EE3A: Pathways and initiatives for low-income older people to manage energy

Final Report

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Consortium Partners

Project Partners

Project Team	Members
Regional Development Australia Illawarra (RDAI)	Deborah Petkovic: Overall Project Manager Natalie Burroughs: CEO RDAI
University of Wollongong (UOW)	Prof Paul Cooper: Retrofit and Overall Academic Program Leader Prof Gordon Waitt: Social Geography Research Leader Kate Roggeveen: Social Geography Research Fellow Michael Tibbs: Retrofit Research Fellow and Project Manager Dr Georgios Kokogiannakis: Retrofit Program Researcher Clayton McDowell: Retrofit Program Researcher Laia Ledo Gomis: Retrofit Program Researcher
Macquarie University	Associate Prof Ross Gordon: Social Marketing Program Leader Katherine Butler: Social Marketing Project Manager Joshua Beard: Social Marketing Designer
WEA Illawarra	Kerrie Smith: Coordinator of EE3A Community Training Graham Neville: Trainer
Warrigal	David Rogers: Property and Sustainability Manager Laura Pritchard: Environmental Sustainability Officer
Royal Freemasons' Benevolent Institution	Steven Ellitt: Assets and Contracts Manager
IRT Group	Andrew Hahn: Head, Property Development
Illawarra Forum	Nicky Sloan: CEO
Viridis Australasia	Stephen Choi: Retrofit Implementation Coordinator Rory Eames: Retrofit Implementation

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Authors

Paul Cooper (University of Wollongong)
Ross Gordon (Macquarie University)
Gordon Waitt (University of Wollongong)
Deborah Petkovic (RDA Illawarra)
Natalie Burroughs (RDA Illawarra)
Michael Tibbs (University of Wollongong)
Katherine Butler (University of Wollongong/Macquarie University)
Kate Roggeveen (University of Wollongong)
Clayton McDowell (University of Wollongong)
Georgios Kokogiannakis (University of Wollongong)
Laia Ledo Gomis (University of Wollongong)
Christopher Magee (University of Wollongong)

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1 EXECUTIVE SUMMARY

1.1 Purpose and Background

Energy Efficiency in the 3rd Age (EE3A) was one of 20 projects across Australia that received funding under the Australian Government's Low-income Energy Efficiency Program (LIEEP). The objectives of LIEEP were to:

i. Trial and evaluate a number of different approaches in various locations that assist low-income households to be more energy efficient.
ii. Capture and analyse data and information to inform future energy efficiency policy and program approaches.

The EE3A project was delivered in line with the scope of the LIEEP program's objectives, the specific objectives were to:

1) Trial and evaluate a number of different approaches in the Illawarra region that assist low income older person households to be more energy efficient whilst maintaining quality of life/comfort across Independent Living Unit (ILU) residences, owner-occupied and private rental households.
2) Capture and analyse data and information to inform future energy efficiency policy and program approaches

The participants in the EE3A project were people aged 60 years and older with low income according to Australian Bureau of Statistics household income statistics. Given that the EE3A project involved working with potentially vulnerable low-income older people, the project sought to improve energy efficiency and thermal comfort in the home, wellbeing, and quality of life of participants.

This project sought to identify and overcome 'barriers' at home to increased energy efficiency and well-being for low-income older householders. Our starting point was a number of related questions:

a) Do older, low-income Australians value domestic energy efficiency?
b) Are older low-incomed Australian households limited in their adaptive energy efficiency capacity, especially the lack of financial and accurate information on alternative day-to-day practices and energy technologies for their homes?
c) What factors work for and against physical domestic energy efficiency retrofits in older, low-income households including: cultural, social and technical barriers to physically installing retrofits.

The EE3A project used a 'bottom-up' and consumer/participant-centred social marketing approach. This approach prioritised understanding of the everyday realities and practicalities of project participants. The project design brought participants' ideas, strategies and activities to the fore. In doing so, people were positioned as a key part of the solution to tackle energy efficiency rather than as a problem. The EE3A social marketing approach also used segmentation, targeting and positioning to deliver multi-component and tailored activities to participants in accordance with their homes and their practices. This approach differed from top down, one-size-fits-all strategies that can fail to acknowledge and align with the everyday realities of different population groups.

To undertake this task, the EE3A project team examined the effects of three innovative and multi-component intervention approaches:

1) A tailored social marketing program was delivered to over 830 households;
2) A subset of 185 of those 830 households also received customised energy efficiency retrofits; and
3) Community energy efficiency workshops and leadership capacity building courses were delivered with the intent to extend the project reach and effects in the broader community.

It should be noted that this project was entitled Energy Efficiency in the 3rd Age (EE3A) at the point that funding was awarded. However, in accordance with best principles in social marketing, the project team undertook extensive participant research, consultation and brand development. The "Energy+Illawarra" project was the community-focused brand for the intervention. Accordingly, this report refers to the project intervention name as Energy+Illawarra in many sections.

1.2 Project Methodology

The project utilised an interdisciplinary, multi-method, and multi-stakeholder approach to improving energy efficiency, thermal comfort and wellbeing for low-income older households. The project brought together the expertise and skills of engineers, social marketers and geographers, the principal regional development agency, community services and organisations, aged care providers, training and lifelong learning providers, and a range of key commercial providers of technical expertise, materials and service support for the project. This approach was designed to meet the social policy objective of reducing domestic energy costs while maintaining the quality of life and thermal comfort of older low-income people ageing in their homes.

To achieve the project objectives the following three (3) trials and associated activities were carried out:

1. **Social Marketing Only Program**
    a. Recruited and conducted a baseline survey regarding knowledge, attitudes, value perceptions, everyday practices and existing behaviours among a cohort 830 participant households within the Illawarra region.
    b. Recruited and conducted the same baseline survey with a control group cohort of 632 participant households located outside the project region of the Illawarra.
    c. Conducted qualitative formative research and household ethnographies with a sample of community participants to develop insight and understanding about the realities and practicalities of everyday home energy use, and barriers and facilitators to using energy efficiently.
    d. Utilised the analysis of the baseline survey, and the qualitative formative research to design and deliver a participant centred social marketing program to all intervention participant households from 2014-2016.
    e. Conducted a follow-up survey regarding knowledge, attitudes, value perceptions, everyday practices and current behaviours among with the intervention and control sample cohorts.
2. **Social Marketing with Retrofits Program**
    a. Randomly selected a sub cohort of 185 participant households from the initial baseline cohort of 830 participants, to be included in the retrofit trial.

    b. Setup monitoring equipment to measure energy consumption and indoor environmental conditions before and after the retrofits.
    c. Characterised residences and optimised retrofits for the sub cohort of 185 participants in retrofit trial.
    d. Conducted household ethnographies with a sample set of 37 participant households to better understand how energy was enrolled to 'make and remake homes'.
    e. Worked with suppliers to install appropriate low emission hot-water systems and other retrofits to meet the need of the sub cohort of 185 residences.
    f. Conducted follow-up qualitative semi-structured interviews as a form of process evaluation and to better understand the trial from participants' perspectives.

3. **Community Training**
    a. Developed and delivered energy efficiency training workshops within the community.
    b. Developed and delivered accredited training courses for aged and community care staff to influence energy efficiency behaviour through existing trusted relationships.

The social marketing program trial included five components:

(1) formative research to develop participant insights about energy efficiency, brand development, and the design, development and implementation of a research insight, theory based, participant-centred;
(2) A segmented and targeted social marketing program featuring a suite of activities regarding home energy efficiency, comfort and wellbeing including: newsletters, narrative videos, Liquid Crystal Display (LCD) brochures, small energy efficiency products (such as fridge magnets and remote control switches);
(3) a project website, social media activity, newspaper advertising, Facebook advertising, media relations and;
(4) media and stakeholder advocacy with energy retailers and policy makers,
(5) sharing of person-centred insights that fed into the retrofit trial.

Energy efficiency retrofit technologies ranged from ceiling and underfloor insulation, through solar hot water and reverse-cycle air conditioning systems, to draught-stripping, lighting, refrigerators and in-home energy consumption displays. Household ethnography insights helped inform the consultation process in regards to the selection of retrofits.

Workshops and training delivered to the wider community were twofold. The first an iPad training course teaching older low-income people how to access energy efficiency information online. The second focussed on development and delivery of courses for health and community care workers. This aim was to improve skills on communicating energy efficiency information in their everyday interactions with clients.

1.3 Key Findings

Results indicate the following.

