International Energy Agency
Energy Technology Initiative on
Demand Side Management Technologies and Programmes

Subtask 9: Ireland

Task 24 – Phase II

Helping the Behaviour Changers

Evaluation Report for Home Energy Saving Kits: Using Bayesian Modelling to test the "beyond kWh" toolkit

June 2018 *Drs. Sea Rotmann and Daniel Chapman*

Incorporating data collected by the Irish funders SEAI and their experts M.CO and the New Zealand HEAT Kit analysis funded by Auckland Council. Many thanks to the useful comments by Ruth Doyle and Susan Cogan, M.CO and Josephine Maguire, SEAI

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Executive Summary

Overview

Home Energy Saving Kit Programmes have enjoyed wide popularity in several countries, and have been part of the behaviour change repertoire for over 2 decades now (see Rotmann, 2018a Task 24 Cross-Country Case Study Comparison). From interviews gathered for the cross-country comparison it became clear that these programmes were usually regarded as highly successful by their programme managers, but few could point to actual, proven behavioural change. One of these programmes, Ireland's *Home Energy Saving Kit Programme*, is the focus of this evaluation report.

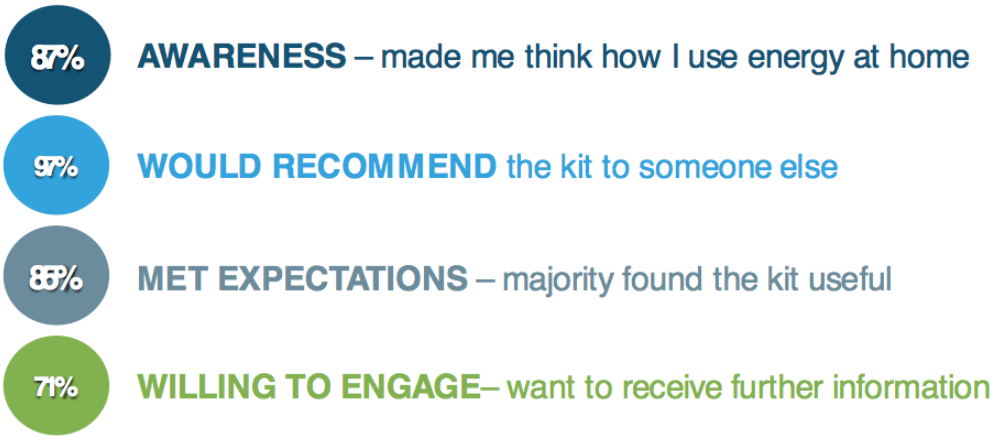
The Irish *Home Energy Saving Kit Programme* is also clearly very successful in terms of how many people have borrowed the kits from libraries (over 700 over a 12-month period) and how long waiting lists were (several months for some). However, in order to know if any actual behavioural change has taken place because of the kits we needed to undertake more in-depth programme evaluation.

From March 2017 to April 2018, the Irish funders and Task 24 *national expert* from the **Sustainable Energy Authority of Ireland** (SEAI) and their *research experts* **M.CO** designed, implemented and analysed a mixed methods research project to better understand user perceptions of home energy saving kits including their impact on everyday energy use practices and energy efficiency investment activity. The study involved 257 surveys, nine interviews, two focus groups and one school workshop. As part of the surveys and focus group research, we tested the Task 24 "beyond kWh" tool, developed by our project partners, the **See Change Institute** (Subtask 9). This report focuses on this toolkit, but is triangulating the results with other quantitative and qualitative analysis from both Ireland (see SEAI, 2018) and New Zealand (see Rotmann, 2018).

The people who loaned and used the kits and who were willing to provide feedback on them had to have a certain level of motivation and interest on the performance of their households (especially in the Sustainable Energy Communities (SECs) that were the target audience for the beyond kWh toolkit). They were thus perhaps among the "early adopter" category and more motivated to save energy than other residents (see p40 in SEAI, 2018). This could potentially have created an inherent bias in this evaluation but does not detract from the fact that their feedback was overwhelmingly positive, very detailed and clearly showed that at least this highly-motivated group of participants had learned and actioned new knowledge on energy-saving opportunities and energy-efficiency investments in their households.

We give some overall snapshot results below, focusing on the difference in survey findings between two key user groups in Ireland and on the impact of the kits as deduced from psychometric analysis designed and evaluated by the See Change Institute. The Irish kits are also compared with a similar evaluation scheme that was undertaken on the New Zealand HEAT kit programme, where applicable. Even though there were differences in the survey questions that were asked, as well as the kit contents, there were enough similarities to draw some loose comparisons between the countries. The ability to contrast and compare between similar schemes in different countries is one of the benefits of an international research collaboration (see also our cross-country case study comparison).

Overview of results



Different user groups tested

To probe the question linked to the influence of 'setting' and whether and how the kit might be embedded into different fora, it was decided to trial the kit in the following contexts (see p10, SEAI 2018):

- **Library setting** – users represent a loose '*community*' – bound by place rather than common interest and exposed to library messaging and library staff communications. Kits were made available across 22 libraries in Dublin.

- **Workplace setting** – users represent a community bound by workplace with an assumed degree of common professional interest – exposed to office-based communications and conversation. Dublin City Council and South Dublin County Council offices were selected for kit trial.

- **SEAI Sustainable Energy Community (SEC) Group** – community bound by place and common interest in energy issues. Social influence likely to be stronger here through engagement of members in broader SEC activities. SAGE (Shankill Action for a Greener Earth) a new SEAI SEC was selected to trial kits.

- **School setting** – users representing a younger demographic, and possible route to access and influence householders through their children's use of the kits. Two secondary schools in County Monaghan, Ireland were selected to trial the kits as part of their existing involvement in SEAI's school programmes.

Willingness-to-act and top actions

Qualitative analysis showed that the majority of respondents in Ireland would consider **home upgrades** (60% in library, 54% in SEC) and **appliance upgrades** (51% in library, 49% in SEC) with purchase of energy-saving **light bulbs and insulation** being the most commonly-mentioned actions and **changes to heating-related settings** the least. This differed from the SEC survey in that 37% said they would **upgrade their heating controls** (vs 20% in the library survey). On the other hand, purchase of energy-saving **light bulbs** (31% vs 40% in library survey), **insulation activities** (20% vs 31% in library survey) and **window replacement** (11% vs 24% in library surveys) were lower in SECs, which could partly be due to this more environmentally-motivated group already having undertaken some of these actions.

Only the "beyond kWh" survey looked at energy-saving motivations before and after using the kit. The main shift was in a slightly higher number of participants saying they now had a "great deal" of energy-saving motivations (from 26% to 34% post kit). In New Zealand, 34% said they considered **home** upgrades, 28% talked about habitual **behaviour changes**, 19% considered **appliance** upgrades, 13% talked about **maintenance/repair** actions and 7% about **changing appliance settings**. The most commonly-mentioned actions were in relation to **curtains and windows, ventilation and insulation**. **Lighting** upgrades were barely mentioned by New Zealand survey

respondents. *These differences between the two countries reflect both, differences in housing stock and the energy-saving tips and guidelines provided in the supporting materials with the kits, as well as the survey design.*

Environmental attitudes and motivations

The majority of the "beyond kWh" SEC sample held **positive environmental attitudes**, and self-reported a **moderate-to-high frequency of energy-saving behaviours**. Respondents in the "beyond kWh" sample primarily elected to use the kit for environmental and moral reasons (43%), more so than financial reasons (20%). This differs from the public library survey where environmental attitudes were shown to be lower drivers (18% in Ireland, 12% in New Zealand) than financial considerations (30% in Ireland, 36% in New Zealand) or home upgrades related to warmth and comfort (22% each in Ireland, only 16% in New Zealand). *The big difference between survey respondents could be due to the fact that the "beyond kWh" sample was taken from a so-called "Sustainable Energy Community" (SEC), where greater-than-normal pro-environmental attitudes may be expected.* One big country difference was that 36% of New Zealand responses related to using the kits as "educational" tools, for example, to teach their family about energy or to learn about home performance. This was not mentioned specifically in the Irish surveys, though a question that asked if they agreed that "their family think about how we use energy in the home" showed 58% agreement.

Bayesian models of the "beyond kWh" pre- and post-surveys suggest **small but positive improvements in pro-environmental attitudes** related to their community, after using the kit. Models of change in **energy-saving motivations and behavioural intentions** were not as robust, and had higher degrees of uncertainty. However, most respondents in the SEC did agree that the kit **met their expectations** (91%) and that it made them think about **their own** (97%) and **their family's** (86%) home energy use. Qualitative data and interviews with other groups in Ireland showed high levels of change in everyday behaviours in particular where investment was not needed (backed up by quantitative data - see p16 SEAI, 2018). Qualitative work also showed intentions to investigate more expensive upgrades, however cost and advice was considered a stumbling block. Qualitative data from interviews and focus groups in NZ seem to show greater rates of change in **energy-saving motivations** and **behavioural intentions** (and actual actions taken) after borrowing the kit. However, they also came from a relatively small, self-selected, highly-engaged group of "early adopters" and may not reflect the majority of kit borrowers.

Awareness of the kit

The majority of survey respondents heard through the kit from the **library** (34%), their **workplace** (19%) or **family and friends** (18%), with smaller numbers hearing from the media and social media (16%), and other (13%). The majority of SEC respondents heard about the kit from their **family, friends and neighbours** (74%) and the remainder directly from the **SEC** (26%). In New Zealand, the vast majority of respondents learned about the kits through their library as they were not loaned out in workplaces or by other Middle Actors. *The different levels of awareness are due to different communication and promotion platforms being used, as well as different Middle Actors (libraries only in NZ; libraries, workplaces and SECs in Ireland).*

Profile of survey respondents

Employment status: The majority of Irish survey respondents were either **employed** (62%) or **retired** (26% c.f. national average of 14.5%). *These numbers may have been influenced by including kit respondents who got kits from their workplaces and SECs*.

Age, gender and ethnicity: There was no major **gende**r bias (50% female, 50% male vs 55% female and 45% male in NZ) though the majority of respondents in the "beyond kWh" survey were male (65%). **Age** groups were relatively uniformly represented although the 18-30yo were under-represented in both, Ireland and New Zealand (perhaps due to home ownership issues?) and 60+ year olds were slightly over-represented in the "beyond kWh" sample (43%). NZ also showed a high rate of **non-native speaking** respondents (36%) which is high compared with the NZ average (around 15%), but fits with the fact that Auckland is the 4th most cosmopolitan (i.e. foreign-born) city in the world.

Housing age and stock: Over half of the houses from Irish survey respondents were **built before 1978** (59% vs 46% of the SEC sample) and only 20% (26% of the SEC sample) were **built after 1994**. Most survey respondents lived in **semi-detached homes** (66% vs 46% national average, though only 14% of "beyond kWh" survey) and 9% (vs 11% national average) lived in **apartments**. Only the "beyond kWh" survey asked if kit borrowers owned vs rented and all but 3 respondents **owned** their own home. We did not collect housing data in New Zealand but from follow-up phone calls, we could determine that 73% of the respondents **owned** their home and 27% **rented**.

Emerging energy personas

Insight from the Irish study (including 9 Interviews, qualitative responses from the survey and 2 focus groups, p21 SEAI, 2018) revealed the following energy personas and associated motivations for borrowing the kits (a fifth persona, the **Educator**, was also observed in New Zealand):

1. Verifier: used the Home Energy Saving Kit to verify the quality of energy efficiency upgrades that they had already completed to their house
2. Savvy persona alludes to those who were technically savvy and had a good idea about their home energy efficiency needs but needed a boost of confidence to follow- through with action

3. Energy saver personas were interested in technologies and saving energy

4. Aspirational: Environmentally-aware and wanting to understand how they could take action as part of an existing environmental orientation.

Evaluation of Kit

Ease of use of tools – Most of the tools were regarded as very easy to use (**fridge/freezer thermometer**, **thermal leak detector, stopwatch, digital thermometer/hygrometer**) though the **radiator key** and **plug-in meter** were regarded as the most difficult. In New Zealand, where no fridge/freezer thermometer or radiator key were provided, the **plug-in meter** was regarded as the most difficult-to-use tool. This was largely down to its small display size, for which a magnifying glass was provided in the toolkit.

Which tools were most useful – By far the most useful tools were thought to be the **thermal leak detector** (62% in Ireland, 84% in New Zealand) and **digital thermometer/hygrometer** (54% in Ireland, 84% in New Zealand). The **stopwatch** was regarded as the least useful (in Ireland 63% least useful vs 43% in NZ), followed closely by the **radiator key** (57%). In the SEC, most respondents (57%) also ranked the **thermal leak detector** first, and the **stopwatch** and **radiator key** last (66% and 54% respectively) in terms of usefulness. Respondents were the most ambivalent about the **plug-in meter** and **fridge/freezer thermometer**. *It needs to be noted that there was a difference in scales in the Irish (6-scale) vs NZ (5-scale) survey, thus showing slightly less positive results in Ireland.*

Despite the largely favourable attitude towards the kits, 40% of SEC respondents had comments with **proposed changes** to the kits (see details in Appendix 2).

