. Given that 59,795 households were reached through the dissemination campaigns, and assuming they learned at the same level as the Action Group, this represents a reduction in consumption of 3,590,000 kWh/year.	

45. Taupukas residential awareness		Valuntiené (2009)
Lithuania		
Year of the pilot/evaluation	1998–1999	
Goals of the intervention	To tackle low awareness and effectiveness of energy consumption measures among end-users.	
Description	The “Taupukas” programme was part of an awareness strengthening campaign in Lithuania, aimed at the residential sector, given the situation of the Lithuanian energy sector in 1997. The main idea was to implement an advertisement campaign promoting the benefits of energy and water reservoir savings. It was decided to develop a 5-year strategy to raise awareness of energy efficiency. In order to facilitate implementation strategy measures “Taupukas” was created. Also the task of the “Taupukas” programme was to develop capacities of the Energy Efficiency Centre, the only institution responsible for energy saving in Lithuania in 1997, which had no experience of the implementation of such campaigns.	
Intervention type	Instructions; feedback.	
Approach	Education and awareness campaign.	
Number of individuals/ households targeted	1,016 respondents were interviewed/surveyed in the first round, and 1,014 in the second round.	
Outcomes	Among the households that completed both inquiries (52% completed the first, and among these, 56% completed the second enquiry), a large majority (86%) had changed their behaviour towards energy compared to the previous year. This meant adopting new behaviours such as turning down heating an hour before going to bed, taking shorter showers, using less water to clean the dishes, and using energy-saving bulbs, among others.	

46. Transition Streets		Ward et al. (2011)
United Kingdom, Totnes		
Year of the pilot/evaluation	2010–2011	
Goals of the intervention	A core value of the Transition movements is to “help create thriving, healthy, caring local communities where people’s ways of life take into account the needs of future generations”.	
Description	Transition Together (TT) and Transition Streets (TS) are linked initiatives of Transition Town Totnes. Transition Together brings together groups of neighbouring households in order to take practical steps towards a more sustainable way of living in their homes. Transition Streets was a specific version of TT, funded to March 2011 and supported by the Department for Energy and Climate Change Low Carbon Community Challenge research programme. Through TS, households in TT groups were then eligible to apply for grants of £2,500 or £3,500 (per household depending on income) towards installing their own solar photovoltaic panels, once they had demonstrated a commitment to household energy reduction by carrying out other measures. To date, over 450 people in Totnes and District have joined the scheme and worked through the 7-session programme. The Transition Streets project in Totnes consisted of 468 households forming small social groups and used a workbook with practical actions to reduce energy use and other household bills, following a 7-session programme.	
Intervention type	Instructions; rewards; social modelling.	
Approach	Working through groups.	
Number of individuals/ households targeted	The survey included 63 individuals (around 15% of the total population involved in the project): 56 of those individuals provided full data sets. Face to face interviews were also organised with 24 interviewees.	
Outcomes	Financial savings per household per year were £570. Average carbon savings per household per year were 1.3 tonnes. Homes equipped with solar PV get an income of around £400-800 per year and additional carbon savings of 0.4–0.7 tonnes. Payback is typically within 5-9 years. The authors estimate that the 468 households save in total, per year, £266,760 and 608 tonnes of CO ₂ . Based on actions taken, authors estimate a total reduction in heating and power demand of around 1.5m kWh per year – that’s 14% of the average household’s usage. In line with the authors’ findings from the Evaluation Forms, about 83% of participants have made improvements to their home as a result of the project and only about 10% said they’d already done as much as they could. 86% have made behavioural changes, with the rest saying they already did these things before joining the group. The most popular actions adopted were monitoring energy usage in the home; always turning things off at the wall when not in use; buying local and seasonal foods; using the heating system and thermostat, and monitoring home water usage. Over 90% said it would be Very Easy or Somewhat Easy to sustain the changes (behavioural).	