1) Analysis of the baseline and follow-up survey data found that the Social Marketing Only, and the Social Marketing with Retrofit groups had significantly higher levels of perceived social value

and ecological value; higher levels of perceived thermal comfort during winter and greater perceived comfort in their overall home and bedroom compared to the control group.

2) These two intervention groups also had more positive attitudes towards energy efficiency compared with the control group. The Social Marketing group had significantly higher perceptions of comfort in their main living room compared with the control group. Satisfaction with thermal comfort was higher in the Social Marketing Only group compared with the other two groups.

3) This suggests that the interventions had an effect on changing attitudes, value perceptions towards being energy efficient, and perceptions of thermal comfort. Research evidence identifies that attitudes (Azjen and Fishbein, 1977; Kraus, 1995), and perceived value are predictors of future behaviour (Sweeney and Soutar, 2002). Perceptions of thermal comfort are an important indicator of comfort and wellbeing in the home (Ormandy and Ezratty, 2012).

4) Narrative/Fact Videos on LCD Brochures were widely seen as an innovative and successful way of communicating messages of Energy Efficiency to our cohort (see Section 3.1.7.4).

5) Due to a range of project delays and practicalities, the follow-up survey took place while the Social Marketing and Social Marketing with Retrofits programs were still being initiated and had not been fully delivered. As a consequence, no significant effects on self-reported energy efficiency behaviours were identified in this first follow-up survey. However, as stated above, previous peer-reviewed research identifies that attitudes and perceived value are predictors of behaviour change. Our results indicate significant effects on these outcomes from the intervention, even when this was measured in the early stages of implementation. A second follow-up survey to be delivered in the 3rd quarter of 2016 will facilitate more accurate assessment of effects on behaviour change.

6) Our analysis of participants' electricity bills and comparison of these against benchmarks of energy consumption by households in the community generally (at postcode level) demonstrated quantitatively that our Social Marketing with Retrofits cohort of householders use less energy than the general population. This was particularly true of households in aged care independent living units where the median energy consumption was 22.5% less than the benchmark general community (see Section 4.2.2.3), whereas the median for the other homes in this cohort was only 0.45% below the benchmarks.

7) We found that older low-income people are already doing much of the work of energy efficiency (see Waitt *et al.* 2016). What emerged in this study was that older low-income people often consider energy use through the lens of thrift and not being frivolous or wasteful.

8) We identified that although older low-income people are often using little energy, this can be problematic and create what Waitt *et al.* (2016) refer to as 'tyrannies of thrift' whereby being thrifty with energy use can lead to significant risks to comfort, health and wellbeing.

9) Ageing bodies: sickness and palliative care. The ways that energy is used, or enrolled, in the home changes across a person's life or lifecycle. In our project our older low-income households drew attention to the ways in which decisions around domestic energy use and energy retrofits is deeply embedded in sickness, dying and death.

10) One of the fundamental premises of Energy+Illawarra was that energy efficiency, comfort, and costs, are intertwined, and this was captured in a quote from one participant (65 years of age, retired, in the broader community, living with others), when asked about the conversations he has with others about energy efficiency and comfort:

    > *"it's not a one-sided conversation, because when you're talking about energy efficient, you're saying about money, you're talking about comfort, you're talking about everything that goes with it, what you've got to do to your house, how you can change your house. So it's all part - you can't sort it out into one part or the other, it all goes together."*

11) We found that older low-income households do not generally talk freely about or share their energy efficiency practices with their peers, or others, unless they have a high-level of trust of the other parties involved (including the researchers on the present project).

12) Thermal Comfort.
    a) In many cases homes were found to have indoor temperatures well outside the accepted limits for thermal comfort, which could have significant impacts on the health and well-being of occupants (World Health Organisation, 1987). Our investigation of indoor temperatures in 170 houses in the Social Marketing with Retrofits cohort, which were monitored over a winter period, revealed that (Figure 4.42b):
        i) Approximately half of these homes exhibited temperatures below 16°C for at least 20% of the winter: and
        ii) A considerable number of homes (approximately 10% in Figure 4.42b) exhibited temperatures below 16°C for very long periods in winter (over 65% of the total period).
    b) There are important and sometimes complex relationships between thermal comfort conditions in people's homes and their energy consumption. A simple example is that where improving thermal comfort by simply providing more heating or cooling without improving the efficiency of a heating or cooling system will increase energy consumption. However, more complex effects may come into play, for example increasing the mean indoor temperature in winter will also increase the energy consumption of a fridge in the home.

    13) Retrofits. A wide range of energy efficiency retrofit types (19) were trialled in this project. The fraction of houses/households that were deemed suitable for each retrofit varied very significantly, from over 60% of households retrofitted with the most common retrofit to only 1% for the least common. Factors in determining which retrofits were appropriate for a given building were complex, and ranged from technical suitability through to strong participant preferences. Some of the key findings in respect of a selection of specific retrofits include the following.

14) Insulation.
    a) The retrofitting of both ceiling and under-floor insulation was found to be effective and well-received by participants.
    b) It was not possible to determine whether insulation was present in the ceilings of a surprisingly high proportion of dwellings (29%), due to lack of householder knowledge and/or inaccessibility of the ceiling space to the audit team.

c) Our initial analysis of two cases indicates that increases in average indoor temperature as a function of outdoor temperature (temperature 'signatures' of given houses) of between 1 and 2 ^{o}C resulted from the installation of insulation.

d) The research team developed a cost benefit measure to estimate the cost to increase the mean indoor temperature as a function of outdoor temperature by 1.0^{o}C. The cost benefit estimated for these two ceiling and under-floor case studies, using the cost of installation only, was \$20/^{o}C and \$28/^{o}C per m^2 of insulation, respectively. *Note: that these figures are case study figures for particular buildings, climate zones, occupant practices, etc. They cannot be used to make generalizations about insulation retrofits in general.*

15) Fridges and freezers.

a) The average number of fridges that were self-reported per household by participants in this project was higher than the NSW average in previous Australian Bureau of Statistics surveys;

b) Importantly, our Building Characterisation Audits also found that many households. possessed an even larger number of fridges than they self-reported through the evaluation survey.

c) Our testing of existing fridges/freezers in participants' homes indicated that the energy consumption of these fridges can be significantly different to that predicted by the Energy Rating Labels on those fridges. In the relatively small number of cases of existing fridges in Energy Rating Labels in our retrofit homes *in situ* energy consumption was found to as little as half that given on the Energy Rating Label. Previous research also indicates that fridge energy consumption is strongly dependent on usage and environmental factors including: air temperature surrounding the fridge, quantity and type of items loaded in or out; frequency and duration of door openings.

d) Cost benefit analyses of fridge replacements are therefore fraught with complexity and uncertainty, given the issues listed above. The University of Wollongong engineering team are continuing to conduct research into this issue, including *in situ* monitoring of new fridges in participants' homes and laboratory Energy Label testing of fridges that have been removed from homes during the retrofits.

e) There appeared to be a low awareness by participants of the substantial energy savings available by replacing and rationalising the number of fridge/freezers in their home; and

f) There are a wide range of participant preference factors (e.g. aesthetics, emotional attachment to old appliances, etc) that will be import to address in future fridges/freezers replacement programs.

g) Older low-income households were found, in many cases, to have strong emotional attachments or functional preferences in relation to particular appliances/technologies (e.g. fridges/freezers), which was found to be more important than information on appliance performance in determining whether they proceed with a retrofit or not. The project team worked to with great success overcome this barrier by carefully assessing such emotional attachments and the likely energy/comfort impact of an appliance retrofit during the Building Characterisation Audit, before offering retrofits to participants.

16) Lighting retrofits.

a) Direct cost benefits calculations indicate that do-it-yourself (DIY) retrofits of LED bulbs to replace incandescent, halogen and CFL bulbs result in payback periods of order 0.9, 1.3 and

8.7 years, respectively. (*Note: that a number of assumptions apply to these calculations of nominal payback periods*. *See Section 4.2.12 for details*).

b) Through the interactions with participants it was clear that there were significant co-benefits that come from lighting retrofits including:
   i) Longer life of LED replacements means longer intervals between replacements. This is very important for older and infirm people, with health benefits accruing from the reduced risks and worries of falls and other difficulties in replacing bulbs.
   ii) Better quality of life through increased illumination (lux) levels, which is particularly important for older people.