Summarised Recommendations for SEAI

More "beyond kWh" survey data is needed in order to make more definitive statements about the behavioural and attitudinal influence of the Irish energy saving kits. However, considering the pro-environmental nature of the SEC sample, the preliminary results suggest that the use of energy saving kits **may be an effective tool in improving energy-saving behaviours**, or at the very least in **increasing receptivity to similar programmes in the future**. This is supported by the qualitative and survey data in both, Ireland and New Zealand. More standardised pre- and post-data collection seems warranted in future roll-outs of the kits to be able to prove actual behavioural change has taken place, and in future iterations of the programme, to also hopefully be able to estimate or even measure the **energy savings** and **other co-benefits** from the programme.
For the ongoing and reiterated *Home Energy Saving Kit Programme*, the authors have the following summary recommendations (more detailed recommendations are given in the back of the report):

(1) ***Fine-tune and test*** *the current kit before nation-wide expansion to other public libraries across Ireland.*

(2) ***Continue stocking the kits*** *in all public libraries and consider the use of "**Energy Champions"** to help collect feedback, anecdotes and provide follow-up information for kit borrowers.*

(3) ***Re-assess the information materials*** *provided with the kit, to ensure tools and information materials are as easy to use and informative as possible.*

(4) ***Re-assess the type of suitcase*** *and potentially offer a smaller, more "business-like" option, such as New Zealand's.*

(5) *Continue to provide **on-going training for library staff** and supplies for restocking kits when they are returned, including a check list.*

(6) *Undertake a short pilot with **thermal imaging cameras** as they were found to have some of the highest behaviour change impact in New Zealand.*

(7) *Continue to engage other **Middle Actors** including schools and SECs and assess which are the most trusted, especially to vulnerable communities.*

(8) ***Develop an App*** *or more tailored solutions for closing the gap between negative results and positive actions, based on end user data and needs.*

(9) *Continue to use the Task 24 **"Beyond kWh"** Pre- and Post-survey methodology.*

Background

Ireland joined IEA DSM Task 24 as sponsor in Phase II, in late 2015, via the **Sustainable Energy Authority Ireland** (SEAI). After our first "Behaviour Changer" workshop in Dublin in April 2016, it was decided to focus the Subtask 6 case study on *Middle Actors in the Residential Sector*. **SEAI** then chose to upscale and roll-out **Codema's** *Home Energy Saving Kit* Trial to include more public libraries in Dublin, two workplaces and a Sustainable Energy Community (**SEC**), called "Shankhill Action for a Green Earth", or **SAGE**.

Home Energy Saving Kit programmes, where small toolkits with various energy-efficiency and energy–measuring tools are loaned out for free via public libraries, were first trialled in South Australia in the early 2000s. They have since found quite enthusiastic uptake, particularly in English-speaking countries (see the Summary Database of the Task 24 cross-country comparison). As part of the Task 24 research support for Ireland, a cross-country case study comparison was undertaken, where programme managers from several countries (Australia, USA, Canada, Ireland and New Zealand) were interviewed regarding their experiences with the kits. One of them was **Auckland Councils'** *HEAT Kit* programme manager, who subsequently asked the Task 24 Operating Agent to undertake the evaluation of their programme. This report focuses on outcomes from the Irish evaluation, but will make comparisons to the New Zealand one, where applicable.

Introduction – the Irish Home Energy Saving Kits

An initial *Home Energy Saving Kit* trial was run by **Codema** for 12 months in 2016, consisting of 17 kits in 10 Dublin libraries. This pilot was decided to be expanded with **SEAI** funding in 2017.

What is in the Irish Home Energy Saving Kits?

The Home Energy Saving Kit contains 6 measurement tools to assess current energy use, or determining/fixing the (in)efficiency of:

- **heating** (radiator key),
- **appliances** (plug-in energy monitor),
- **insulation** (thermal leak detector),
- **fridge/freezer** (fridge thermometer)
- **thermal envelope** (digital thermometer and humidity metre)
- **water** (stopwatch to measure water flow in e.g. shower)

Some of these tools are very simple to use (e.g. stopwatch or fridge thermometer) and some require more reading instructions and effort (e.g. plug-in energy monitor or thermal leak detector). Some are simply to provide insights into the current situation, including showing potential issues like leaks or draughts which would require further (possibly high-cost) investment. Others can be used to immediately remedy a problem – e.g. the fridge/freezer thermometer or radiator key. The kit also comes with an instruction manual and Home Energy Savings Tips booklet, a top ten checklist, guide to light bulbs and energy savings, map of where to get it, promotional booklet and worksheets to easily fill in the results. There are also public information sessions in some libraries where end users can learn about how to use it. And there are videos to help with ease-of-use.

New Zealand's HEAT kits are very similar, though have some country-specific differences. For example, they do not contain a **radiator key**, as radiators are extremely uncommon heating sources in NZ. They also do not contain a **fridge thermometer**, although the information material advises to use the digital thermometer to measure fridge temperature. It does also contain an **extension lead** and **magnifying glass**, to make the hard-to-reach and hard-to-read **plug-in energy monitor** easier to use.

The contents of the Home Energy Saving Kit (Source: CODEMA)

Who is collaborating on this research and what are its aims?

The joint steering group includes *Behaviour Changers* (see Rotmann 2016 for description) from **Codema,** Dublin's Energy Agency ("The Providers" of the kit); **SEAI** ("The Decision-makers" and funders of the more extensive roll-out of the kit, representing government); **Dublin City Public Libraries** ("The Middle Actors" loaning out the kits); **M.CO** ("The Experts" designing the mixed methods research approach and evaluating subsequent data) and, to a lesser extent, the See Change Institute, **SCI** (supporting "beyond kWh" survey design and evaluation discussed here) and a Sustainable Energy Community, **SEC** ("The Conscience" helping with roll-out). All workshops, stakeholder motivations and a description of the journey of how this project was shaped over the last 2+ years, are discussed in more depth in the Cross-Country Case Study Comparison (Rotmann 2018) and final Irish Country Report.

What are Sustainable Energy Communities (SECs)?

A Sustainable Energy Community (SEC) is a community in which everyone works together to develop a sustainable energy system. To do so, they aim as far as possible to be energy-efficient, to use renewable energy and to develop de-centralised energy supplies. This integrated approach allows for a balance of demand and supply, which gives the community greater energy autonomy. *An SEC is a community bound by common interest and environmental/community motivations – social influence is likely to be stronger here.*

Model of Sustainable Energy Community (Source: SEAI)

Research aims

The research aim is to **evaluate the impact of these kits** on both habitual energy use behaviours **and** energy investment behaviour. Consideration is also being given to expanding the reach of the kits through schools in the future.

SEAI also want to add a **social dimension** to see if embedding them within an existing community / interest group (i.e. one of SEAI's Sustainable Energy Communities and a workplace) improves the likelihood of deeper behaviour change.

In short, the aims are to:

- Learn what tools have most effect on householder 's energy efficiency behaviour and feed into any further plans to develop the kit.
- Establish if the tools can lead to householder action in relation to home energy efficiency upgrades.
- Ascertain what supports are needed to complement the kit.
- Identify opportunities to use the kits in other fora.
- Pilot various targeted communication channels to householders.

Evaluation of the *Home Energy Saving Kit* programme

Task 24 tools & reports for evaluating behavioural interventions

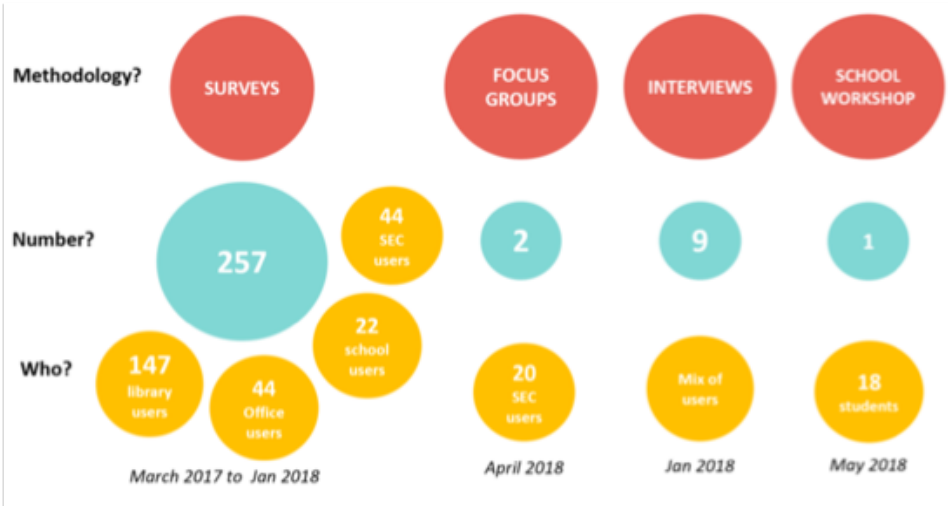
The importance of evaluating and measuring behavioural interventions has been discussed in depth in Subtask 3. From Rotmann (2017): "Task 24 also addresses the all-important question of how to best evaluate successful long-term behaviour change outcomes from the perspective of the various *Behaviour Changers* who are our target audience. It became clear very quickly that this was the most challenging aspect of Task 24 (see Karlin et al 2015). In-depth positioning papers (Mourik et al 2015) looked at the various disciplinary approaches to evaluating behaviour change interventions and discussed the many issues *Behaviour Changers* face when assessing successful outcomes for different stakeholders and end users.

Karlin, Ford and McPherson-Frantz (2015) then developed a toolkit to evaluate behaviour change programmes 'beyond kWh' (*Subtask 9*). This toolkit is open to be field-tested by any interested countries or non-state actors so we can assess cultural and sectoral idiosyncrasies. It is based on the NZ 'Energy Cultures' framework (Ford, Karlin and McPherson-Frantz 2016). The tool already underwent psychometric testing of a set of scales that can be used to collect self-reported data as a part of evaluation of behavioural interventions building on the preliminary instruments drafted for Task 24. This was done by refining and psychometrically validating the following scales for use in

field studies within California (Southern California Edison, 2015): 1. *Norms* (e.g., efficacy, social norms); 2. *Practices* (e.g., one-time, habitual); 3. *Material culture* (e.g., appliance stock); 4. *Context* (e.g., demographics, housing); 5. *User experience* (e.g., ease of use, engagement). All these different evaluation tools will feed into *Subtask 8* (*Toolbox of interventions for Behaviour Changers*)."

Irish and New Zealand field trials and their evaluation

Rotmann (2018a) discusses in detail how the Irish *Home Energy Saving Kits Programme* was chosen as Subtask 6 case study. This report also provides a country case-study comparison of different Energy Saving Kit programmes and pilots in several states in the US, Canada, Australia, Germany and New Zealand (see also the summary excel sheet attached to the report). **Auckland Council** in New Zealand has a very similar *Home Energy Audit Tool Kit (HEAT)* kit programme (see Rotmann, 2018b). The Council also has undertaken some limited post-surveying of participants, but not the more comprehensive pre- and post- "beyond kWh" survey undertaken in Ireland. This report discusses the analysis of the two types of surveys, focus groups and interviews of the Irish programme. Some contrasts and comparisons between the evaluation and results of the two programmes will be made, where appropriate.



Overview of the main evaluation methods used here (Source: SEAI, 2018)

Dublin and Auckland public library surveys (Phase 1)

The original field trials were using public libraries in Dublin and Auckland as the *Middle Actors* loaning out the energy saving kits. Unfortunately, both trials were commissioned before the 'beyond kWh' Subtask 9 survey tool could be modified to be tested with it. The Irish and Auckland kits both contain a (paper and online) survey for people who have borrowed the kit (to be filled in after they return it), with an incentive of winning €100 shopping voucher (Dublin) or receiving a free LED light bulb (Auckland). The Irish library feedback survey methodology, questions and summary results (all created by **M.CO**) can be found in SEAI (2018).

Sample size Dublin: Aimed for 200 surveys for the public libraries, collected 257 (around 35% of kit borrowers). M.CO also undertook nine interviews, two focus groups and one school workshop.
Sample size Auckland: 78 surveys (a little under 10% of kit borrowers) were obtained in the 12-month study period.
Survey Type Dublin and Auckland: basic PROFILING, assessment of MOTIVATIONS, EXPERIENCE, UTILITY and IMPACT of the kits.

Beyond kWh questionnaire (Phase 2 – only in Ireland)

With M.CO, we have created a more in-depth before/after questionnaire for Ireland, which follows the Subtask 9 'Beyond kWh' toolkit (methodology, survey and result details supplied by **See Change Institute**, see Appendix 1). It also differed in audience as it was undertaken in a **Sustainable Energy Community** (SEC) rather than with library users. Many questions overlap with the library survey, in the hope to triangulate the data from both. Focus groups (Phase 3, undertaken in April 2018) also helped further triangulate and sharpen the data (see SEAI, 2018).

Sample size in an Irish Sustainable Energy Community (SAGE): aimed at 40 pre- and post-survey responses, collected 44 PRE- and 39 POST-surveys. Statistical analysis using Bayesian modelling is discussed in Appendix 2.
Survey Type: The beyond kWh survey adds questions to the ones already asked in the feedback survey. These questions have been psychometrically-validated and include changes in ENERGY KNOWLEDGE, PERSONAL AND SOCIAL NORMS and CONNECTION & CONCERN (as this is relevant to SECs and their motivations to use the kit). The tool comprises a PRE- and POST survey. A more detailed description of the "beyond kWh" methodology and its statistical analysis is given below.