47. San Marcos experiment		Schultz et al. (2007)
United States, California		
Year of the pilot/evaluation	2005–2006	
Goals of the intervention	To (a) reduce average household electricity consumption; and (b) overcome the boomerang effect by which people who consume less than average try to "catch up" with the average by consuming more energy.	
Description	This research aimed to examine the way in which normative information may differentially affect an important social behaviour depending on whether the message recipients' behaviour is above or below the norm. This was tested through a field experiment conducted in San Marcos by a team from California State University, San Marcos. The team examined the effects of normative information on household energy consumption, and sought to investigate the effect of "injunctive norms" (which describe what is commonly approved or disapproved within the culture) to diminish the "boomerang effect" compared to "descriptive norms".	
Intervention type	Instructions; feedback; social modelling.	
Approach	Comparative feedback involving normative and injunctive messages.	
Number of individuals/ households targeted	287 households were involved in the study; 246 were included in the long-term analysis since 41 households behaved inconsistently and were excluded from longer-term changes analysis.	
Outcomes	Short and long term energy consumption for households that were above average in terms of energy consumption decreased. The "boomerang effect" was buffered by the "descriptive norm and injunctive message" method tested by the research team. The "descriptive norm and injunctive message" consisted of messages written on door hangers and left on participants' doors. The messages contained information on how much energy, in kilowatt-hours per day, the household had used in the previous week; descriptive normative information about the actual energy consumption of the average household in their neighbourhood during that same period; pre-printed advice on how to conserve energy, and finally, a happy or sad face depending on whether the household had consumed less or more than the average.	

48. Off. Really Off?	
Wortmann et al. (2003)	
Germany, Schleswig-Holstein	
Year of the pilot/evaluation	2000–2002
Goals of the intervention	To encourage people to switch their electric appliances off fully rather than to leave them on standby.
Description	The “Off. Really Off?” campaign against useless standby consumption was run by the Energiestiftung (Energy Foundation) in the Northern German state of Schleswig-Holstein from November 2000 until June 2001 (followed by reminder ads in autumn 2001 and spring 2002). Its goal was to reduce the standby consumption of electric appliances and electronic equipment in households and offices. The campaign served as a pilot project for an approach on the national level. The project could be financed sufficiently with a budget of about 890,000 Euros incl. taxes, and another 135,000 Euros for the “reminder campaign”. Two representative samples of the population and specialist dealers for electrical equipment in two German states (one as “control group”) were interviewed by phone before the launch of the campaign, at the peak of the advertising pressure and one year after. The results are presented with special emphasis on sustainable effects with respect to energy awareness and interest of the consumers as well as on their intention to act and on specific actions like switching the TV off from the main power switch (i.e. <i>really</i> off). For most of these items, long-lasting effects could be observed.
Intervention type	Justifications; instructions.
Approach	Education and awareness campaign.
Number of individuals/ households targeted	1,000 individuals.
Outcomes	Although they are mostly self-reported, some effects of the campaign could be assessed. When asked which method they use to turn off the television, 58% of respondents claim they use the master switch compared to 49% at the beginning of the campaign. In Lower Saxony, where there was no campaign effect, the figure (58%) remains unchanged.

Appendix B: Search protocol for the Rapid Evidence Assessment

Sources

We performed the search on relevant academic and non-academic databases and organisational and other websites (to identify relevant grey literature). Our list of sources (academic and grey) for the search is provided in Table A1.

We added to these results by “snowballing”. We did this by hand-searching bibliographies of relevant papers that met the relevance inclusion criteria as described below, and performing citation searches on included full text studies to identify additional articles. Attempts to locate other relevant published and unpublished studies have been made by making direct contact with experts in the field through key informant interviews.

Table A1: Databases for the search

Subscription and non-subscription databases ¹	Initial list of institutions and organisations for grey literature (This list will be refined after our expert interview)
<ul style="list-style-type: none"> • Web of Knowledge • EBSCO, which includes: <ul style="list-style-type: none"> ○ EconLit ○ PsycInfo ○ GreenFILE ○ Academic Search Elite ○ Business Source Premier ○ Social Science Abstracts • Energy Citations Database (ECD) 	<p>UK</p> <ul style="list-style-type: none"> • DECC • Energy Saving Trust • NESTA (e.g. Green Streets) • The Scottish Government’s Built Environment Research <p>USA</p> <ul style="list-style-type: none"> • Opower • The Precourt Energy Efficiency Centre at Stanford • The Behaviour, Energy and Climate Change Conference (BECC) • American Council for an Energy-Efficient Economy (ACEEE) <p>Other countries</p> <ul style="list-style-type: none"> • Électricité de France • European Council for an Energy-Efficient Economy (ECEEE) • IEA policies and measures database • The MURE Database (http://www.mure2.com/)