17) Draft sealing.
   a) Draft sealing of doors and windows in homes was found to be a retrofit that could be applied to a very significant proportion of homes in the project (62%).
   b) Blower door tests were carried out on 13 number homes, and in addition to quantitative evaluation of the building envelope, the process also had the benefit of highlighting to participants where heated or cooled air may be lost from their building.
   c) Cost benefit estimates. From the results of a sample of blower door tests an estimate of the direct cost-benefit of draft stripping on heating/cooling energy consumption using weather data and assumed heating/cooling practices has been carried out for 5 homes. For DIY installations the payback period could be very favourable (i.e. significantly less than one year). But a number of major assumptions were made in these calculations, and very significant variations in payback period were found (by factors of >20 for DIY costs). These variations arise because of many complex issues such as condition of existing door/window seals, climate, etc. For full details see Section 4.2.10.2.
   d) Participants were generally happy with these retrofits, though some complained that the new seals made opening/closing doors too difficult for them.

18) In-home energy consumption display retrofits were installed in approximately half of homes in the Social Marketing with Retrofits cohort. The majority of participants welcomed the display and actively used it to better understand their consumption patterns and performance of particular appliances. Several reported buying new appliances and changing practices as a result. On the other hand a small minority took slight offence at the offer to have an in-home display installed; in some cases implying that they thought that monitoring their energy consumption could be seen as being ‘judged’ by the project.

The findings above give support to our view that it is important to adopt an insight-driven, consumer/participant-centred, and multifaceted approach to residential energy efficiency interventions.

Delays in both the completion of installation of retrofits and access to electricity bills (until February 2016) meant that, at the time of writing, an in-depth cost benefit analysis of the program as a whole, or of all the components separately, cannot yet be completed. However, the University of Wollongong and Macquarie University have committed to continue to collect further data and work on analysis of this data beyond the formal end of this LIEEP project. This includes a commitment to undertake a 3rd follow-up survey of participants in this project in the 3rd quarter of 2016. Results of this work will be made available in due course as an addendum to the present report.

1.4 Recommendations

The following key recommendations arise from this trial and should be considered for any future design and delivery of residential energy efficiency programs.

1. Our project has demonstrated that a residential energy upgrade program targeting older low-income households will have the best chance of success if a householder-centred, insight-driven, multi-component, interdisciplinary team intervention approach is taken.
2. Our trial identified that participant orientation and being participant-centred are very important. In relation to energy efficiency this means that it is important to position householders at the heart of the solution instead of considering buildings and behaviours as the problems to be solved. This supported by further evidence from the behaviour change field (see Department of Health, 2004; French and Gordon, 2015).
3. Energy efficiency among older low-income households is also concomitant with issues around comfort in home (particularly thermal comfort), everyday practicalities, and issues of health and wellbeing. This suggests that energy efficiency should be redefined to focus not only on issues around energy saving, economics and cutting back, but should also focus on using energy smartly and wisely to maintain comfort, health and wellbeing, particularly for low-income groups. In the Energy+Illawarra project, we used the following definition of energy efficiency: “Energy efficiency is using energy wisely and economically to sustain everyday life, live comfortably and support wellbeing”.
4. As identified in this project, due to the complexity of issues around energy efficiency and home energy use, interdisciplinary and multi-stakeholder approaches that meld science, social science, and community practice are essential.
5. Future energy efficiency social marketing programs, and energy policy, should address the issue of ‘tyrannies of thrift’ and try to support people to use energy efficiently in ways that maintain or facilitate their comfort, health and wellbeing.
6. Evidence from this project identified that one-size fits all and single component or magic bullet interventions (e.g. education alone or policy change alone) are not enough to achieve behaviour change. This result echoes that in the behaviour change field (see Department of Health, 2004; French and Gordon, 2015). Energy efficiency programs should be based on research insights and understanding of priority groups, be segmented and targeted to different priority groups, and use multi-component interventions that combine various activities including policies, regulation, influencing community/social norms, marketing and communications, investment in housing infrastructure, and provision and access to products, services and materials.
7. Research insights in this project identified some key areas for future research to investigate how energy is strongly associated with ageing bodies, end-of-life, sickness, dying and death. Future delivery of energy efficiency programs and associated research must therefore pay closer attention to the intersections between energy, health and home. This is particularly important for older low-income households who are concerned about the increasing impact of energy consumption on their health, and *vice versa*, as they continue to age.
8. The evidence from focus groups and ethnographies pointed to energy frugality practiced by some participants, their reported ‘Billing Anxiety’, and a fear amongst some of turning on heaters in winter. The monitoring techniques pointed to ambient thermal temperatures in several households well below recommended World Health Organisation levels for

extremely long periods in winter. This leads to our recommendation that further research be carried out that prioritises those most at risk of fuel poverty. This would include a more in-depth analysis of low energy use and ill health, and a cost-benefit analysis of a winter fuel bill assistance program for older low-income households living in cooler climatic zones.

9. Future government programs wishing to evaluate the impact of various interventions on household fuel bills should preferably have a central formal agreement between the government agency and all relevant energy utilities to supply billing data prior to commencement of the program. This should include an agreement on release of full household tariff data, Solar PV and off-peak metering configurations, etc. This recommendation is based on the difficulty experienced by the project team in gaining traction with electricity and gas distributors/retailers.
10. Future government household energy efficiency programs requiring a quantitative assessment of the efficacy of the interventions should be carried out over a five-year timeframe to facilitate establishment of benchmark 'before intervention' performance and sufficient evaluation to allow the effects of longitudinal changes independent parameters such as weather, etc. to be incorporated. This recommendation is based on our experience in surmounting the challenges of analysing household energy use data versus the impact of energy interventions in a relatively short timeframe.
11. The results of our testing of existing fridges has demonstrated the need for further in-depth research on the performance of existing and new fridges in people's homes, so as to develop a statistically valid methodology and results for estimation of the cost benefit of replacing an existing fridge or freezer.
12. An open-source Home Energy Efficiency Decision Support (HEEDS) tool. Following the success of the Retrofit Assessment and Implementation Process designed and implemented in this trial, which combined the scientific assessment of the house with insights from how everyday practices sustain a house as a home, we recommend that this process now be refined and made available as an open-source Home Energy Efficiency Decision Support (HEEDS) tool. This tool will: facilitate home energy characterisation; be customisable to account for material, personal and social characteristics of households; provide options regarding retrofit recommendations; include a module to support face-to-face consultations with householders to finalise retrofit allocation and implementation processes.

2 INTRODUCTION

In June 2013, Regional Development Australia Illawarra (RDAI) was awarded a $2.3 million grant from the Australian Government in Round 2 of the Low-income Energy Efficiency Program (LIEEP) to conduct the Energy Efficiency in the Third Age (EE3A) project, now Energy+Illawarra. The grant funds were supplemented by $1.2M of committed in-kind and cash contributions from partner organisations, i.e. University of Wollongong (UOW), IRT Group, Royal Freemasons Benevolent Institution, Warrigal, Illawarra Forum, Southern Councils Group and WEA Illawarra.

This project focused on reducing energy consumption whilst maintaining quality of life/comfort across Independent Living Unit (ILU) residences, owner-occupied and private rental households. The Energy+Illawarra project also aimed to provide better understanding domestic energy use amongst older low-income households. The greater Illawarra Region , i.e. the area as defined by the five Local Government Areas (LGAs) of Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee provided the field site for the project.

The project was conducted over a three-year period and concluded in May 2016.

The objectives of the Energy+Illawarra project directly supported and further refined the Australian Government’s objectives for the broader LIEEP initiative. The objectives for the project were to:

1. Trial and evaluate a number of different approaches in the Illawarra region that assist low-income older person households to be more energy efficient whilst maintaining quality of life/comfort across Independent Living Unit (ILU) residences, owner-occupied and private rental households; and
2. Capture and analyse data and information to inform future energy efficiency policy and program approaches.

2.1 Outline of the Multi-component Trial Methodology

The project utilised an interdisciplinary, multi-method, and multi-stakeholder approach to improving energy efficiency, thermal comfort and wellbeing for low-income older households. The project brought together the expertise and skills of engineers, social marketers and geographers, and key community stakeholders including the regional development agency, community services and organisations, aged care providers, training and lifelong learning providers, and a range of key commercial providers of technical expertise, materials and service support for the project.

The EE3A project used a ‘bottom-up’ and consumer/participant-centred social marketing approach in which ideas, strategies and activities were focused around research insights and understanding of the everyday realities and practicalities of project participants. Therefore, a key feature of the project was the generation of research insights among the target group to inform the development and tailoring of the intervention by the participant group in ways that work for them, and that will be most readily taken up by their peers beyond this project. These research insights also provided valuable information and learning to help inform future energy policy and programs.