Focus Groups & interviews (Phase 3 in Ireland, Phase 2 in NZ)

Focus group methodology is described in detail in Rotmann (2018b) and in SEAI (2018). Focus groups are group interviews and a form of qualitative data collection. They can reveal a wealth of detailed information and deep insight. Where surveys are used to getting information about people's attributes and attitudes a focus group helps understand things at a deeper level.

A focus group takes more time to prepare, logistically, than individual **interviews**. It can provide a different insight by observing the group's dynamics but interviews are also important in providing additional depth and wealth of information.

Focus group size: Two focus groups (n=10 for each one) were held in Dublin, with participants who volunteered from the SAGE Sustainable Energy Community. Unfortunately, only one focus group (n=5) could be held in Auckland.
Interview size: In Dublin, nine interviews with a mix of kit borrowers across demographic profiles and loan settings (e.g. SEC, workplace and library). Eight interviews with kit users were held in Auckland, plus an additional one with the Programme Manager for the cross-country comparison.

A short summary analysis of the information manuals and tips provided in the kits is given in Appendix 2. This information was used to inform which behaviours should be prompted in the "Beyond kWh" survey.

Methodology and Analysis of "beyond kWh" survey

User profiles

35 participants from a **Sustainable Energy Community** (SEC) completed both pre- and post-Kit surveys and thus analyses were restricted to these participants with data at both time points. However, due to missing data (i.e., a small set of unanswered items), the sample size of each analysis varies slightly. Originally, 44 individuals participated in the pre-Kit phase, though 9 participants did not return for the post-Kit survey. Therefore, we focus here on the results from the 35 participants with completed data at both time points. Majorities of the sample were **male** (n = 23), **60+ years old** (n = 15), and lived in either a **detached house** (n = 14) or **semi-detached house** (n = 13). Most of the participants' residence was built in the periods of **1979-93** (n = 10), **1950-78** (n = 8), or before **1950** (n = 8). All but three participants were **owners** of their residence.

Measures

Measures were included at both the pre-Kit and post-Kit phases to understand participants' **energy-related attitudes, environmental behaviours**, and their **thoughts** on the Kits. The sets of items are described in full below (the pre- and post-surveys can be found in Appendix 1). Items were measured at both time points unless explicitly mentioned otherwise.

Frequency of Household Energy Conservation

A single 4-point item measured the frequency with which individuals generally try to conserve energy in their household.

Rationale for Household Energy Conservation

Nine survey items measured various potential rationales for energy conservation in their household, using the same 4-point scale as the frequency of household energy conservation measure. These nine items included:

Environmental impact
Cost of the energy bill
Increasing the value of my home
Convenience
Habit
Comfort
Keeping my use similar to others
Because it's the right thing to do
Guilt

In addition, at Time 2 (POST), several items were added assessing additional motivations not measured at Time 1 (PRE):

Challenging myself
Learning about energy use
Benefit to society
Attitudes toward Energy Savings, Climate Change, and Community/Personal Responsibility

Using a traditional Likert scale, participants were asked to rate the extent to which they agreed or disagreed with nine statements related to **energy savings, climate change attitudes, and community and/or personal responsibility to address environmental/energy issues**. Two items measured the extent to which participants viewed their community from an **environmental/ ecological perspective**. Two items measured participants' concerns about **climate change and ecological impacts**. Five items assessed various attitudes and perceptions related to **personal and community energy use**. These included one item about **community conservation,** one regarding **perceived community expectations of personal environmental action**, and three related to perceptions of **personal responsibility and willingness to address environmental problems**. The original "beyond kWh" tool (see Southern California Edison, 2016) was modified to this specific country- and intervention context. For example, more questions on **community responsibility** were included in the survey aimed at SECs.

Frequency of Environmental Behaviours

Participants self-reported the **general frequency** with which they engaged in a variety of energy saving and pro-environmental behaviours. These included **13 everyday behaviours**, rated on 5-point frequency scales, as well as **four additional behaviours** on more technically/involved household behaviours (e.g., bleeding radiators, get boiler professionally serviced), scored on 4-point frequency scales. The latter were chosen **based on the tools supplied in the kit**, as well as the additional supporting material which highlighted specific energy-saving actions.

Pre-Kit Only Measures

At the pre-Kit phase only, participants were asked to indicate how they had heard about the Kit in the first place, as well as their central motivations for borrowing the Home Energy Saving Kit.

Post-Kit Only Measures

In addition to the pre- and post-Kit responses, several sets of items were included at Time 2 only in order to quantify users' impressions of the Kit. These included the following:

Ease of Use: participants were asked to rate the ease/difficulty (6-point scales) of using six different tools within the Home Energy Saving Kit.

Ranked Utility: participants ranked the usefulness of each of the six different tools on 6-point scales (each tool was assigned one number).

Overall Impressions: five items measured participants' overall impressions of the Kit, using 3-point Likert-type scales.

Recommendations to Others and for Kit Improvement: A single yes/no item measured participants' willingness to recommend the Kit to others, followed by an open-ended item inquiring about any potential changes to the Kit that participants would view as beneficial.

Post-Kit Action Intentions: Participants were asked to check all that apply from a list of nine actions which they were considering since using the Kit. These included the following:
Buying energy saving light bulbs
Buying more energy-efficient appliances
Insulating my attic / roof
Insulating my walls
Upgrading my boiler
Upgrading my heating controls
Getting a Building Energy Rating (BER) done
Replacing my windows

Procedure

Between October and November 2018 the kits were loaned out to SEC members. This was co-ordinated by the SEC's mentor with four of the SAGE leaders, each of whom was responsible for a kit each. They undertook to pass the kit out amongst neighbours, friends and family at least once a week per kit. Participants were asked to complete the pre-Kit survey before receiving the kit and the mentor assisted in getting these, and the post-Kit surveys, to be completed. All surveys were done on-line and progress was tracked fortnightly by the mentor with M.CO's assistance.

Analytic Strategy for Beyond kWh survey

Analysis of this data involved a combination of descriptive and inferential assessment of pre- to post-Kit response differences. For the measures addressed only at the pre-Kit phase or only at the post-Kit phase, we rely on descriptive and graphical plots. To examine whether participants' household energy-saving attitudes and their behavioural intentions were influenced by their experiences using the Kits, we directly compared each participant's responses on the pre-Kit items to their responses to those same items post-Kit. For the analysis of pre- to post-Kit changes, we rely on a Bayesian implementation of hierarchical regression (Gelman et al., 2013). As this technique is perhaps less common than other approaches familiar to readers, the strategy is described in more detail in Appendix 1.

Due to the small number of responses and limited response variation across time points, the majority of measures were not suitable for assessment using the formal hierarchical models. Therefore, in the results section we provide inferential assessments only for several of the measures where appropriate, and rely on descriptive patterns for the remaining majority. In the event that more data are able to be collected in the area, we would be able to update these models.

Results of "Beyond kWh" survey

Descriptive results

Table 1 provides a descriptive picture of how SAGE participants first heard about their Kits, as well as why they decided to use the Kit. The majority of respondents (~74%) heard about the Kit through **family, friends, or neighbours**, and close to half (~43%) selected the Kit due to their concern about **environmental issues**. This stands in direct contrast with the findings from the library surveys in both Ireland and New Zealand.

Table 1. Pre-Kit Descriptive Measures

Where did participants hear about the Kit?	*Number of Respondents Indicating Yes*
SEC direct contact	9
Social media	0
Family, friends or neighbours	26
General Media	0
Why did participants select the Kit?	*Number of Respondents Indicating Yes*

Because I'm concerned about environmental issues	15
I'm interested in making improvements to my home	5
I'm interested in new technologies	2
To find ways to make my home warmer and more cosy	5
To save money on my energy bills	7
Other: Because my neighbour asked	1

Following usage of the Kit, all but two participants indicated that they would **recommend the Kit** to others. Rankings of the utility of different Kit tools suggest that participants found the **thermal leak detector** to be the most useful, while the **radiator key** and **stopwatch** were rated as least useful. Table 2 provides frequency counts of the ranked results.

Table 2. Rankings of Kit Tools

	Ranked 1st (Most Useful)	*Ranked 2nd*	*Ranked 3rd*	*Ranked 4th*	*Ranked 5th*	*Ranked 6th* (Least Useful)
Temperature and humidity meter	6	10	8	8	1	2
Radiator key	4	3	4	5	7	12
Fridge / freezer thermometer	2	6	10	7	7	3
Thermal leak detector	14	6	4	4	3	4
Stopwatch	2	3	2	5	11	12
Plug-in energy monitor	7	7	7	6	6	2

Table 3 depicts the frequency counts for participants' **agreement with various statements** about the Kit. Nearly all participants in the sample agreed that the Kit **met their expectations**, and made them **think about their home and family's** energy use. The majority of participants also indicated that using the Kit encouraged them to think about **home upgrades and appliance replacements**.

Table 3. Appraisals of Kit

Appraisal	*Disagree*	*Neither*	*Agree*
Met my expectations	0	3	32
Made me think about my home use	1	0	34
Made me think about my family's home use	0	5	30
Encouraged us to think about replacing appliances	7	9	19
Encouraged us to think about upgrading our home	7	11	17

While participants had a favourable opinion of the Kits overall, 14 of the participants indicated that there were **changes they would recommend** to the Kit. Appendix 2 provides participants' recommended changes in full.

Table 4 provides frequency counts of the actions participants indicated that they would consider doing in the future. The most frequent actions from the list provided were **upgrading heating** controls (~37%, only 23% in library survey), **purchasing efficient appliances** (~34%) or energy-

saving **light bulbs** (~31%, 40% in library survey). **Insulation** activities (~17-20%, 31% in library survey) and **window replacement** (~11%, 24% in library survey) were selected with the lowest frequency.

Table 4. Post-Kit Action Intentions

Future Action	*Number of Respondents indicating Yes*
Buying energy-saving light bulbs	11
Buying more energy-efficient appliances	12
Insulating my attic/roof	6
Insulating my walls	7
Upgrading my boiler	8
Upgrading my heating controls	13
Getting a building energy rating done	8
Replacing my windows	4

Motivations to Save Energy

Table 5 provides frequency counts of participants' **self-reported motivations to save energy** in their household before and after using the Kit. All participants reported have some degree of energy-saving motives. There was a shift from the pre- to post-Kit period, with a slightly higher number of participants indicating 'a great deal' of energy-saving motivations.

Table 5. Energy Saving Motives - Frequencies

	Not at all	*Somewhat*	*A little bit*	*A great deal*
Energy Motives - Pre	0	20	6	9
Energy Motives - Post	0	20	3	12

Bayesian Modelling

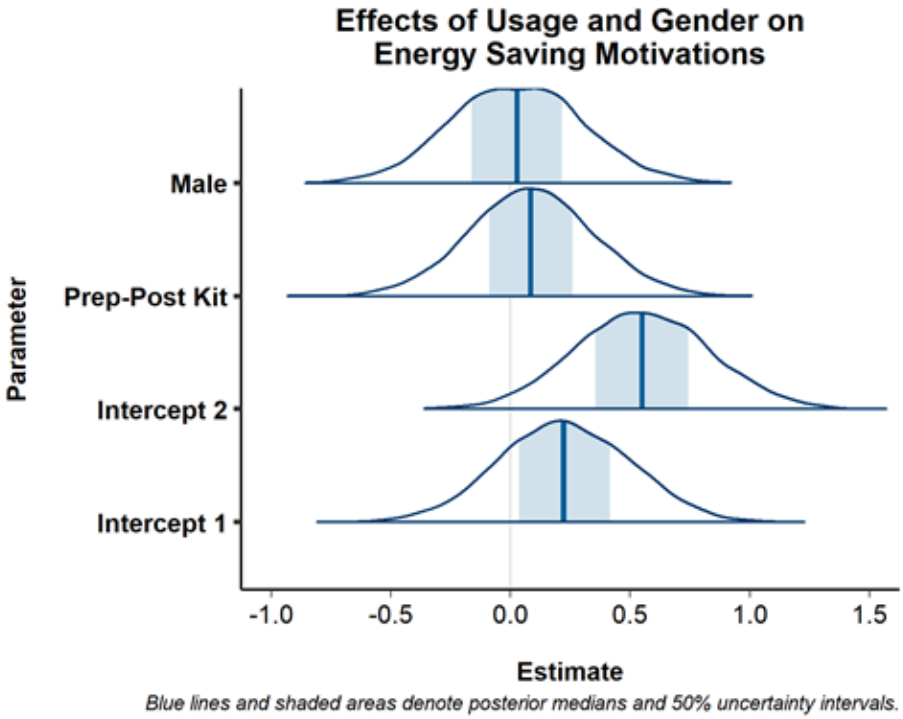
To examine how individual participants shifted between these two time points, an ordinal probit regression was performed using the hierarchical strategy described earlier. We estimated the increase in self-reported motivations to save energy in their household from the pre- to post-Kit time periods. Ordinal probit regression is a desirable alternative to other forms of regression when the response (i.e. **motivations to save energy**) is comprised of several ordered categorical responses (Kruschke & Lidell, 2017; see all references in Appendix 2).