Search terms

Table A2 provides the list of search terms that were used for the review. We structured search terms in four lists:

- List A: terms to identify studies in the domestic sector
- List B: terms to identify energy studies
- List C: terms to identify interventions/treatments to influence behaviour in the domestic energy sector

¹ These databases included the following journals, among others: *Energy Policy*, *Energy*, *Energy Economics*, *Energy Conversion and Management*, *Applied Energy*, *Renewable and Sustainable Energy Reviews*, *Environment & Behaviour*, and *Journal of Environmental Psychology*.

- List D: terms to ensure the studies are relevant to behaviour (since many of the terms in List C have generic meanings).

The lists were connected together in a search string using AND; the terms within each list were connected together in a search string using OR (although we use bullets in the Table to present the main concepts separately).

We applied the search terms to TITLE-ABSTR-KEY, although this depended on the functionality of each database searched.

The search was conducted by a research librarian. We used combinations of the search terms in each category in formats applicable to each database and website. Truncation was used as appropriate (e.g. behavio*).

We pilot-tested these search terms and found that there were many hits coming from some clearly irrelevant academic disciplines (e.g. pharmacology, neuroscience, veterinary, animal, zoology, biology, toxicology, and nutrition). Therefore, to improve the relevance of our search, in selected academic databases we applied “topic filters” to automatically remove hits from irrelevant disciplines (see the full list of “topic filters” in Box A1).

Box A1: Topic filters applied

Topic filters applied to the search in the Web of Science:

- | | | |
|------------------------------------|------------------------------------|---------------------------------------|
| • ZOOLOGY | • ELECTROCHEMISTRY | • BIOTECHNOLOGY APPLIED MICROBIOLOGY |
| • MARINE | • SUBSTANCE ABUSE | • MEDICINE GENERAL INTERNAL |
| • FRESHWATER BIOLOGY | • FOOD SCIENCE TECHNOLOGY | • AGRICULTURE MULTIDISCIPLINARY |
| • AGRICULTURE DAIRY ANIMAL SCIENCE | • BIOLOGY | • NURSING |
| • PHARMACOLOGY PHARMACY | • METEOROLOGY ATMOSPHERIC SCIENCES | • TROPICAL MEDICINE |
| • VETERINARY SCIENCES | • PSYCHIATRY | • MATERIALS SCIENCE MULTIDISCIPLINARY |
| • ENTOMOLOGY | • PARASITOLOGY | • PEDIATRICS |
| • NEUROSCIENCES | • FISHERIES | • OCEANOGRAPHY |
| • NUTRITION DIETETICS | • THERMODYNAMICS | • CHEMISTRY PHYSICAL |
| • TOXICOLOGY | • ENDOCRINOLOGY | • FORESTRY |
| • ELECTROCHEMISTRY | • METABOLISM | |

Topic filters applied to the search in the Academic Search Elite:

- | | |
|----------------|---------------|
| • ZOOLOGY | • MEDICINE |
| • ANIMAL | • NURSING |
| • PHARMA* | • MAMMALOGY |
| • VETERINARY | • ABUSE |
| • NEUROSCIENCE | • PRIMATOLOGY |
| • NUTRITION | • VIOLENCE |
| • TOXICOLOGY | • BIOLOG* |