This participant-centred approach positions people as a key part of the solution to tackling energy efficiency rather than as a problem. The EE3A social marketing approach also used segmentation, targeting and positioning to deliver multi-component and tailored activities to participants in accordance with their homes and their practices. This innovative and creative project approach was designed to meet the social policy objective of reducing energy costs while maintaining the quality of life and thermal comfort of lower income older people ageing in their homes. The three intervention components were

i) Social Marketing Only;
ii) Social Marketing with Retrofits; and
iii) Community training.

The participants in the trials were aged 60 years and over and were of low-income according to the Australian Bureau of Statistics decile categorisations of income in Australia (ABS, 2011).

Apart from the control group cohort from the evaluation survey study, all project participants were recruited from the greater Illawarra region.

The following diagram provides an overview of the approach and how each of the trial approaches were planned to be delivered.

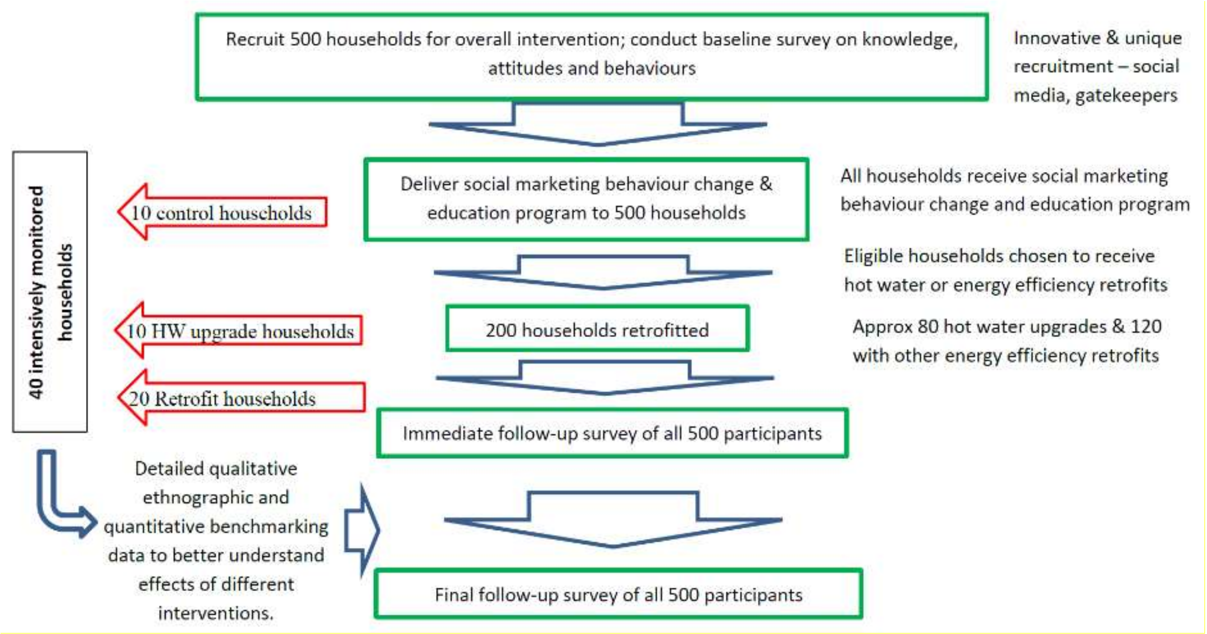

Figure 2.1 Schematic of project activities.

It should be noted that insights presented in Boxes throughout this report from semi-structured interviews are selected from, rather than representative of, the total sample. Each participant was given a pseudonym. Further qualitative analysis will be required to provide more comprehensive and representative discussion of the trial findings.

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3 SOCIAL MARKETING BEHAVIOUR CHANGE PROGRAM TRIAL

3.1 Methodology

3.1.1 Introduction

Associate Professor Ross Gordon, Department of Marketing and Management at Macquarie University and Visiting Senior Research Fellow at the University of Wollongong led the social marketing behaviour change program trial. Ross was supported by Katherine Butler, Project Manager, Centre for Health Initiatives at the University of Wollongong until 2015 and at Macquarie University in 2016. Josh Beard, Designer at Macquarie University was also a member of the social marketing team. This core team was supported by a number of research assistants and student volunteers who carried out surveys, assisted with fieldwork, data analysis, and social marketing activities, and a range of professional organisation staff including a video production agency, a LCD brochure manufacturer, the University of Wollongong media relations team, and a local printery.

The social marketing project team also worked closely and in partnership with the engineering and geography teams, RDAI, Aged Care Providers, Illawarra Forum, WEA Illawarra and Viridis Australasia to share insights, knowledge, and learning and to deliver the Energy+Illawarra project. Therefore, the contribution of all of these staff and stakeholders was essential to the social marketing behaviour change program trial.

"Social marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviour that benefit individuals and communities for the greater social good. Social marketing practice is guided by ethical principles. It seeks to integrate research, best practice, theory, audience and partnership insight, to inform the delivery of competition sensitive and segmented social change programs that are effective, efficient, equitable and sustainable." (iSMA, AASM and ESMA, 2013).

The inclusion of a social marketing program was a vital part of the project in the facilitation and engagement of project participants, as well as the broader community, and the program activities and development of resources. Social marketing programs involved the use of marketing and other relevant approaches to effect pro-social outcomes and social good. Accordingly, social marketing programs often seek to influence awareness, knowledge, attitudes, behaviours, the performance of practices, and structural and environmental conditions that affect a social issue like energy efficiency (French and Gordon, 2015).

Social marketing programs should always be citizen oriented and follow a bottom up, participatory approach in which programs, strategies and tactics are based around the realities, needs and wants of people's lives, rather than a top down expert driven approach. Therefore, social marketing considers people as part of the solution to social issues, not the problem. Good social marketing programs should also make judicious use of theory to help inform, develop, understand and evaluate.

Social marketing programs also seek to create value for citizens, and identify clear exchanges that offer value – such as benefits to people from being energy efficient like saving on their energy bills, feeling good about saving energy, and making a small contribution to protecting the environment.

Social marketing also considers the competition to behaviour and social change, and tries to address barriers to pro-social outcomes.

This method also does not approach citizens with a one size fits all option, but uses segmentation and different targeted and tailored approaches to facilitate change. Social marketing also offers a strategic approach to behaviour and social change and encourages systems thinking, in which social issues and complex social problems (also known as wicked problems) are influenced by systems that interact and affect one another. Therefore, if social policy and programs are to be effective, systems interactions, the elements of a system, and the effects of systems needs to be acknowledged and understood.

In relation to intervention strategies and tactics, social marketing draws on a wide range of tools across the marketing mix – moving far beyond simple communications or promotion, but using a number of complementary approaches such as communications, branding, products and materials, services, training, advocacy, and policy change (French and Gordon, 2015). For the Energy+Illawarra social marketing program, the Consortium Group identified a number of objectives. The key objectives have been identified in Table 3.1 against the Social Marketing Benchmark Criteria.

Table 3.1 Key objectives against the Social Marketing Benchmark Criteria.

Behaviour Change	Raise awareness and increase energy efficient behaviours, comfort and wellbeing among elderly residents of the Illawarra region of NSW.
Customer orientation	Using consumer research to focus on the target population, and fully understand what moves and motivates them. Gain key stakeholder understanding. Involve the target audience, and pre-test intervention materials with them.
Theory	Program will make use of appropriate use of behavioural theory to guide interventions. For example, value theory in marketing can be used to promote the functional and emotional and ecological benefits of energy efficient behaviour change.
Insight	Baseline survey, literature searching, and formative research will be used to generate insight and inform development of social marketing program.
Exchange	The social marketing program will consider the benefits and costs of adopting and maintaining energy efficient behaviours, and identify and provide incentives to change.
Competition	We will seek to understand what competes for the participants' time, attention and inclination to behave in a particular way, and address barriers to behaviour change.
Segmentation	We will segment the participants according to type of residence, demographic, and psychographic (attitudes, beliefs and value perceptions) and target communication strategies accordingly.
Marketing Mix	Program will use a range of appropriate marketing communication strategies identified during consumer research as appropriate for the target audience: examples may include peer to peer communication, events, leaflets, brochures, posters, website, and branding, to encourage energy efficient behaviours.

The social marketing program involved the iterative stages of formative research, design, pretesting, delivery and implementation, and finally evaluation – which is an ongoing activity.