Bayesian hierarchical ordinal regression was used to examine the changes in **energy savings motivations**. In this process we modelled the influence of kit exposure (pre-to-post) on energy saving motivations, while allowing the model estimates to account for having repeated measurements from the same participant at both, the pre- and post-kit phases. We also accounted for several pertinent demographic characteristics in the models. Specifically, **participant gender, age,** and **age of home** were entered. The statistical approach to this is described in Appendix 2. Put simply, we estimated primary effects of time (pre- to post-kit) and gender, while allowing the outcome estimates to vary by age and home age for each participant. We were interested in the **influence of gender** given the suggestion of past research that it plays a role on environmental attitudes (e.g. Hornsey et al., 2016).

Figure 1 provides a visual depiction of the result estimates. There was little evidence to suggest changes in energy saving motivations in this model based on **kit usage** (*Posterior Median* = 0.08,

95% HPDI = -0.41, 0.61) or between **genders** (*Posterior Median* = 0.03, *95% HPDI* = -0.51, 0.56). In both cases, the majority of the most credible values were close to zero.

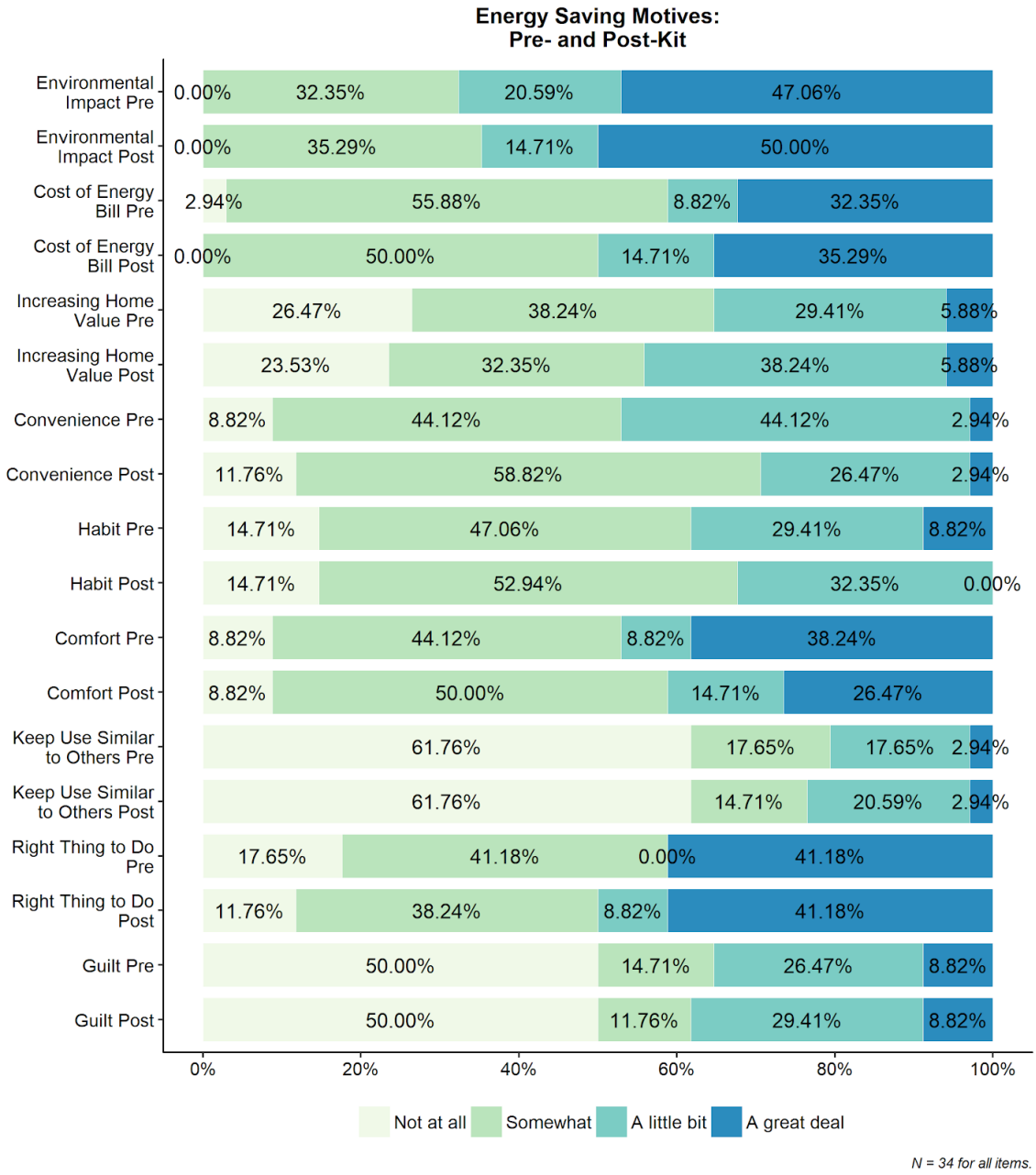
Figure 1. Results of Energy Saving Motivations Model



Blue lines and shaded areas denote posterior medians and 50% uncertainty intervals.

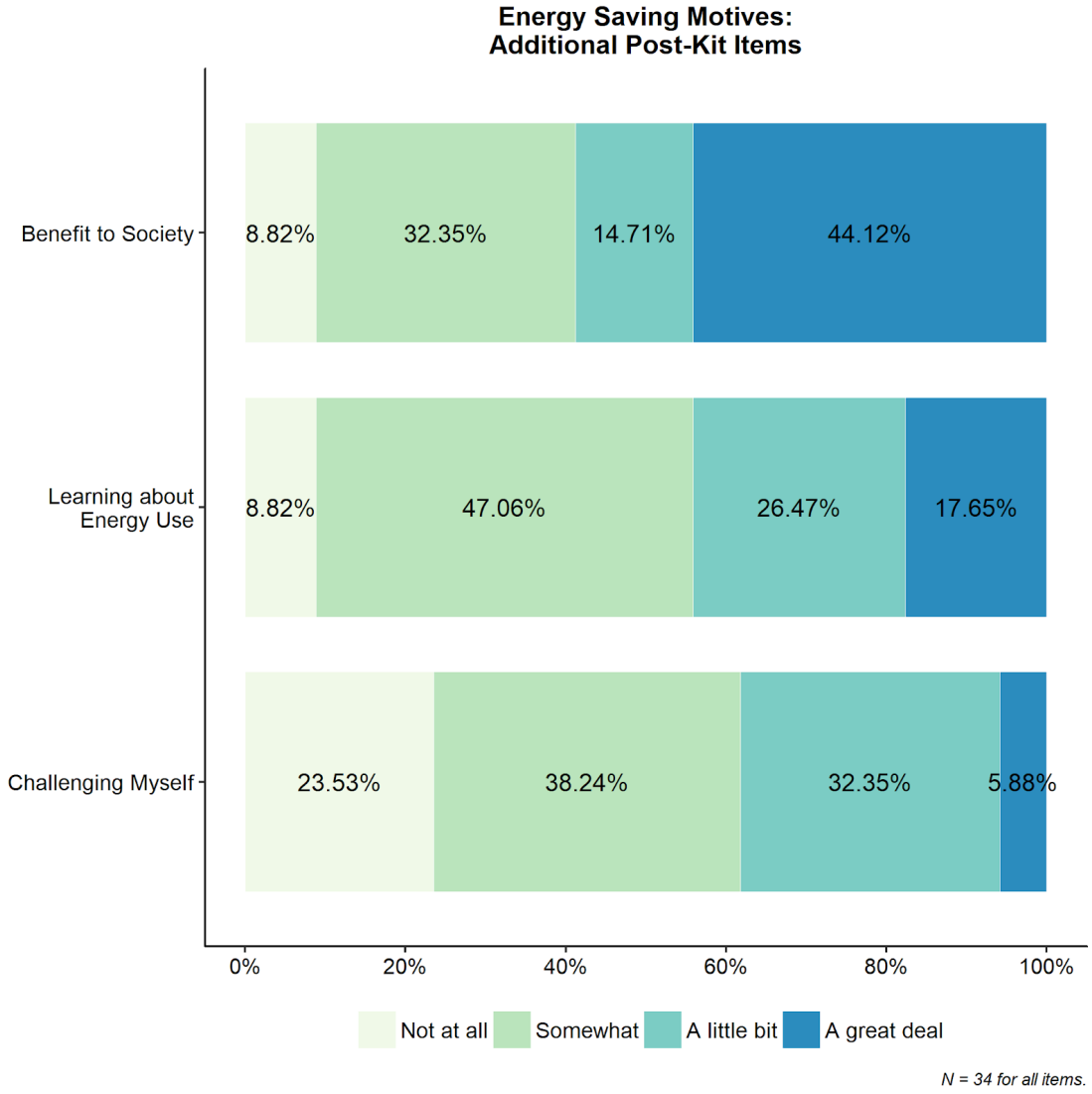
When asked about the variety of **different energy-saving motives**, participants' responses were similar at the pre- to post-Kit times across each motive. Figure 2 provides the response percentages for each. **Environmental and moral motives** were among those that received the highest ratings, as well as **comfort** and **home value**. Keeping one's use **similar to others**, and feelings of **guilt** received some of the lowest ratings. Due to the observed small differences, and the number of items that did not have responses in all categories, these items were not examined using the hierarchical regression models. However, it is notable that **environmental impacts** in particular had a higher percentage of top ratings, more so than the cost of one's **energy bill**. This suggests that in general, the motives of these Kit users were more favourable to the environment than what might be observed in the general population (c.f. the library survey). Figure 3 provides the response percentages for the **additional items** measured only at the post-Kit time period.

Figure 2. Specific Motives for Saving Energy



N = 34 for all items.

Figure 3. Additional Post-Kit Energy Saving Items



Energy-Related Attitudes

Figure 4 provides grouped histograms for each item in the set of questions about **energy-related attitudes, climate change**, and **community/personal responsibility**, visually demonstrating the changes in pre- and post-Kit scores at each level. No participants disagreed with the idea that individuals have a responsibility to help the environment, and nearly all agreed that climate change is a serious problem. Responses were more mixed on items assessing belief that they are part of an ecological community, or whether their community is an environmental system. Most participants saw a problem with overuse of energy and felt morally obligated to reduce their personal energy use. Due to the aforementioned skew in the data and lack of responses in several categories, we were unable to perform hierarchical regressions on all of these items independently or in a composite. Instead, the first three items (ecological community, community as environmental system, and ecological catastrophe) were averaged into a smaller composite due to possessing more desirable statistical properties. This combined measure had adequate internal reliability (Cronbach's alpha = .81 at pre, .83 at post) and moderate variability (see Table 6).

Figure 4. Pre- and Post-Kit Energy-Related Attitudes

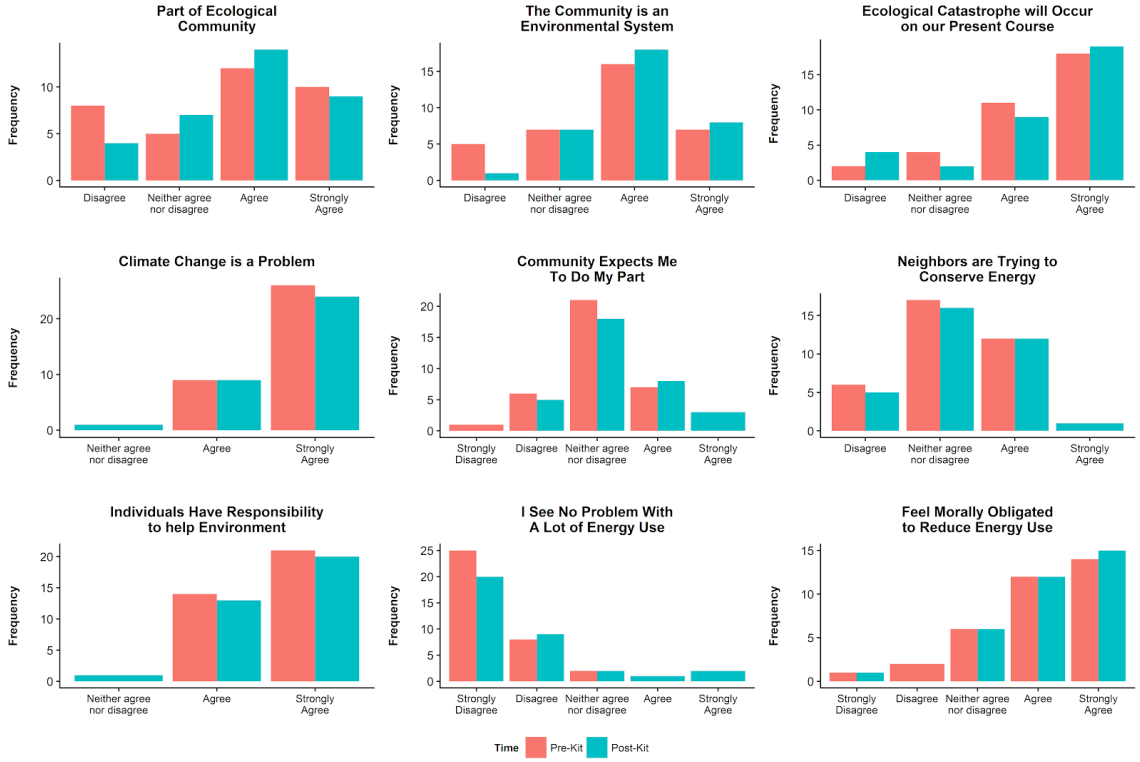


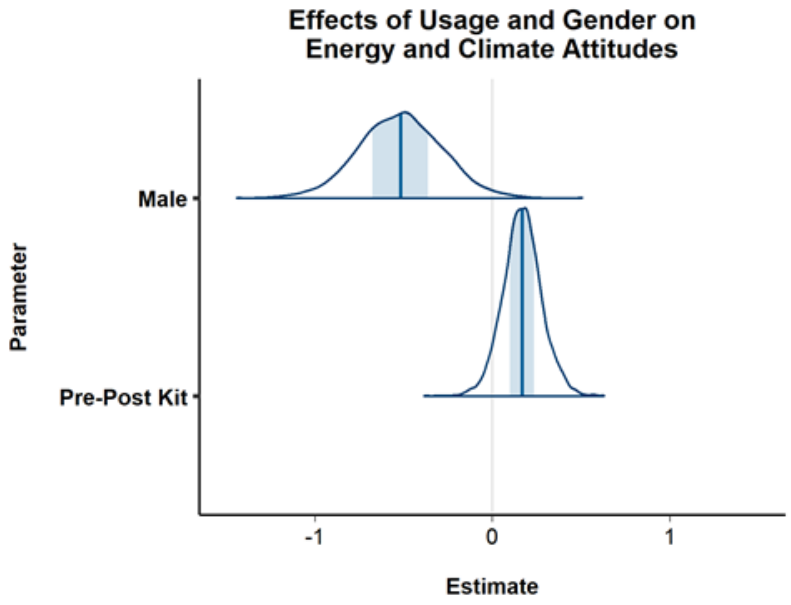
Table 6. Descriptive Measures of Energy-Saving Attitudes

	M	*SD*	*Median*	*Skew*
Pre-Kit	3.90	0.85	4.00	-0.34
Post-Kit	4.02	0.80	4.33	-0.39

Using the three-item composite, we estimated the extent to which participants' energy-related attitudes shifted from pre- to post-Kit. Bayesian regression analyses were performed again, although with several modifications (see Appendix 2).