Table A2: Relevant search terms

List A: Terms to identify studies in the domestic sector	List B: Terms to identify energy studies	List C: Terms to identify interventions to influence behaviour in the domestic energy sector	List D: Terms to ensure the studies are relevant to behaviour change
<ul style="list-style-type: none"> • Home • Residential • Domestic • House^{*a} 	<p><i>List B1: generic terms:</i></p> <ul style="list-style-type: none"> • Energy^b • Electricity • Gas^c • Power <p><i>List B2: Energy services terms to increase comprehensiveness of the search:^d</i></p> <ul style="list-style-type: none"> • Heat* OR thermal • Cool* • (Space conditioning) OR comfort • Lighting OR lights OR illumination • Refrige* • Cook* OR boil* • Wash* OR laundry OR clean* OR dry* OR shower Or bath* • (Energy AND Comfort) <p><i>List B3: Electric appliances terms comprehensiveness of the search:^e</i></p> <ul style="list-style-type: none"> • Thermostat* • Boiler* • Radiator* • Air con* • Hot water • Electric* AND appliance* • (White goods) 	<p><i>List C1: Types of interventions in the terms of reference:</i></p> <ul style="list-style-type: none"> • Information OR advice OR support • (Social AND (marketing OR network OR media)) • Engagement AND (customer OR community OR neighbour*) • Regulat* OR legislat* OR Standard* <p><i>List C2: Types of treatments in Osbaldiston and Schott (2012), excluding feedback.^f</i></p> <ul style="list-style-type: none"> • Easy OR Convenience OR Prompts OR Justifications OR Instructions OR (Rewards OR Incentiv*) OR Social model* OR Cognitive dissonance OR Commitment OR (Goal AND setting) <p><i>List C3: Additional "treatment" terms:</i></p> <ul style="list-style-type: none"> • Champion OR (Opinion leader) • Competition • Guilt • (Peer AND (network OR communication)) • (Normative messaging) • (Goal substitution) <p><i>List C4: Terms from MINDSPACE:^g</i></p> <ul style="list-style-type: none"> • Messenger* OR Incentiv* OR Norms OR Default* OR Salien* OR Priming OR Affect* OR Commitment* OR Ego* • Nudg* OR (Choice environment) OR Cues OR (Mental shortcut*) OR (Loss AND avers*) OR (emotional association*) OR Reciproc* OR inertia OR Penalit* OR heuristic* OR bias* <p><i>List C5: Additional terms related to information and advice:</i></p> <ul style="list-style-type: none"> • Label* • Communication OR leaflet OR booklet OR brochure OR Workshop OR campaign OR education*) • (Mass media) OR (Media campaign) OR Advert* <p><i>List C6: Generic terms related to change:</i></p> <ul style="list-style-type: none"> • Chang* OR influenc* • encourag* OR reduc* OR improve* • policy OR intervention OR program* • manage* <p><i>List C7: Generic terms related to conservation or consumption:</i></p> <ul style="list-style-type: none"> • Conserv* • Consum* OR Usage OR use OR using 	<ul style="list-style-type: none"> • Behavio* • Habit • Habitual

Notes overleaf.

Note a: * is the symbol for “wildcards”, so that house* will allow us to capture terms such as house as well as household.

Note b: Using the generic term energy would allow us to pull many common terms used in the literature, including energy conservation, energy efficiency, energy consumption, energy use/using/usage, energy demand reduction, energy wastage, energy management, energy control, etc.

Note c: We have only listed the major energy types, i.e. gas and electricity, on this list. There are other potential sources of fuel or energy, e.g. LPG, heating oil, wood, coal, charcoal, ground and air source heat, solar thermal, etc, that are not listed here, as we can safely assume that relevant, good-quality studies about these fuels would be picked up by the term “energy” in the titles or abstracts. We have tested this assumption in the pilot and judged that including “niche fuel types” to the list adds little value.

Note d: These terms in B2 will be used in addition to the generic terms in B1 to increase the comprehensiveness of the search. We list the key residential energy services here. It would be impossible to provide an exhaustive list of energy services here. The general principle applied here is that we only include a term if it represents a discipline on its own such that one would reasonably expect the term “energy” to not be included in the titles/abstracts. For example, many studies on thermal comfort may not mention the term energy, so the term “thermal” is included in the list of search terms.

Note e: These terms in B3 will be used to complement the generic terms in B1 and B2, to increase the comprehensiveness of the search. We list the key residential energy-using products here. It would be impossible to provide an exhaustive list of energy-using products here. Similar to our approach in listing energy services, the principle applied here is that we only include a term if it represents a discipline on its own such that one would reasonably expect the term “energy” to not be included in the titles/abstracts.

Note f: We do not include “feedback” as a search term per se so that we will not pull studies that *solely* examine feedback. However, where feedback is examined alongside other relevant interventions/treatments, it will be included.