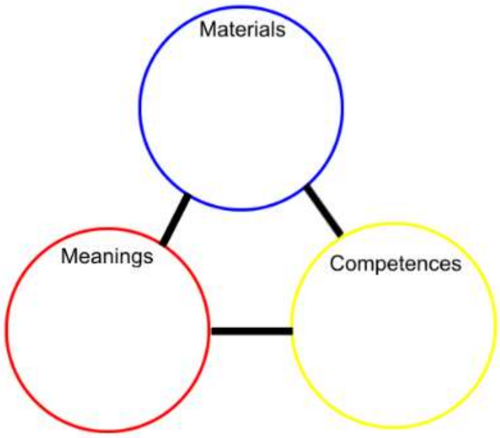
3.1.2 Theory

As identified earlier, good social marketing programs should always make judicious use of theory. Theory can help predict, understand, explain, and evaluate people's knowledge, attitudes, behaviours and practices, and help in understanding the social world (French and Gordon, 2015). Accordingly, the Energy+Illawarra project draws upon three main theoretical frameworks: the social ecological model, social practice theory, and value theory.

Energy+Illawarra utilises a social ecological model (Dahlberg *et al.* 2002) approach to social marketing, acknowledging that tackling complex social issues like energy efficiency requires insight, and action at the micro/meso/exo/macro level (Bronfenbrenner, 2005).

Accordingly the baseline and follow-up surveys measure participant's knowledge, attitudes, and behaviours not only at the individual level, but concerning the community level (families, peers, workplaces, public services), and the macro/policy level (policy, government, social norms, the built environment). Furthermore, the social marketing program uses a social ecological approach, seeking to influence the individual through activities including products, home installations, promotion and communications; the community through events, peer to peer conversation, and training; and the macro environment through media relations, advocacy, policy change, influencing social norms, and changes to the built environment.

The project also draws upon social practice theory (SPT), a social theory that helps understanding of people's energy use as part of everyday life (see Reckwitz, 2002; Schatzki, 2002; Shove *et al.* 2012). SPT is a framework for understanding the social world and the performance of everyday practices as citizens go about their everyday lives. Social practices refer to everyday practices, such as consumption of food (Warde, 2005), cycling or indeed any other physical activity (Spotswood *et al.* 2015) or using energy in the home (Shove, 2012), and the way that these are typically and habitually performed in society (Schatzki, 2002). Such activities are comprised of different elements such as bodily and mental activities, use of materials/things, knowledge, language, structures, space and place, and individual or group agency, that are utilised to routinely perform the practice (Reckwitz, 2002). Figure 3.1 presents a framework of social practices developed by Shove *et al.* (2012).



Materials: including things, technologies, tangible physical entities, and the stuff of which objects are made

Competences: which encompass skill, know-how and technique; and

Meanings: symbolic meanings, ideas and aspirations (Shove *et al.*, 2012, p.14)

Figure 3.1 The social practice framework.

SPT offers a theoretical lens for understanding not just behaviour or a set of behaviours, but the various components that underpin performance of a practice, such as using energy in the home and being energy efficient. Using a SPT approach the focus is not primarily on people and their behaviours, but on the practices themselves and how they are performed. Therefore, practice theory offers a broader and more nuanced lens for understanding social issues than approaches that focus on economic rational action, or personality and the psychology of individual behaviour (Spotswood, 2016). As such, SPT can help locate and understand discrete social behaviours such as using a fridge, or switching the heating on or off within a broader rubric of the practices people perform in everyday life. The value of SPT for social marketing and behaviour change has recently been identified (Spotswood *et al.* 2015, French and Gordon, 2015). For example, SPT offers a powerful approach for use in formative research that can inform the development of social marketing behaviour change programs. Gaining insight on how people use various elements and resources to perform everyday practices such as using energy can offer valuable new insights and understanding as well as help inform policy and interventions. Indeed, SPT is now being used widely across the social sciences and is informing and influencing policy in relation to energy and many other social policy areas (see Shove, 2014).

The Energy+Illawarra project also drew on value theory, a conceptual framework from the marketing and consumer research literature (Sánchez-Fernández and Iniesta-Bonillo, 2007). Value can be defined as the regards that something is held to deserve, the importance, worth, or usefulness of something. Value theory proposes that consumers such as the participants in the Energy+Illawarra project perceive value in buying and using goods and services (Sánchez-Fernández and Iniesta-Bonillo, 2007), *or in performing behaviours – such as using energy efficiently* (French and Gordon, 2015). Value theory posits that consumers may perceive economic, functional, emotional, social, and ecological value in buying or using goods and services, or performing behaviours. Furthermore, value theory research suggests that the greater value people perceive the stronger the influence on their behaviour (as illustrated in Figure 3.2).

Functional value relates to the utility, convenience, and control value provided by the consumption of something. It is extrinsically motivated (perceived as a means to an end), and for the benefit of the self rather than others. In social marketing an example would be the consistency in the quality of a screening service, control over the process being well delivered, and being of acceptable standard of quality (Zainuddin *et al.* 2011).

Economic value is a consumer perception focused on price and cost-benefit analysis from consuming goods and services, or from performing behaviours. Economic value is intrinsically motivated. An example here may be whether consumers perceive that using energy efficiently would provide value for money.

Emotional value is self-oriented, and relates to consumer perceptions of whether the consumption provides an emotional experience and for no other end-goal (Holbrook, 2006). Emotional value is intrinsically motivated (it is an end in itself). Essentially, emotional value can be related to different affective (emotional) states that are felt during a consumption experience that can be positive (e.g. confidence and pleasure) negative (e.g. anger and fear) (Sánchez-Fernández and Iniesta-Bonillo, 2007), or even neutral (ambivalence).

Social value is the perceived value through consumption that relates to influencing other people as a means to achieving a desired goal, such as social status or having influence within groups (Russell-Bennett *et al.*, 2009). It is also extrinsically motivated, but is directed at others (Holbrook, 2006). For example, a person may use energy efficiently to appear energy conscious and not wasteful in the eyes of family or friends.

Ecological value relates to consumer perceptions of value through a consumption experience that provide value for ecological/environmental issues. It is intrinsically motivated, and acknowledges the impacts that consumption behaviour and experiences can have on the natural environment (Koller *et al.*, 2011).

Therefore, the Energy+Illawarra project aimed to measure participants' perceived economic, functional, emotional, social, and ecological value of using energy efficiency in the baseline and follow-up surveys. The social marketing program was also aimed at increasing participants' perceived value in using energy efficiently, and demonstrating that social marketing can be used to help create value. In addition, the results of the response to the value theory questions at baseline have been used to **segment** (group) participants according the different values they perceived towards using energy efficiently. Subsequent social marketing materials, communications and messages were then tailored and positioned to these different segments according to their value perceptions.

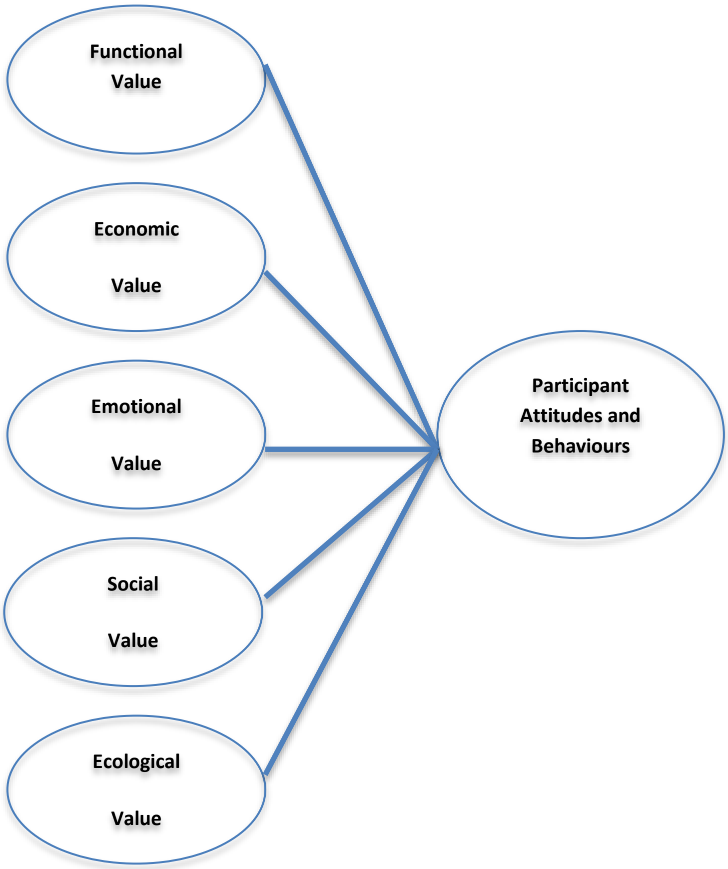


Figure 3.2 Value theory and consumer attitudes and behaviour.