Bayesian hierarchical regression was also used to examine whether the same set of predictors described earlier influenced energy and climate attitudes. The outcome was again allowed to vary by **home age** and **participant age**, while directly estimated the effect of **kit usage** and **gender**. Close to 95% of the posterior probability was positive, suggesting a primarily positive effect of kit usage of energy and climate attitudes. However, the estimate were small in size and closer to zero, and thus would be unlikely to be 'statistically significant' by conventional standards (*Posterior Median* = 0.17, *95% HPDI* = -0.05, 0.4). The effect of being **male** (relative to female) was primarily negative (*Posterior Median* = -0.52, *95% HPDI* = -0.99,-0.06) and large in size, indicating that **males held more negative environmental attitudes than females**.

Figure 5. Energy and Climate Change Attitudes Model



Blue lines and shaded areas denote posterior medians and 50% uncertainty intervals.

Frequency of Environmental Behaviours

Figures 6a and 6b provide the distribution of responses for each behavioural frequency item at each time point. The majority of behaviours were engaged in with a moderate to high degree of frequency by participants. Behaviours that had more variability and slightly lower frequencies included **unplugging appliances** and/or rechargeable devices, as well as **reducing shower time**.

Figure 6a. Behavioural Frequency Part 1

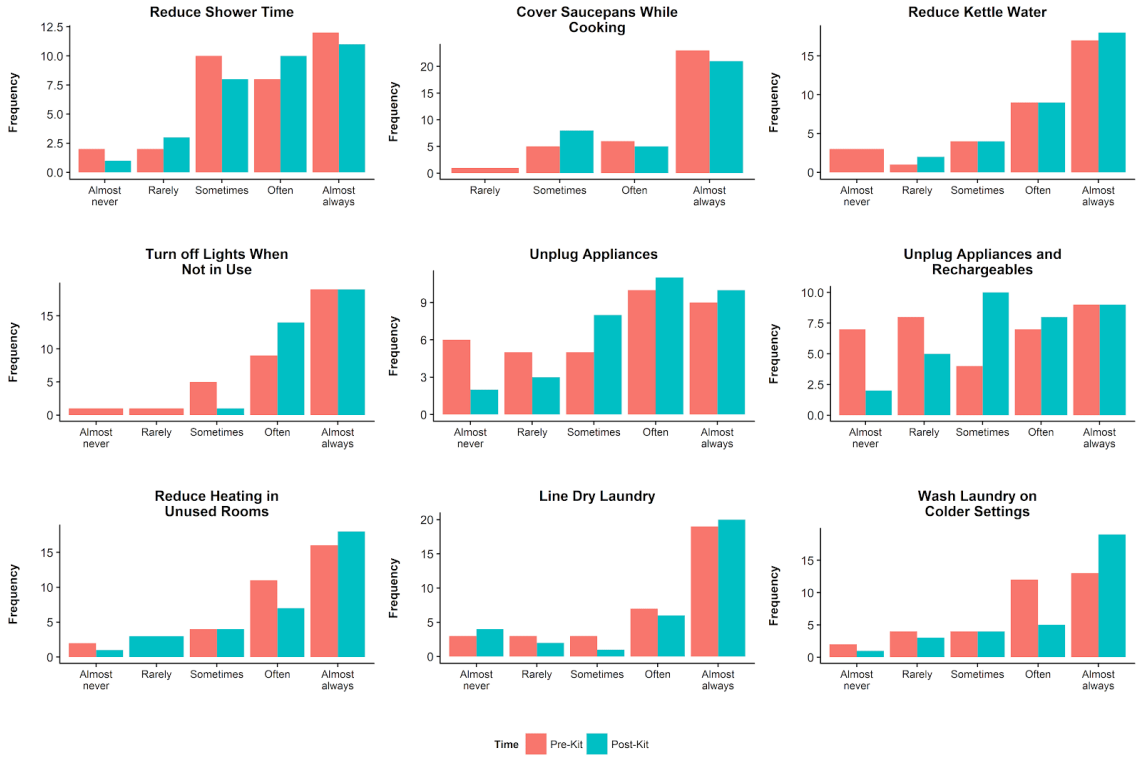
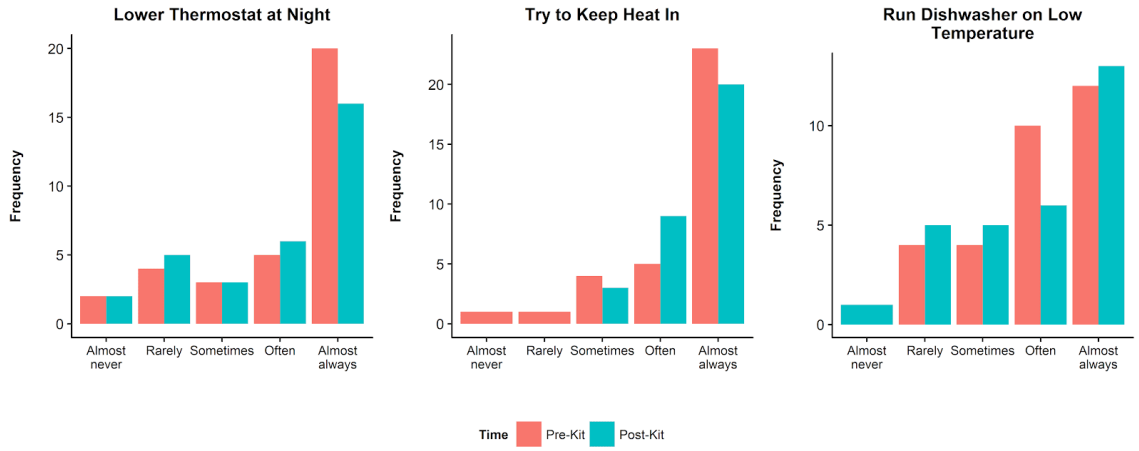


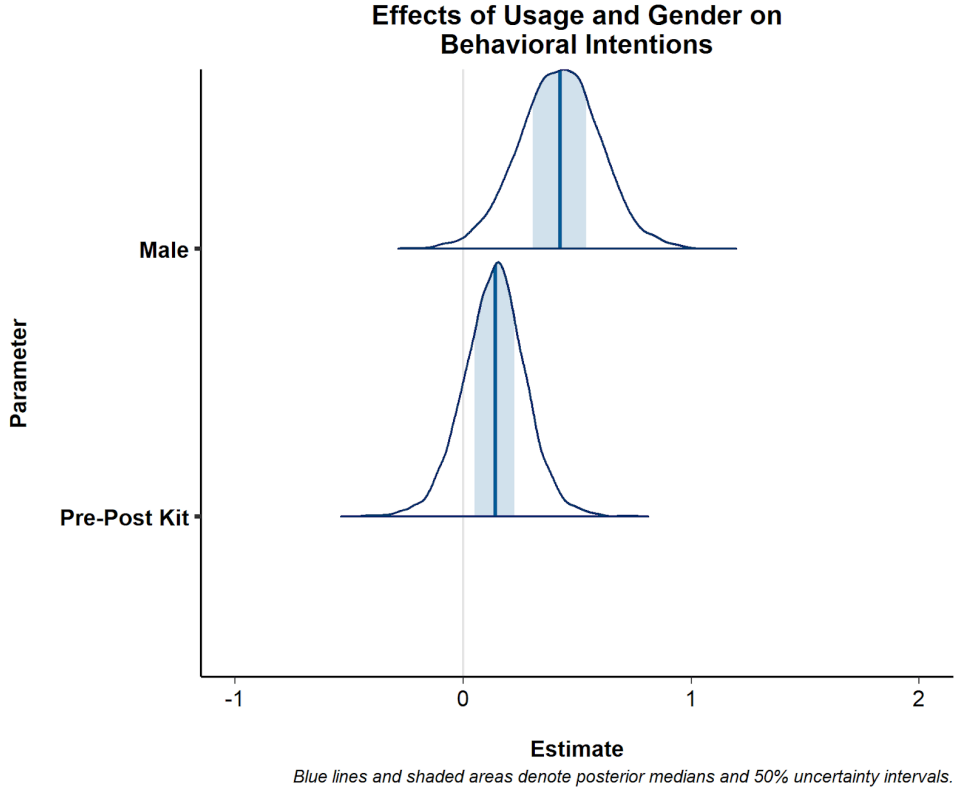
Figure 6b. Behavioural Frequency Part 2



Given the constrained variation in these responses, we again did not subject the individual items to regression analyses. We did, however, create a composite of behavioural frequency by averaging the scores on each item together, in order to allow for hierarchical modelling. When creating this composite, the item measuring whether people **line-dry laundry** was dropped due to low internal reliability with the other items and a slight negative correlation in the post-Kit measurement. After removing this item, the 12 items had moderate internal reliability (Cronbach's alpha pre-Kit = .82, Cronbach's alpha post-Kit = .71). It is notable, however, that the reliability of the measures was greater at the pre-Kit phase than at the post-Kit phase, suggesting the potential for more unaccounted variability in post-Kit responses.

The same Bayesian hierarchical regression model was estimated for the behavioural frequency composite measure. Figure 7 displays the posterior distributions of the model. As depicted, there was little evidence to suggest a robust effect of kit usage on these behavioural intentions (*Posterior Median* = .14*, 95% HPDI* = -.13, .41). Interestingly however, there was some evidence for an influence of **gender, with males in this case reporting greater behavioural intentions than females** (*Posterior Median* = .42*, 95% HPDI* = .06, .77). In both cases there was noticeable variation in the estimates.

Figure 7. Behavioural Frequency Model Results



Blue lines and shaded areas denote posterior medians and 50% uncertainty intervals.

Insights, conclusions and recommendations

Main points of interest

The people who loaned and used the kits and who were willing to provide feedback on them had to have a certain level of motivation and interest on the performance of their households. They were thus perhaps among the "early adopter" category and more motivated to save energy than other residents. This could potentially have created an inherent bias in this evaluation but does not detract from the fact that their feedback was overwhelmingly positive, very detailed and clearly showed that at least this highly-motivated group of participants had learned and actioned new knowledge on energy-saving opportunities and energy-efficiency investments in their households.