Note g: The terms “incentiv*” and “commitment” have already been listed previously under “types of treatments in Osbaldiston & Schott (2012)” but we are repeating them here for completeness.

Inclusion/exclusion criteria

Inclusion and exclusion criteria were designed to identify which studies retrieved through the search were relevant to our review question. We employed three sets of inclusion/exclusion criteria. The first set was applied to the search specification (e.g. year and country filters). The second set was applied to titles and abstracts, and was designed to be broad and inclusive, to avoid excluding potentially relevant studies. More stringent criteria were applied to full text to ensure only methodologically and topically relevant studies inform the final review question.

Inclusion/exclusion criteria applied to the search specification

- Location: we were interested in identifying a breadth of relevant international comparative experiences; as such we did not set boundaries on the countries included.
- Time period: since 2000.
- Language: we pulled studies with English keywords, but did not restrict the search language so studies written in languages other than English but with English keywords can be identified through the search.

Further details explaining our choice of location and time period filter are provided in Box A2.

Inclusion/exclusion criteria for titles and abstracts

We structured the second and third set of inclusion/exclusion criteria around the PICO framework (population, intervention, comparison and outcome) recommended by a number of systematic review agencies including the Collaboration of Environmental Evidence.*

- **Population:** Titles/abstracts must consider at least a policy/programme/intervention targeting energy-using behaviours *in the home*, i.e. our population of interest is household or individuals.
- **Interventions:** Titles/abstracts that discuss *solely* a policy/programme/intervention that uses direct feedback (e.g. information in real time, such as smart meters), historic feedback interventions, and demand-side response interventions (e.g. using price signals to shift demand) will be excluded from the review.

We included studies where there was insufficient information to determine whether or not they fit these criteria based on the title/abstract.

Inclusion/exclusion criteria for full text

- **Comparison:** Must have been an experiment that made a comparison between groups (e.g. treatment vs control) or made a comparison across time (e.g. pre-test vs post-test, baseline vs treatment).
- **Outcomes:** Must have examined habitual behavioural change or potential spillover/spin-off effects. Therefore we will exclude studies where the outcome analysed related *solely* to a one-off purchasing decision.
- **Outcomes:** Must have been a measured behaviour in a real-world setting, either observed or self-reported would be included; however, research that relied on behavioural intentions or staged laboratory behaviours would be excluded. Qualitative as well as quantitative research would be included.

* CEE. *Guidelines for Systematic Reviews in Environmental Management*. 2010. As of 12 September 2012: <http://www.environmentalevidence.org/Authors.html#Guidelines>

Box A2: Reasons for the chosen time period and country filter**The period of time to be covered by the searches**

Due to changing social contexts, especially the public profile of energy security and climate change issues, responses to interventions relying on messages relating to these issues are likely to have changed over the last couple of decades. Therefore, we consider recent experiences to be core to this review, and recommend a comprehensive search of the literature since 2000.

However, we see that it is also important to cover key lessons from the literature in the 1980s and 1990s. To do this efficiently, we draw on existing “meta-studies” of that experience. As a starting point, we used:

- Osbaldiston, R. & Schott, J.P. “Environmental Sustainability and Behavioral Science.” *Environment and Behavior* 2012; 44(2):257–99.
- Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. “A Review of Intervention Studies Aimed at Household Energy Conservation”. *Journal of Environmental Psychology* 2005; 25:273–91.

Countries to be reviewed

Energy-using behaviours are affected by physical and social determinants. For example, studies relating to home heating regimes in Scandinavian or tropical regions would be less relevant than those from mid-latitudes. That said, we have not set country filters and have covered trials and evaluations that took place in US and Canada, Scandinavia, Europe, Japan and Australia and New Zealand, as suggested in the terms of reference.

Interviews with international experts

To ensure relevant international experience is considered and key interventions (especially those in the grey literature) are not omitted, the research team corresponded with four international experts (listed below) about relevant trials and key repositories of relevant grey (or academic) literature.

The four international experts who have informed the search of evidence are:

- Dr. Wokje Abrahamse (University of Victoria, Canada);
- Prashant Vaze (Chief Economist at Consumer Focus, UK);
- Professor Harold Wilhite (University of Oslo, Norway); and
- Dr Susie Moloney (RMIT University, Australia).

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