3.1.3 Recruitment

The overall the Energy+Illawarra project used a randomised control study evaluation design, and recruitment for the evaluation study was also used for recruitment of participants for the Social Marketing Only, and Social Marketing with Retrofits intervention trials. Randomised control group evaluation study designs, also known as randomised control trials or RCTs are commonly recognised as the gold standard methodology for evaluating intervention effects (Stead and Gordon, 2009). For the intervention group, based on sample power calculations and expected attrition during the course of the project, a target baseline sample was set at a cohort of 900 participants (so as to ensure maintenance of participation by over 500 participants by the end of the trial).

The recruitment of low-income participants over 60 years of age was originally designed to occur through the various consortium member relationships and networks. Consortium members were able to provide access to existing networks that fell within the target criteria, however there were limited staff resources available to spend the necessary time in the field to introduce the project, establish whether a potential participant satisfied all the criteria, and obtain the necessary consent forms. Therefore, RDAI engaged a market recruitment agency, I-view, who was responsible for recruiting participants over the April to May 2014 period.

It was intended that at least 100 participants residing in independent living units (ILUs) were to be recruited from particular villages operated by the aged care village providers (Warrigal, IRT Group and RFBI) who were project consortium members. I-view was instructed to recruit the ILU participants during face-to-face forums organised at each village. Following this initial approach a total of only 34 participants were recruited in this way. It became clear that this initial approach was not suitable due to resource issues and poor response rates. Accordingly, I-view were instructed to telephone all residents that had listed phone numbers whose address coincided with targeted aged care villages. This amended recruitment process for ILU participants was given ethical approval by the UOW Human Research Ethics Committee.

The remaining target baseline sample was recruited by generating a random sample of participants. This involved randomly calling listed telephone numbers within the specified geographic locations during which community members undertook a short, five minute telephone survey to screen for eligibility (including age and income, see Appendix A for more details). Once eligibility was established, the I-view contact briefly explained the project and asked the participant for consent to pass their contact details on to UOW to be followed up.

Once eligibility and consent were established by I-view, a project member of the UOW team engaged each participant directly by a follow-up telephone call in the few days following the first contact. It was during this telephone call that the team member fully explained the project, and invited informed consent. It was explained that "*Your participation is entirely voluntary and you are free to withdraw from the study at any stage. Refusal to participate in the study will not affect your relationship with the University of Wollongong. You will be requested to sign a consent form prior to the first questionnaire survey to confirm your understanding of these things and to indicate that you are happy to participate in the study*". It was also during this follow-up telephone call by the project team that the participant was invited to complete the baseline survey, at a time and location appropriate to them. Informed written consent would then be collected at the time of completing the survey.

Due to some refusals to participate, unavailability of potential participants, and attrition (e.g. moving away or physical incapacity) between initial contact and the baseline survey administration, a total cohort of 830 project intervention participants went on to complete the baseline survey. Therefore these 830 participants formed the initial baseline cohort for the Energy+Illawarra intervention.

Control Group. In addition to the intervention cohort, I-view was also employed to generate a random sample of control group participants. These control group participants resided in other parts of NSW geographically removed from the Illawarra, and would not be exposed to the intervention. The control would be surveyed at baseline, and at both follow-up surveys to act as a control comparison to the intervention group. This randomised control group evaluation study design is commonly recognised as the gold standard methodology for evaluating intervention effects (Stead and Gordon, 2009). I-view undertook a random sampling of older low-income participants meeting the same selection criteria as the intervention cohort from their national consumer panel. A cohort of 632 control group participants formed the baseline sample.

The intervention cohort, and control group cohort of participants were then surveyed about their knowledge, attitudes, self-reported behaviours, perceived value of using energy efficiency, perceptions of thermal comfort, and satisfaction with thermal comfort at baseline in May-September 2014 prior to the intervention. The same cohorts were then surveyed again one year later at Wave 2 with a follow-up survey (May-September) using the same evaluation survey questionnaire with the same survey questions. The Wave 2 survey was originally designed to be immediately post-delivery of the interventions (social marketing, and social marketing including retrofit). A 2nd follow-up survey (Wave 3) will be conducted to provide further evaluation of the intervention in May-September 2016, outside the scope of the LIEEP-funded project. It should be noted that although the Wave 2 follow-up survey was originally designed to occur immediately post intervention, due to delays, difficulties and complexities in rolling out the interventions and particularly the retrofit trial means that roll out of these was in an early stage. To clarify, this meant that the Wave 2 evaluation survey was not able to capture data following the full delivery of the interventions. It was not possible to delay the Wave 2 survey due to methodological design issues, as energy use is heavily influenced by seasonal variations in climate and comparing survey data collected in winter, with survey data collected in Spring or Summer would have yielded largely meaningless results.

3.1.4 Formative research

Formative research, in addition to secondary research of existing literature and knowledge, and baseline assessments of existing knowledge, attitudes, behaviours and practices, is a key element that informs social marketing programs (French and Gordon, 2015). In the Energy+Illawarra project, formative research was undertaken to gain insights and understanding of the participants' knowledge, attitudes, value perceptions and behaviours in relation to energy use, to understand energy use practices in the home, explore questions about energy efficiency and thermal comfort, as well as identifying barriers, incentives and potential tactics and strategies to behavioural change. This stage was critical to insight and understanding of the important issues, and for identifying potential strategies for facilitating behaviour change that would then be used to inform the development of the social marketing program.

In this project, the formative research was conducted through exploratory focus groups with a purposive sample of the target audience of low-income residents of the five LGAs of the project (that is, Wollongong, Shellharbour, Kiama, Shoalhaven and Wingecarribee Councils). It is important to note here that the formative research participants were not part of the intervention group of n=830 participants who completed the baseline survey. Eleven focus groups were held with a total of 55 participants (35 female, 20 male) that were aged 60+, with a personal disposable income below $26,104 per annum (the Australian Bureau of Statistics threshold for low-income). Two of the 11 groups were held with residents living in independent living units (ILU) in residential aged care villages. A $50 Coles/Myer voucher was provided as recompense for time and effort to each participant. The participant information sheet and consent form for this component of the research are found in Appendices A2 and A3.

A semi structured discussion guide was developed, and was informed by an extensive review of the literature. The discussion guide can be found at Appendix B. The focus group discussions were digitally recorded, transcribed and entered into the QSR NVivo 10 qualitative data software tool ready for analysis. A corpus of 13 hours, 14 minutes and 49 seconds of audio, and 443 pages of transcripts was produced. Once the data was collected and loaded into the software program, the researchers initially reviewed the data, and then met and discussed emergent themes from the data. Data was then coded into tree and free nodes across several different themes including: current knowledge, attitudes, behaviours and practices of energy use in the home, value perceptions towards using energy efficiently, barriers, enablers and strategies to support being energy efficient, and suggested tactics and tools to support energy efficiency. Data was coded in NVivo into each node by two of the researchers, with inter-coder reliability checks conducted on all coding decisions, and with a third researcher resolving any coding disagreements. The researchers then further considered and discussed the coding process and the thematic analysis during an iterative process involving numerous meetings over a period of several months to reach a negotiated interpretation and representation. Themes and findings from the analysis were also shared with a selected number of study participants to provide a form of member checking, with any feedback considered and incorporated into the interpretations provided here. Our analysis of the formative research data presented four key themes regarding energy use practices that informed the subsequent intervention. Although a deeper analysis of these themes is published elsewhere (see Waitt *et al.* 2016; Butler *et al.* 2016; Gordon *et al.* 2016), a summary of these is presented forthwith.

First, we found that older low-income people are already doing much of the work of energy efficiency (see Waitt *et al.* 2016). Participants identified how their practices often focused on not wasting energy, and they appeared to be fairly conscious of their energy use and discourses of energy efficiency in the home. For example, participants mentioned how they would turn off lights when not in use, did not use gas heaters, or reverse cycle air conditioners: “I have a gas heater, but I don’t use it much”. This may be somewhat unsurprising given their low-income, yet research among other low-income consumer groups such as young adults has identified that they are not always very energy efficient (Mulcahy, 2015). What emerged in this study was that low-income older people often consider energy use through the lens of thrift and not being frivolous or wasteful. Essentially a generational perspective of thrifty energy use practices is suggested, with low-income older people being energy efficient, and younger generations being positioned as more wasteful. As such, our social marketing program aimed to not come across as preaching about practices that many low-income older people already employ, but to focus on reflecting upon existing capabilities and strategies that people use.

Insight 3.1 Energy efficiency through the lens of thrift and not being wasteful of resources.