Comparison between survey groups and countries

Even though there were many similarities between the different survey groups (public libraries in Ireland and New Zealand; workplaces and SECs in Ireland) there were some interesting differences as well:

- One major difference between the library and SEC survey was the most commonly-mentioned actions respondents said they would undertake after borrowing the kit. Library (and workplace) respondents overwhelmingly mentioned **lighting** and **insulation** as the top measures (see p18, SEAI 2018), and **changing heating controls** as the least. In the SEC, almost twice as many respondents said they would take actions in relation to **heating controls**, but **insulation** and **window replacement** were markedly lower in the SEC surveys. The kits and information material provided in them was exactly the same. *Maybe the SEC group were a more informed audience and so understood the savings to be made through heating control upgrades. Also, new knowledge may have been gained on the heating control topic through borrowing the kit while they would have been aware of insulation measures already through the SEC. Some of the difference could also be due to the different housing stock (many more library survey respondents lived in semi-detached housing than in the SECs and the SECs were slightly skewed towards an older and more male-dominated group)*.
- Another marked difference was in the most commonly-mentioned actions between Irish and New Zealand respondents: The majority of actions in New Zealand related to **curtains**

and windows, ventilation and moisture control and **insulation**. **Lighting** upgrades were barely mentioned at all in New Zealand, though they came out top in Ireland. *This could be due to the fact that NZ houses have much more severe issues with cold and damp and many government-led mass marketing campaigns around the link between health and warm and dry housing were led as part of the "Warm Up New Zealand" insulation subsidy programme, which ran from 2008-2016. On the other hand, even though a link was provided to the government's "EnergyWise" website on lighting upgrades, this wasn't specifically promoted in separate fact sheets and tips in the NZ HEAT kit (see Rotmann, 2018b), like the other actions were. Thus, it seems that both in Ireland and New Zealand, kit users did learn from the additional information provided in the kits and responded accordingly.*

- Another marked difference was in pro-environmental attitudes and motivations between library survey and SEC survey. Where **financial** considerations trumped in library surveys, followed by **home upgrades** and **comfort** considerations, **environmental** concerns were absolutely the top motivation in SEC survey respondents. New Zealand showed similar attitudes as the library survey in Ireland, with the one exception that using the kits as "educational" tools were also commonly mentioned. In the SEC survey where **learning about energy use** was a specific question, 44% of respondents also said it was either very (18%) or a little important (26%). *It is unclear why education and learning seemed to be a higher requirement for New Zealand kit users, although it was clear from Irish focus groups and interviews that the kit was often used as a family activity and kids learnt with parents from the experience e.g. shorter showers for teenagers, encouraging them to switch off lights. It is possibly not unexpected that SEC respondents claim higher environmental attitudes and motivations than the general public.*
- There was quite strong agreement as to which tools were the easiest to use (**thermometers, stopwatch, thermal leak detectors**) and the most useful (**thermal leak detector, digital thermometers/hygrometers**), in both countries and among all surveys. In Ireland, all survey respondents thought the **stopwatch** and **radiator key** to be least useful (in New Zealand the **stopwatch** was also regarded as least useful) and the **plug-in meter** had the most ambivalent results, with people being torn as to its usefulness and ease-of-use (in New Zealand especially, there were big issues with the readability of the meter). *Based on these results, some recommendations as to possible changes to the tools in the kit are made (see below)*.
- One major country difference was in the **type of suitcase** used in the kits. The New Zealand HEAT kit came in a small, strong, metal case which users loved (see Rotmann 2018b). The Irish suitcase also provoked some reactions with some regarding it as "bulky" or looking "like a kid's lunchbox".

Specific findings from the "Beyond kWh" Pre- and Post-Surveys

The ability to compare results from the same survey respondents before and after the kits were used, provides an extra level of insight. In addition, many of the "beyond kWh" survey questions had been *psychometrically* (psychometrics = statistics plus psychological insights) validated (SCE 2016). That means, that the most statistically significant way of asking the questions (including the scales to be used) was used. However, we also wanted to be able to triangulate as much as possible between the SEC and the library surveys and thus a core set of questions were asked in both. Another group of questions was specifically adapted to the Irish country context for the Beyond kWh survey and tip content differed (especially the top tips given in the additional information provided in the kits, see Appendix 2). However, the relatively low number of respondents (n=35 who completely filled in both pre- and post-surveys) and fact that we did not have a control group did reduce the effectiveness of the Bayesian models somewhat.

A major finding from the "beyond kWh" survey was that **environmental** attitudes were much higher in the SEC respondents and that **energy-saving motivations** shifted positively after using the kits. There was no difference between **genders** for energy-saving motivations (Fig 1). The **cost of energy bills, increasing home value** and **doing the right thing** all increased in importance following kit usage, whereas **convenience** as a motivator / barrier to action decreased (Fig 2). By far the most important energy-saving motive post-kit was **benefit to society** (59%, Fig 3). Seeing that no SEC respondents disagreed with the idea that individuals have a **responsibility to help the environment** and that **climate change is a serious problem** as well as feeling **morally**

obligated to reduce their personal energy use (Fig 4), it is quite apparent that stronger pro-environmental attitudes and motivations can be found in SECs compared with the general population. Interestingly, more detailed statistical analysis showed that **males held more negative environmental attitudes than females** (Fig 5), which matches with other findings in the literature (e.g. Plavsic 2013, Wallhagen 2018).

When we look at behavioural frequencies before and after the kit was borrowed in the SEC group (Fig 6a and b), a few behaviours stand out: even though many behaviours are reported to increase after borrowing the kit (especially **unplugging appliances, wash laundry on colder settings** and **turn off lights** when not in use), some slightly decreased (**reduce heating in unused rooms, lower thermostat at night, run dishwasher at low temperatures**). If this is just an artifact of small sample sizes or if certain behaviours do seem to get regarded as less important (or reporting could be more honest following the receipt of information with the kit!), is unclear. One thing that was interesting was that **males reported greater behavioural intentions after borrowing** the kits than females (Fig 7). This could be due to the finding that males, even though they often report environmental aspects to be less important than females, generally feel they can do more to positively impact on the environment (Wallhagen 2018).

Conclusions

Referring back to our initial research aims we can conclude the following:

1. Learn what tools have the greatest impacts on householder's energy efficiency behaviour and feed into any further plans to develop the kit.
   - ⇨ The most useful and most easy-to-use tools were the thermal leak detector and digital thermometer/hygrometer. The stopwatch and radiator key were regarded as least useful.
2. Establish if the tools can lead to householder action in relation to home energy efficiency upgrades.
   - ⇨ Yes, they can, however, it is still largely the most-engaged early adopters who will be taking the most action, or for those who had already contemplated it as an idea, the kit provided further motivation and validated the need for upgrades.
   - ⇨ To make it easier to educate other users of the toolkit why and how they can take immediate actions, a more detailed, tailored and streamlined process (such as a gamified App, see below) is needed.

3. Ascertain what other support systems or tools are needed to complement the kit.
   - ⇨ A gamified App which would lead people through step-by-step instructions could help ensure that the most use is gained out of the tools in the toolkit. Ultimately, we want each tool to prompt one, or several actions the householders can take and guide them through it. Collecting and sharing the data they measure and providing immediate and tailored feedback how to improve their energy efficiency or home's performance based on their circumstances and needs is one of the added benefits of an App.

4. Identify opportunities to use the kits in other fora.
   - ⇨ Trialing the kits in public libraries, work places and the Sustainable Energy Communities was a great example to show how different Middle Actors and communities engage with the kits. More specific evaluation (e.g. utilising the "beyond kWh" tool and having control groups) could help identify the most trusted Middle Actors and how to engage different communities best. It is also good to know that a school pilot was recently started, as engaging children with the kits (to take home to their families) is definitely a good way of promoting their educational value.

5. Pilot various targeted communication channels to householders.
   - ⇨ So far, the same information was provided with the kits to the different communities. However, it would be good to trial how different message framing could promote better uptake and engagement with the kits, both in different communities and using different Middle Actors.

Detailed Recommendations

For the ongoing *Home Energy Saving Kit Programme* in Ireland, we have the following recommendations. They are based on specific feedback from Behaviour Changers during workshops, and from kit survey respondents and the analysis of the survey data, focus groups and interviews (based on M.CO's summary information, see SEAI, 2018). Some are also informed by the New Zealand findings and author's own recommendations (see Rotmann, 2018b):

1) **Continue stocking the kits** in all public libraries in Dublin and roll them out to other counties.

2) **Increase the number** of kits for **promotion** of the kits, especially towards the winter months. Have enough kits for display purposes in the libraries (and/or provide posters or stands).

3) **Re-assess the information materials** provided with the kit, for example, provide subtitles on "How to" videos and translate the written materials into other commonly-spoken languages and undertake some user testing to improve message framing. Link the tools to a bigger action, such as asking to have a **home energy assessment undertaken next**. Highlight the educational potential of the kit and ability to include the whole family in the home assessment. *All of this would form part of the development of an App to go with the kit (see Recommendation 10).*

4) Re-assess the **type of suitcase** used with the kits. As the strong, positive reactions towards the New Zealand HEAT kit suitcase have shown, having a solid but not too-bulky suitcase that is both durable and looks "business-like" may be a good option to have (additionally to the plastic suitcases, as some people also really liked them). It is expected that giving people the choice of two suitcases will improve their perception of the kits (can be tested as part of a future survey).

5) Provide **on-going training for library staff** to ensure all librarians are aware of processes for checking and restocking kits when they are returned, including a check list. Ensure they can explain the more difficult tools for people who come back to ask. Consider the use of "**Energy Champions"** to help collect feedback, anecdotes and provide follow-up information for kit borrowers.

6) Several people in New Zealand asked for **thermal imaging cameras**. Their usefulness in visualising thermal leaks or building stock inefficiencies is well known. International research, such as highlighted by Task 24 (Goodhew et al, 2014), showed that householders who received a thermal image reduced their energy use after a 1-year follow-up, whereas householders who received a carbon footprint audit and a non-intervention control demonstrated no change. In a second study, householders were nearly 5 times more likely to install draught proofing measures after seeing a thermal image. The effect was especially pronounced for actions that addressed an issue visible in the images. BRANZ 2013 mentioned some caution, for example, that the best time for image surveys is winter and that they are less reliable in spring and autumn. However, seeing most kits are loaned out in winter months, and the relative ease-of-use and effectiveness of such cameras suggests that it may be good to stock one or two smaller ones in some main libraries. A slightly cheaper option that attaches to smart phones is also possible but may present more technical difficulties for users. Either way, a small user-testing pilot with several volunteers should be undertaken before committing to any purchase.

7) Re-assess continuing the use of the **stopwatch** (seeing most people will have one on their phone) and **radiator key** but look at the information provided regarding **heating controls** (considering they were among the lowest recorded actions).

8) Provide more information on how to **ventilate the home and reduce dampness**, particularly to consider ways to improve understanding on how to interpret and act upon the humidity readings.

9) Find other **Middle Actors** who can promote the kits (e.g. realtors or financial literacy and budgeting service groups, especially targeted at immigrant and vulnerable communities). As the Irish pilot is being rolled out to schools and other community groups, it is important to design a small evaluation programme to assess which Middle Actors (if any) are the most trusted and useful to promote (correct use) of the kits, especially to vulnerable communities.

10) Develop an **improved Home Energy Savings Kit** with potential new tools, also including an App to be piloted across the country.

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Appendix 1. “Beyond kWh” survey (See Change Institute)

“Beyond kWh” pre- and post-survey

PRE-Survey

1. How did you hear about the kit?

- [ ] SEC direct contact
- [ ] Social Media
- [ ] Family, friends or neighbours
- [ ] General media i.e. newspaper, TV or radio
- [ ] Other (please specify)

2. What was your main reason for borrowing the Home Energy Saving Kit?

- ( ) To save money on my energy bills
- ( ) To find ways to make my home warmer and more cosy
- ( ) Because I'm concerned about environmental issues
- ( ) I'm interested in making improvements to my home
- ( ) I'm interested in new technologies
- ( ) Other (please specify)

3. In general, how much do you try to save energy in your household?

- ( ) Not at all
- ( ) A little bit
- ( ) Somewhat
- ( ) A great deal

4. How much does each of the following motivate your household to save energy?

	Not at all	A little bit	Somewhat	A great deal
Environmental impact	○	○	○	○
Cost of my energy bills	○	○	○	○
Increasing the value of my home	○	○	○	○
Convenience	○	○	○	○
Habit	○	○	○	○
Comfort	○	○	○	○
Keeping my use similar to others	○	○	○	○
Because it's the right thing to do	○	○	○	○
Guilt	○	○	○	○

5. Please indicate how much you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I think of myself as part of an ecological community	○	○	○	○	○
I think of my community as an environmental system composed of interrelated parts	○	○	○	○	○
If things continue on their present course, we will soon experience a major ecological catastrophe	○	○	○	○	○
Climate change is a problem for society	○	○	○	○	○
People in my community expect me to do my part	○	○	○	○	○
My neighbours are trying to conserve energy	○	○	○	○	○
Each individual has a responsibility to do his or her part for the environment	○	○	○	○	○
I don't see any problem with using a lot of energy	○	○	○	○	○
I feel morally obliged to reduce my energy use, regardless of what other people do	○	○	○	○	○

6. How frequently do you..?

	Almost never	Rarely	Sometimes	Often	Almost always	N/A
Limit time in the shower	◯	◯	◯	◯	◯	◯
Cover saucepans while cooking	◯	◯	◯	◯	◯	◯
Fill kettle only with required water	◯	◯	◯	◯	◯	◯
Turn off lights when not needed	◯	◯	◯	◯	◯	◯
Turn off or unplug appliances when not in use	◯	◯	◯	◯	◯	◯
Unplug appliances when not in use including rechargeables once recharged	◯	◯	◯	◯	◯	◯
Reduce heating in unoccupied rooms	◯	◯	◯	◯	◯	◯
Line dry clothes washing	◯	◯	◯	◯	◯	◯
Wash clothes washing on colder settings	◯	◯	◯	◯	◯	◯
Wait for full load before clothes washing	◯	◯	◯	◯	◯	◯
Adjust thermostat setting at night or while away	◯	◯	◯	◯	◯	◯
Try to keep heat in by closing doors, curtains and using draught excluders	◯	◯	◯	◯	◯	◯
Run your dishwasher on low temperature	◯	◯	◯	◯	◯	◯

7. How often do you...?

	Every six months	Every year	Every year to two years	Almost never	N/A
Bleed your radiators	◯	◯	◯	◯	◯
Defrost your fridge/freezer	◯	◯	◯	◯	◯
Check temperature of your fridge/freezer	◯	◯	◯	◯	◯
Get boiler (for gas or oil heating) professionally serviced	◯	◯	◯	◯	◯

8. Are you?

◯ Male

◯ Female

9. Please check which of the following age ranges apply to you:

- ◯ 18-30
- ◯ 31-45
- ◯ 46-60
- ◯ 60+

10. Please check which of the following applies to you:

- ◯ Student
- ◯ Employed
- ◯ Unemployed
- ◯ Retired
- ◯ Other

11. What type of home do you live in?

- ◯ Bungalow
- ◯ Detached house
- ◯ Semi-detached house
- ◯ Terrace/end of terrace
- ◯ Apartment

12. Do you own or rent your residence?

- ◯ Own
- ◯ Rent
- ◯ Other (please specify)

13. When was your home built?

- ◯ After 2006
- ◯ 1994-2006
- ◯ 1979-1993
- ◯ 1950-1978
- ◯ Before 1950
- ◯ Don't know

You must have completed both the pre and post surveys to be eligible

Would you like to be entered into a draw for one of five energy monitors?

- ◯ Yes
- ◯ No

Would you like us to send you further information on energy clinics in your area?

- ◯ Yes
- ◯ No

POST-Survey

1. How easy was it to use each tool in the Home Energy Saving Kit?

	Very easy	Easy	Neither easy nor difficult	Diffcult	Very difficult
Temperature and humidity meter	◯	◯	◯	◯	◯
Radiator key	◯	◯	◯	◯	◯
Fridge/freezer thermometer	◯	◯	◯	◯	◯
Thermal leak detector	◯	◯	◯	◯	◯
Stopwatch	◯	◯	◯	◯	◯
Plug-in energy monitor	◯	◯	◯	◯	◯

2. Please RANK the tools in the kit in order of how useful they were? 1 = most useful, 6 = least useful

- ⠿ [ ] Temperature and humidity meter
- ⠿ [ ] Radiator key
- ⠿ [ ] Fridge/freezer thermometer
- ⠿ [ ] Thermal leak detector
- ⠿ [ ] Stopwatch
- ⠿ [ ] Plug-in energy monitor

3. Overall the Home Energy Saving Kit:

	Agree	Neither agree nor disagree	Disagree
Met my expectations	○	○	○
Made me think about how I use energy in the home	○	○	○
Made my family think about how they use energy in the home	○	○	○
Encouraged us to think about replacing appliances to reduce energy use	○	○	○
Encouraged us to think about upgrading our home (e.g. additional insulation, new boiler, etc.) to reduce energy use	○	○	○

4. Would you recommend the Home Energy Saving Kit to others?

- ○ Yes
- ○ No

5. Would you recommend making any changes to the kit?

- ○ Yes
- ○ No

What changes would you recommend making to the kit?

6. In general, how much do you try to save energy in your household?

- ○ Not at all
- ○ A little bit
- ○ Somewhat
- ○ A great deal

7. How much does each of the following motivate your household to save energy?

	Not at all	A little bit	Somewhat	A great deal
Environmental impact	○	○	○	○
Cost of your energy bill	○	○	○	○
Convenience	○	○	○	○
Habit	○	○	○	○
Comfort	○	○	○	○
Keeping my use similar to others	○	○	○	○
Benefit to society	○	○	○	○
Because it's the right thing to do	○	○	○	○
Guilt	○	○	○	○
Learning about energy use	○	○	○	○
Increasing the value of my home	○	○	○	○
Challenging myself	○	○	○	○

8. Please indicate how much you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I think of myself as part of an ecological community	○	○	○	○	○
I think of my community as an environmental system composed of interrelated parts	○	○	○	○	○
If things continue on their present course, we will soon experience a major ecological catastrophe	○	○	○	○	○
Climate change is a problem for society	○	○	○	○	○
People in my community expect me to do my part	○	○	○	○	○
My neighbours are trying to conserve energy	○	○	○	○	○
Each individual has a responsibility to do his or her part for the environment	○	○	○	○	○
I don't see any problem with using a lot of energy	○	○	○	○	○
I feel morally obliged to reduce my energy use, regardless of what other people do	○	○	○	○	○

9. How frequently do you…?

	Almost never	Rarely	Sometimes	Often	Almost always	N/A
Limit time in the shower	○	○	○	○	○	○
Cover saucepans while cooking	○	○	○	○	○	○
Fill kettle only with required water	○	○	○	○	○	○
Turn off lights when not needed	○	○	○	○	○	○
Turn off or unplug appliances when not in use	○	○	○	○	○	○
Unplug appliances when not in use including rechargeables once recharged	○	○	○	○	○	○
Reduce heating in unoccupied rooms	○	○	○	○	○	○
Line dry clothes washing	○	○	○	○	○	○
Wash laundry on colder settings	○	○	○	○	○	○
Wait for full load before doing clothes washing	○	○	○	○	○	○
Adjust thermostat setting at night or while away	○	○	○	○	○	○
Try to keep heat in by closing doors, curtains and using draught excluders	○	○	○	○	○	○
Run your dishwasher on low temperature	○	○	○	○	○	○

10. How frequently do you..?

	Every six months	Every year	Every year to two years	Almost never	N/A
Bleed your radiators	○	○	○	○	○
Defrost your fridge/freezer	○	○	○	○	○
Check the temperature of your fridge/freezer	○	○	○	○	○
Get boiler (for gas or oil central heating) professionally serviced	○	○	○	○	○

11. Since using the kit I am thinking about the following measures? (check all that apply)

- [ ] Buying energy saving light bulbs
- [ ] Buying more energy-efficient appliances
- [ ] Insulating my attic/roof
- [ ] Insulating my walls
- [ ] Upgrading my boiler
- [ ] Upgrading my heating controls
- [ ] Getting a Building Energy Rating (BER) done
- [ ] Replacing my windows
- [ ] None of the above

Detailed feedback and recommendations from survey respondents

Question: "Would you recommend making any changes to the kit?"

Bold = recommendation from participant

Participants' responses are reproduced directly below without any post-editing.

[1] Met my expectations

[2] Very easy to use and covered most areas of home energy

[3] no changes needed

[4] N/A

[5] Maybe allow people to purchase

[6] Suggest alternatives to save energy

[7] Radiator key did suit old radiators. No monitoring of heavy use items, immersion, dryer, washing machine, dishwasher.

[8] none

[9] The energy monitor is wildly inaccurate when reporting the cost. In my test of the kettle, the kettle boiled in 3.5 minutes and used 2.4kW. The energy monitor electricity cost was set to 0.144 €/kWH. So the cost should be: (3.5)(2.4)(0.144)/(60) or about 2 cents. The energy monitor displayed 14 cents.

[10] N/A

[11] No changes

[12] It would be interesting if there was a way to measure the energy consumption of the lights. Our house was recently renovated and well insulated and our appliances are new, therefore using the kit did not make me think about doing any improvement work. However the Thermal Leak Detector let me see that the new windows and insulation are very effective!

[13] The tools were easy to use and the instructions easy

[14] The kit is very easy to use with step by step instructions. Extra batteries could be included in kit.

[15] The readings from the Temperature & Humidity Meter readings strongly disagrees with the other readings, including the readings from our home central heating temperature gauge.

[16] Although I was very interested in seeing the results of the plug-in energy monitor, I found it too difficult to use, especially because my time with the kit was limited. It would need a lot of time to use and get any useful data from anything but a kettle.

[17] None. Very user friendly and educational

[18] Stopwatch no longer required, I used my phone. Rad bleed key didn't work on worst radiators, as they were imperial and not metric

[19] None

[20] NA

[21] No changes
[22] No changes
[23] temp and humidity device was very slow to react meaning inaccurate readings

[24] Very useful kit. I had previously done some of the basics. The thermal leak detector was awesome, The monitor plug was also useful
[25]<NA>
[26] Plug in monitor is not easy to read. It did not do as indicated in the instructions. I just used it to compare lamps and saw quite a difference in the non-energy saving bulbs.

[27] N/A
[28] N/A
[29] Carbon Monoxide meter would be useful
[30] COULD IT BE IN A SMALLER CASE?
[31] <NA>
[32] It works fine
[33] A gadget to track outdoor v indoor temperature as the house calls down at night, to estimate insulation effectiveness
[34] An energy meter that can be clamped around the supply cable for units were socket is inaccessible or positioned so that the plugin meter cannot fit.
[35] I think it is fine.

Hierarchical Regression and the Benefits of a Bayesian Approach

Because we were comparing participants' energy attitudes and behavioural intentions before using the Kit to after using the Kit, we had responses to the same items at two time points from the same participants. Therefore, participants' responses at the two time points were not statistically independent, as their answers on the first iteration yielded some information into their potential responses on the second iteration. Non-hierarchical regression is ill-suited for this analysis task, as independence of observations is a key statistical assumption underlying that technique. Therefore, alternative approaches are required.

One common alternative in some research fields is to attempt to predict participants' second set of scores (i.e., their post-Kit responses) while statistically 'controlling' for their first set of scores (e.g., pre-Kit responses). However, this approach is known to be unreliable and is discouraged in modern statistical practice in spite of its common use (Gelman & Hill, 2007). Therefore, we elected to use the hierarchical regression approach.

Hierarchical models are able to estimate data with multiple 'levels', thus accounting for the non-independence of observations. In the case of these data, we have responses at two levels: the 'population level' (i.e., a code distinguishing pre-Kit and post-Kit time periods), and the 'group level' (i.e., every participants' response at each time point). The hierarchical regression analysis allows the simultaneous assessment of both population- and group-level effects. Using group-level regression intercepts and slopes (sometimes called 'random intercepts/slopes'), we are therefore able to do assess several things in the same model. For example, we are able to assess the overall degree of pre- to- post Kit change in behavioural intentions (i.e., the population-level effect) while also estimating the patterns for each participant across each time point (i.e., the group-level effects). This allows the ability to explore variation across time points as well as across individuals.

The power of hierarchical models have made them the go-to approach for many statistical problems, such as longitudinal data analysis and time series analysis. Hierarchical (Bayesian) regression has been advocated for as the default approach for most regression problems (Gelman, Hill, & Yajima, 2012; McElreath, 2016). While hierarchical regression techniques also have non-Bayesian implementations, there is (growing) widespread consensus that Bayesian methods are best suited for the task (Gelman & Hill, 2007; Gelman et al., 2013; McElreath, 2016). While the technical details for this rationale are mostly beyond the scope of this report, it is sufficient to say that the power of Bayesian estimation in hierarchical models comes from *adaptive partial pooling* (Gelman et al., 2013). The Bayesian model 'learns' from the data while it is fitting the model and uses these adaptive 'hyperpriors' to inform estimates of other levels in the data. This process tends to produce more accurate estimates as a result compared with other methods, including non-

Bayesian hierarchical models (McElreath, 2016). The power of this approach cannot be understated: regularizing priors and adaptive partial pooling enable complex and nuanced models to be fit, including models where there are more parameters than actual participants (c.f., Gelman & Hill, 2007).

Interpreting Bayesian Models

The inner workings of Bayesian analysis and perspectives on probability exceed the limitations of this summary, but several important points regarding the interpretation of Bayesian models are warranted (for accessible introductions to Bayesian inference, see McElreath, 2016, and Kruschke & Liddell, 2017).

First, Bayesian estimation does not involve the calculation of p-values for 'statistical significance', and involves a fundamentally different perspective on probability and inference. There are well-documented problems with p-values and the approach of searching for 'significant' values (e.g., Wagenmakers, 2007), culminating in a recent call from several applied researchers and statisticians to abandon the statistical significance frame altogether (McShane et al., 2018). What this means in practice is that the approach of trying to identify meaningful effects to inform policy by searching for p-values that are below .05 (or .01, etc.) is misleading. Therefore, we do not use such methods in this report.

Second, traditional approaches such as maximum likelihood estimation (the estimation underlying ordinary least squares regression) only provide a single point estimate as a plausible value. This is problematic, as it can falsely imply a degree of certainty in the result if not interpreted with caution. Confidence intervals are sometimes used to assist with this, though their interpretation is notoriously difficult and do not provide the certainty many researchers would hope for (Morey, Hoekstra, Rouder, Lee, & Wagenmakers, 2016). As an alternative, Bayesian analysis provides a full distribution of plausible point estimates, with varying degrees of probability assigned to these estimates. This fundamental fact of Bayesian analysis makes the interpretation and summarization of results very straightforward: values closer to the centre of the distribution of an estimate have higher probability than values closer to the tails.

This full 'posterior distribution' of values can be summarized using 95% highest posterior density intervals (HPDIs), which quantify the values of the distribution that capture 95% of the probability density. However, it is vital to note that it is *inappropriate* to interpret these 95% posterior density intervals as 'statistically significant' if the interval does not include a value of zero. This is because the posterior distribution *already contains the full probability distribution*, and the choice of 95% HPDIs (vs. 50%, 75%, etc.), is an arbitrary choice. Indeed, this approach includes much more rich information for application than the dichotomous thinking often introduced when using p-values and confidence intervals. For our analyses, we provide appendices that include the full posterior distributions for every model estimated, where readers can directly view which values are most plausible (conditional on the model we have specified). In the results, we provide summaries of 95% highest posterior density intervals as a way of communicating the probability and uncertainty in different findings (e.g., wider HPDI's may suggest greater uncertainty/variability).