Energy efficiency through the lens of thrift and not being wasteful of resources

Thrift was a consistent theme that emerged across our older low-income households. For example, when talking about energy efficiency in an interview Jemima (retired, living in the community, Wollongong) said:

> *I was brought up not to be wasteful…My mother was born in 1897. She had five daughters born to her during the depression, so we were taught from childhood not to be wasteful about anything. So that's a good grounding, you see. And probably many people of our age have similar thoughts because of their upbringing.*

Thrifty practices are understood as reducing energy consumption, to enable expenditure elsewhere in the household budget. Thrift has a number of important policy implications. First, some older low-income households think of themselves as being actively engaged in energy efficiency through not wasting. Hence, this is a cohort of people who should be engaged as knowledgeable about energy use, and for whom not wasting is a priority. If policy positioned them as lacking knowledge, this might work against engagement in energy efficiency programs. Second, for older-low-income households, thrift is tied to narratives of generational difference. Practices associated with being thrifty are closely aligned with differentiating themselves from a younger generation that are positioned as part of a wasteful, consumer-orientated, throw-away society. Third, there are examples of the tyrannies associated with thrift. As outlined in our article in *Energy Policy*, thrifty household practices may result in older low-income households concealing everyday heating/cooling practices from close family and friends resulting in them living with extreme temperature, moving around their homes in the dark at night to save energy by switching lights of a night, and hanging onto energy inefficient appliances under the assumption it is the morally right thing to do.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

Second, our research identified that although older low-income people are often using little energy, this can be problematic and create what Waitt *et al.* (2016) refer to as 'tyrannies of thrift' whereby being thrifty with energy use can lead to risks to comfort, health and wellbeing. Tyrannies of thrift relates to practices of making do with less that create problems. For many low-income older people, domestic energy use is often framed by reducing waste, a context of scarcity, and being smart, sensible and thrifty. Such practices include continuing to use a working but old and inefficient fridge "But what do you do when you've got a good fridge? It's working. You just don't get rid of it like the young ones do and get another one"; or not using lighting when visiting the toilet during the night "I know a friend who used to use the street lights at night through the window instead of turning lights on. He had a fall in the bathroom and ended up in hospital". As illustrated here, these practices can lead to negative economic and ecological outcomes (increased energy waste and higher bills due to an inefficient old fridge), and threats to health and wellbeing as shown by the person ending up in hospital after a fall in the dark. This suggests that in future energy efficiency social marketing programs, and energy policy, it would be important to address these tyrannies of thrift and try to support people to use energy efficiently in ways that maintain or facilitate their comfort, health and wellbeing.

Third, our research identified a number of myths, and lack of or misunderstandings about energy use and energy efficiency (see Gordon *et al.* 2016). We should acknowledge again that we did find that older low-income participants often deployed good energy saving tactics. However, this was not universal, and we did identify practices that were not efficient and where strategies to support change may help. For example, participants referred to not using reverse cycle air conditioners that they had in their homes “because it’s too expensive”. This is despite evidence showing that reverse cycle air conditioning is actually an efficient way to heat the home. Furthermore, other myths were mentioned like turning lights on and off causing a power surge and using more electricity - “people used to think if you turn a light on, it causes a small power surge and that you should leave it on rather than turning it on and off again”. Therefore, the social marketing program sought to address myths and lack of or misunderstanding about energy efficiency.

Fourth, the formative research identified that low-income older participants hold different value perceptions towards using energy efficiently. This appeared to have some influence over their attitudes, behaviours and practices. Our research here found that economic value is an important concern for low-income older participants, e.g. [with energy efficiency] “when you end up on a fixed income you save wherever you can”. However, economic value does not appear to be the only concern for low-income people with regards to their energy use practices and being energy efficient. Functional value was also found to be important to participants (being able to use energy efficiently in an easy and straightforward way), e.g. “[being energy efficient] I don’t think it’s easy but I think once you’ve committed to it then it becomes easier” (Butler *et al.* 2016, p11). Finally, ecological value (using energy efficiently to help the environment) was also important, e.g. [Do you think being energy efficient can make a contribution to the environment?] “I think it’s very much like recycling and everything else you do. It’s a little bit…and if everybody does their little bit. And we’re very conscious – certainly for our grandchildren”. To summarise, the analysis of participants’ (consumer) value perceptions towards using energy efficiently, economic value, functional value, and ecological value were found to be important motivations.

Strategies

An analysis of the formative research revealed a range of strategies that should be considered in the social marketing program. These included:

1. Redefining energy efficiency
2. Information and Information Sources
3. Building Characteristics, Appliances and Materials
4. Home visit schemes and householder training
5. Peer to peer networking
6. Reinforcing existing capacities and behaviours
7. Policy support
8. Information and support from energy suppliers
9. Myth-busting
10. Advocacy.

3.1.5 Social Marketing Program Design

Utilising insights from the review of existing literature, the baseline survey and the formative research, ideas for the social marketing program began to be generated. The project team developed a strategic social marketing mix (see Table 3.2) which initially identified the range of techniques, tools, and strategies, which would cross a range of downstream, midstream and upstream activities. It was also intended that these would be further developed and built upon during the implementation of the social marketing program. The wider project team also met extensively during this phase of the project to discuss issues around defining energy efficiency as this would be a key discourse in the project. Following scoping of the literature, analysis of the baseline survey, and of the formative research it became apparent that energy efficiency among low-income older people is also associated with issues around comfort in home (particularly thermal comfort), everyday practicalities, and issues of health and wellbeing. This suggests that energy efficiency should be redefined to focus not only on issues around energy saving, economics and cutting back, but particularly for low-income groups should also focus on using energy smartly and wisely to maintain comfort, health and wellbeing. Following extensive discussion among the larger project team a new/redefinition of energy efficiency was created for use in the EE3A/Energy+Illawarra project as follows: “Energy efficiency is using energy wisely and economically to sustain everyday life, live comfortably and support wellbeing”. This definition featured heavily throughout all project activities.

Table 3.2 Strategic Social Marketing Mix.

BENCHMARKS	Extensive formative research conducted to ensure program is consumer oriented, research and insight driven, theory based and ethical.
MASS MEDIA ADVERTISING	See UOW Media Plan. Activities include (but are not limited to): media release development and distribution, anticipated radio, TV and printed news interviews and coverage. Project details and updates included in City Council Newsletters.
OTHER MARKETING COMMUNICATIONS	Three newsletter packs sent out every three months, which will include written information and project materials (see Table 4). Branded merchandise to accompany the written materials (see Table 4). Web 2.0 – Facebook. Project website. Project details and updates distributed with energy bills. Various materials distributed to various project partners and community service centres for display.
CONSUMER MARKETING	Encourage peer-to-peer networking through community training events, continue community education through WEA training events, days and programs.
MACRO-MARKETING	Lobbying Government bodies and energy providers. Advocacy work. Continue development of partnerships with stakeholders.

The newsletter packs were one of the main ‘products’ of the social marketing program, which included all the important energy efficiency facts and myth-busting that the formative research identified needed to be clarified for the target audience. The newsletters were disseminated to project intervention participants (n=830 who completed the baseline survey) through a mail-out directly to project participants’ homes, as well as being made available for the general community through dissemination to community/health centres and relevant community organisations and groups. The outline of and plan for the newsletter distribution can be found at Table 3.3.

Table 3.3 Social Marketing Program Phases.

PHASE ONE	THEME	TOPICS FOR NEWSLETTER AND VIDEOS	PRODUCT
April-May-June 2015	Energy+ Every Day Energy	My Fridge	Fridge magnet thermometer
		Lighting	
		Star Ratings	
		The Laundry	
PHASE TWO			
July-August-September 2015	Energy+ Winter Warming	Heating	Remote Control Power Switch
		Hot water	
		Cooking	
PHASE THREE			
November-December-January 2015	Energy+ Summer Comfort	Keeping comfortable	No product
		Solar Power	
		Active Cooling	
		Personal Cooling	

The diverse mix of strategies and promotional channels utilised as part of the social marketing program are described in Table 3.4.

Table 3.4 Product and Promotion Channels.