Energy Saving Motivations Model

Bayesian hierarchical regression (Gelman et al., 2013) was used to estimate the energy savings model. Cumulative probit regression with flexible category thresholds was implemented. The change in time from pre- to post-kit was estimated as the main predictor, while allowing the intercept and the slope to vary across each participant to account for the two-wave nature of the data. Home age and age of participants, both of which were binned categorical variables, were entered as random intercepts as well, and the slope of pre- to post-kit time was allowed to vary across each. Participant gender (female, male) was also entered as a fixed predictor, with the effect of gender allowed to vary across participant as well.

Weakly informative priors to promote moderate regularization were placed on the regression coefficients and intercept (normal(0, 0.5)). Due to the limited data, narrow regularizing priors were placed on the hierarchical standard deviations to aid in model convergence (normal(0,.15)). After initial model divergences and skew in posteriors were observed, slightly more regularizing priors were placed on the hierarchical standard deviations for home age and age of participants

(normal(0,.10)). The estimated correlation among random intercepts and slopes was given a regularizing Cholesky correlation prior (lkj(5)).

Energy and Climate Attitudes Model

Regularising, weakly informative priors were entered on the regression coefficients (normal(0,1)), and a regularizing prior centred near the outcome median was placed on the intercept (normal(4, 0.5)). Hierarchical standard deviations were given the same priors as the previous model (normal(0, .15)). The estimated correlation among random intercepts and slopes was given a regularizing Cholesky correlation prior (lkj(5)). The residual standard deviation was modelled using a half cauchy prior (location = 0,, scale = 2).

Behavioral Frequency Model

The same model design and set of prior distributions described in the energy and climate attitudes model were applied to this model as well.

Estimation Details

All models were estimated using the 'brms' package (Burkner, 2017) for R. Plots were produced using the *bayesplot* package (Gabry and Mahr, 2018). *Brms* uses Stan, a probabilistic programming language for Bayesian statistics, for full Bayesian inference using Hamiltonian Monte Carlo (Carpenter et al., 2017). Estimation was performed using 3 chains, with 4,000 iterations per chain (2,000 warmup). To aid in convergence and reduce divergent transitions, the delta of the sampling algorithm was increase from .80 (the default) to .99, which is common to do in the case of hierarchical models (McElreath, 2016). Trace plots were evaluated for all models, as well as posterior predictive checks, each of which were adequate for the purposes of model interpretation here (Gelman et al., 2013). Rhat values did not exceed 1 indicating that each chain mixed well (Gelman et al., 2013).

Appendix 2. Short overview of additional kit information

The top ten checklist gives some insights into which behaviours are considered top priority in Ireland:

- get **boiler** (for gas or oil central heating) **professionally serviced** once a year (efficiency/ routine investment, small cost)
- **turn down water temperature** (curtailment/once-off behaviour, free)
- check if water heater has **insulating jacket** (efficiency/once-off investment, small cost)
- replace tungsten bulbs with **CFLs or LEDs** (efficiency/routine investment, small cost)
- **turn off lights** in unoccupied rooms (curtailment/routine behaviour, free)
- **turn off computer** screen when not in use (curtailment/ routine behaviour, free)
- avoid standby by **switching appliances off** walls (curtailment/routine behaviour, free)
- fit **thermostatically-controlled radiator valves** (TRV) to your radiators (efficiency/once-off investment, small cost)
- **open and close curtains** as relevant (curtailment/routine behaviour, free)
- **buy most efficient appliances** using energy label (efficiency/once-off investment, large cost)

In the energy saving kit take-home booklet, these behaviours are noted as the top actions to take in response to the kit tools (the ones repeating from top ten checklist are marked*):

Thermal leak detector:

- **close curtains and doors*** (curtailment/routine behaviour, free)
- **use draft stripping** (efficiency/once-off investment, small cost)
- **get new windows/doors** (efficiency/once-off investment, large cost)
- **upgrade insulation** (efficiency/once-off investment, large cost – but subsidies)

Temperature and humidity meter:

- **turn down thermostat** (curtailment/once-off behaviour, free)
- **use temperature cards** (curtailment/once-off behaviour, free)
- **upgrade to high-efficiency boiler and advanced controls** (efficiency/once-off investment, large cost)

Radiator key:

- **bleed your radiators** (curtailment/routine behaviour, free)
- **get your boiler serviced*** (efficiency/routine investment, small cost)
- **install TRVs*** (efficiency/once-off investment, small cost)

Stopwatch:

- **reduce your shower time** (curtailment/routine behaviour, free)
- **adjust water temperature*** (curtailment/once-off behaviour, free)
- **install aerated shower head and taps** (efficiency/once-off investment, small cost)
- **install solar hot water panels** (efficiency/once-off investment, large cost)

Fridge/freezer thermometer:

- **adjust temperature** (curtailment/once-off behaviour, free)
- **defrost fridge/freezer** (curtailment/routine behaviour, free)

Plug-in energy monitor:

- **turn off appliances*** (curtailment/routine behaviour, free)
- **avoid wastage e.g. kettles, dishwasher and washing machine loads** (curtailment/routine behaviour, free)
- **buy A-rated bulbs and appliances*** (efficiency/once-off investment, large cost)

Additional behaviours from the big energy saving manual (any already mentioned once* or twice**):

Space heating (temperature):

- **use a heating timer (TOP TIP)**
- **turn down room thermostats (TOP TIP)***
- turn radiators down or off
- close doors*
- regularly bleed your radiators**

- put on extra jumper or blanket
- make use of the sun in winter, avoid it in summer*
- don't put furniture in front of radiators
- prevent curtains from hanging over radiators
- use radiator foil
- fit draft excluders around attic door
- buy draft excluders*
- decorate with carpets to insulate floors
- use window seals or gap fillers*
- buy thermal insulated curtains
- place window sills over radiators
- install TRVs**
- get your boiler serviced**
- fit central heating zone valves*
- replace your windows*
- install new insulation in attic*
- install new wall insulation*

Space heating (humidity):

- put bowl of water on top of radiator
- buy plants
- use a ceramic humidifier
- buy energy-efficiency humidifier
- hang up washing outside
- make sure heating is set sufficiently high*
- ensure sufficient ventilation
- buy moisture absorber
- fit window vents
- use de-humidifier

Water heating:

- **adjust temperature of water heating** (TOP TIP)**
- **prioritise taking shower over having bath (TOP TIP)**
- avoid power showers*
- reduce shower flow rate to 9L/m
- fix dripping hot taps
- use shower timer to reduce amount of water
- install aerated taps and shower head*
- insulate pipes
- fit an insulation jacket around hot water cylinder*
- replace water cylinder
- consider solar hot water system*

Appliances:

- **run dishwasher on low temperature* (TOP TIP)**
- **run washing machine on cooler cycle* (TOP TIP)**
- **adjust fridge/freezer temperature* (TOP TIP)**
- put washing out to dry*
- avoid dryer
- keep freezer full
- defrost fridge/freezer regularly*
- move fridge/freezer to cooler location
- cool hot food before putting it in freezer
- turn off all appliances at night**
- use energy-saving mode on computer
- turn computer off overnight*
- turn on electric blanket for half an hour before bed
- boil only as much water as you need*
- user dryer balls
- buy appliance power strips
- replace door seals on fridge/freezer
- upgrade appliances to A+++ rated**
- consider solar PV

Lighting:

- **maximise use of daylight (TOP TIP)**
- **turn off lights after leaving room** (TOP TIP)**
- clean windows regularly
- furnish room to allow maximum daylight for specific activities
- avoid net curtains or blinds that reduce daylight penetration
- clean lights, bulbs and shades
- make use of task lighting
- use dimmer switches and multiple light switches
- use CFLs or LEDs**
- paint walls in bright colours
- consider motion sensors
- install mirrors around skylights
- buy LED or solar fairy lights for garden
- install energy-efficient sky light

Cooking:

- **don't open oven door (TOP TIP)**
- **cook meals together (TOP TIP)**
- **make use of residual heat (TOP TIP)**
- use pots and pans that cover whole size of cooker ring
- use lids on pots and pans
- boil water in kettle before cooking
- use toaster instead of grill
- careful how you use general kitchen appliances most efficiently
- use microwave for smaller meals
- keep oven clean
- replace oven door seals
- use slow or pressure cooker

Energy consumption:

- **read electricity and gas meter (TOP TIP)**
- **find out what tariff you are on and switch to ToU (TOP TIP)**
- **read your energy bill (TOP TIP)**
- **compare tariffs of other utilities (TOP TIP)**
- set yourself target for energy reductions
- get a building energy rating (BER) for your home

IEA Demand Side Management Energy Technology Initiative

The Demand-Side Management (DSM) Energy Technology Initiative is one of more than 40 Co-operative Energy Technology Initiatives within the framework of the International Energy Agency (IEA). The Demand-Side Management (DSM) Energy Technology Initiative, which was initiated in 1993, deals with a variety of strategies to reduce energy demand. The following member countries and sponsors have been working to identify and promote opportunities for DSM:

Austria	Norway
Belgium	Spain
Finland	Sweden
India	Switzerland
Ireland	Canada
Italy	United Kingdom
Republic of Korea	United States
Netherlands	ECI (sponsor)
New Zealand	RAP (sponsor)

Programme Vision: Demand-side activities should be active elements and the first choice in all energy policy decisions designed to create more reliable and more sustainable energy systems
Programme Mission: Deliver to its stakeholders, materials that are readily applicable for them in crafting and implementing policies and measures. The Programme should also deliver technology and applications that either facilitate operations of energy systems or facilitate necessary market transformations

The DSM Energy Technology Initiative's work is organized into two clusters:
The **load shape cluster**, and
The **load level cluster**.

The 'load shape" cluster will include Tasks that seek to impact the shape of the load curve over very short (minutes-hours-day) to longer (days-week-season) time periods. Work within this cluster primarily increases the reliability of systems. The "load level" will include Tasks that seek to shift the load curve to lower demand levels or shift between loads from one energy system to another. Work within this cluster primarily targets the reduction of emissions.

A total of 24 projects or "Tasks" have been initiated since the beginning of the DSM Programme. The overall program is monitored by an Executive Committee consisting of representatives from each contracting party to the DSM Energy Technology Initiative. The leadership and management of the individual Tasks are the responsibility of Operating Agents.

These Tasks and their respective Operating Agents are:

Task 1 International Database on Demand-Side Management & Evaluation Guidebook on the Impact of DSM and EE for Kyoto's GHG Targets – Completed
Harry Vreuls, RVO, the Netherlands

Task 2 Communications Technologies for Demand-Side Management – Completed
Richard Formby, EA Technology, United Kingdom

Task 3 Cooperative Procurement of Innovative Technologies for Demand-Side Management – Completed
Hans Westling, Promandat AB, Sweden

Task 4 Development of Improved Methods for Integrating Demand-Side Management into Resource Planning – Completed
Grayson Heffner, EPRI, United States

Task 5 Techniques for Implementation of Demand-Side Management Technology in the Marketplace – Completed
Juan Comas, FECSA, Spain

Task 6 DSM and Energy Efficiency in Changing Electricity Business Environments – Completed
David Crossley, Energy Futures, Australia Pty. Ltd., Australia

Task 7 International Collaboration on Market Transformation – Completed
Verney Ryan, BRE, United Kingdom

Task 8 Demand-Side Bidding in a Competitive Electricity Market – Completed
Linda Hull, EA Technology Ltd, United Kingdom

Task 9 The Role of Municipalities in a Liberalised System – Completed
Martin Cahn, Energie Cites, France

Task 10 Performance Contracting – Completed
Hans Westling, Promandat AB, Sweden

Task 11 Time of Use Pricing and Energy Use for Demand Management Delivery- Completed
Richard Formby, EA Technology Ltd, United Kingdom

Task 12 Energy Standards - to be determined

Task 13 Demand Response Resources - Completed
Ross Malme, RETX, United States

Task 14 White Certificates – Completed
Antonio Capozza, CESI, Italy

Task 15 Network-Driven DSM - Completed
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 16 Competitive Energy Services
Jan W. Bleyl, Graz Energy Agency, Austria / Seppo Silvonen/Pertti Koski, Motiva, Finland

Task 17 Integration of Demand Side Management, Distributed Generation, Renewable Energy Sources and Energy Storages
Seppo Kärkkäinen, Elektraflex Oy, Finland

Task 18 Demand Side Management and Climate Change - Completed
David Crossley, Energy Futures Australia Pty. Ltd, Australia

Task 19 Micro Demand Response and Energy Saving - Completed
Linda Hull, EA Technology Ltd, United Kingdom

Task 20 Branding of Energy Efficiency - Completed
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 21 Standardisation of Energy Savings Calculations - Completed
Harry Vreuls, SenterNovem, Netherlands

Task 22 Energy Efficiency Portfolio Standards - Completed
Balawant Joshi, ABPS Infrastructure Private Limited, India

Task 23 The Role of Customers in Delivering Effective Smart Grids - Completed
Linda Hull. EA Technology Ltd, United Kingdom

Task 24 Behaviour Change in DSM: Phase 1 - From theory to practice
Phase 2 – Helping the Behaviour Changers
Dr Sea Rotmann, SEA, New Zealand

Task 25 Business Models for a more Effective Market Uptake of DSM Energy Services
Ruth Mourik, DuneWorks, The Netherlands

For additional Information contact the DSM Executive Secretary, Anne Bengtson, E-mail: anne.bengtson@telia.com and visit the IEA DSM website: http://www.ieadsm.org