TARGET AUDIENCE	Tactic/Intervention	MATERIALS	PLACE
Intervention group n = 830	Mail out to residential addresses	Bundle of 'Energy Plus' Phase-appropriate materials, newsletter and products.	Postal delivery to each participant's home.
	Email to participants	Mass email distribution which includes the link to website and Facebook page	Delivered to private email addresses where one is provided.
	Retrofit program n = 200	See SBRC Retrofit program.	Individual homes.
	'Support package' program N = 40	See AUSCCER Ethnography program.	Individual homes.
General community	Website	All materials uploaded before packs sent out	Online
	Facebook	Weekly 'energy facts', FAQs, 'did you know', myths	Online.
	UOW Media Releases	See Media Plan	Mixture of TV, Radio, print and online media.
	Narrative/factual/ educational videos	Topics and narratives developed from formative research focus groups, but based around facts of the newsletters.	Online through the website and promoted on Facebook.
	Posters		Dissemination through Consortium members. Local libraries, service

			centres (Centrelink), community centres and groups, WEA, Illawarra Forum. Bus stop shelters.
	City Council newsletters	Include project updates.	Community-wide delivery.
	Energy provider bills	Information leaflets from bundle packs.	Delivered to community private addresses.
	WEA Training Events	25 x 2 hour workshops, no. x two day training sessions, no. x 7 day accredited training.	WEA organised locations across the three LGAs.

Engaging the local Community Neighbourhood Centres and other community groups was key to distributing the social marketing materials to the broader community (outside the intervention group). Emphasis was placed on engaging these groups as the formative research revealed that these are frequently visited community locations for people in the target group. A list of the 29 different community groups engaged can be found in Table 3.5.

Table 3.5 Community Groups across the Greater Illawarra.

No.	Community Group Type	LCD Brochures Delivered with Videos uploaded	Newsletters Delivered
Neighbourhood Centres			
1	Albion Park Community Centre	Y	Y
2	Albion park Rail Neighbourhood Centre	Y	Y
3	Batemans Bay IRT	Y	Y
4	Batemans Bay Medical Centre	Y	Y
5	Batemans Bay Retirement Village	Y	Y
6	Balgownie Village Community Centre	Y	Y
7	Bellambi Neighbourhood Centre	Y	Y
8	Bulli Community Centre	Y	Y
9	Bulli Senior Citizens' Centre	Y	Y
10	Dapto Neighbourhood Centre	Y	Y
11	East Nowra Neighbourhood Centre	N	Y
12	Fairy Meadow Community Centre	Y	Y
13	Horsley Community Centre	Y	Y
14	Kemblawarra Community Hall	Y	Y
15	North Kiama Neighbourhood Centre	Y	Y
16	Port Kembla Community Centre	Y	Y
17	Shoalhaven Neighbourhood Centre	Y	Y
18	Unanderra Community Centre	Y	Y
19	Warilla Neighbourhood Centre	Y	Y
20	Warrawong Community Centre	Y	Y
Community Health Centres			
21	Jervis Bay Community Health Centre	Y	Y
22	St Georges Basin Community Health Centre	Y	Y
23	Warilla Community Health Centre	Y	Y
Other Engaged Community Groups			
24	Mission Australia Wollongong	N	Y
25	Older and Boulder	Y	Y
26	Illawarra OWN Wellness Centre (Older Women's Network)	Y	Y
27	North Shoalhaven Meals Cooperative	N	Y

Importantly, to tie all the project activities together, a strong brand needed to be developed. Three draft brands were created along with some example social marketing program materials. The project team identified that the brand needed to be dynamic and adaptable across a range of energy issues and behaviours, as well a range of target audiences, such as community members, service providers, installers and tradespeople, as well as local councils, State and National Governments, and policy makers.

3.1.6 Pretesting

Three draft brands were developed for pretesting with two focus groups. The sample was the same target audience in late March 2015 and early April 2015. The two groups pre-testing the brands and materials had a key difference: one group was made up of participants who had previously taken part in the formative research focus groups; the other was made up of participants who had no previous exposure to the project in any way.

The results of the pretesting focus groups found that Energy+ had overwhelming support. It was found to be easy to read, understand, and relate to. The 'plus' symbol was recognised as having the adaptability to, on its own, symbolise the positive/negative current of electricity, but then could be developed to relate to specific behaviours and appliances in the home, i.e. Energy+Winter Heating, and Energy+My Fridge. The colours were also refined based on associations and preferences. The idea of newsletter editions was loosely tied to the seasons with key, short facts and 'myth-busting' was positively received, with confirmation of the types of graphics and images that were preferred.

The results of the pretesting focus group were then used to refine and finalise the branding and social marketing program materials. At this point, one final focus group was held with a combination of participants, again some with previous exposure and some without, to test the aesthetics as well as the format of the social marketing materials with specific attention being drawn to language, font style and size, colouring, and perspective and tone of the messages. Following this further round of pretesting further small amendments and refinements were made to the social marketing materials prior to implementation of the social marketing program.

A copy of the following resources can be found at the corresponding appendix: Energy+Everyday Living newsletter, Appendix C; Energy+Winter Warming, Appendix D; Energy+Summer Comfort, Appendix E.

3.1.7 Delivery and Implementation

3.1.7.1 *Brand*

The brand Energy+Illawarra (see Figure 2.4) was designed to be a dynamic brand; capable of being understood as a standalone logo, and one that could be adapted throughout the lifetime of the project. The logo was adapted to the name and theme of each newsletter, i.e. Energy+Everyday Energy, Energy+Winter Warming, Energy+Summer Comfort. As well as this, the logo was adapted to each issue, topic, behaviour or appliance in the home, i.e. Energy+My Fridge, Energy+Star Ratings, Energy+Personal Cooling. Adding to this, the 'plus' symbol in the logo is also a visual representation of, and association with, electric currents.

ENERGY+
ILLAWARRA
A COMMUNITY ENERGY EFFICIENCY PROGRAM

Figure 3.3 Energy+Illawarra brand.

3.1.7.2 *Newsletters*

Three newsletters containing facts, tips and advice on energy use practices were posted to the 830 intervention participants. These relate to the three phases of the social marketing program. Distribution of a further 3,000 newsletters was made in the wider community to 27 different community and health centres and community organisations, and also project consortium members for dissemination to community members.

Newsletter 1. Everyday Energy – focusing on the following every day energy use practices (seeFigure 3.4).

- Energy+Star Ratings focusing on understanding star ratings and energy consumption of household appliances
- Energy+MyFridge focusing on using fridge-freezers in the home
- Energy+Lighting focusing on use of lighting in the home
- Energy+The Laundry focusing on washing and drying clothes

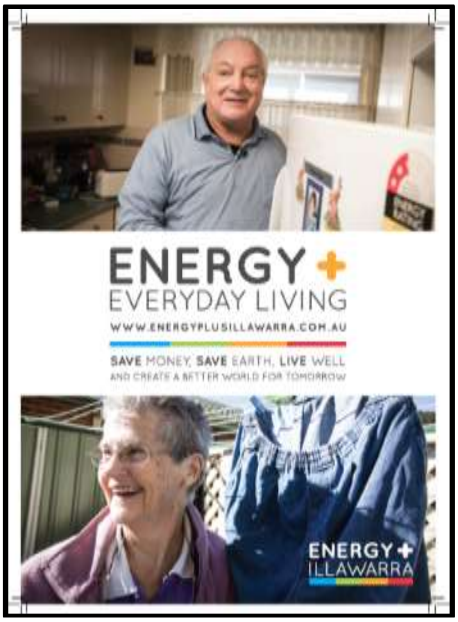


Figure 3.4 Energy+Illawarra Everyday Energy Newsletter.

Figure 3.5 Energy+Illawarra Winter Warming Newsletter.

Newsletter 2. Winter Warming – focusing on the following energy use practices related to winter (seeFigure 3.5)

- Energy+Heating focusing on use of energy to heat the home in winter
- Energy+Hot Water focusing on energy use relating to hot water
- Energy+Cooking focusing on energy use practices related to cooking

Newsletter 3. Keeping Comfortablel – focusing on the following energy use practices related to keeping cool in the warmer months (see Figure 3.6).

- Energy+Solar Power focusing on solar power energy
- Energy+Cooling focusing on energy use and keeping cool in summer
- Energy+Dishwashing focusing on energy use and washing the dishes
- Energy+Standby focusing on energy use and standby power of appliances

Figure 3.6 Energy+Illawarra Keeping Comfortable Newsletter.

3.1.7.3 *Videos*

A series of ten videos containing narratives, stories based on participants' comments in the focus group research, aligned with energy efficiency facts and advice were created for all of the practices that appeared in the newsletters (see Figure 2.8). The videos featured film and audio footage of real project participants telling these stories, followed by animations providing the technical advice and guidance on energy efficiency. The videos are available on the project website (http://www.energyplusillawarra.com.au/) and were also featured on the LCD brochures that were distributed in the community. These videos were made available on the Energy+Illawarra website (http://www.energyplusillawarra.com.au/?page_id=84). Videos were pretested using a separately funded but linked cognitive neuroscience research project that used electroencephalogram (EEG) brain scanning and eye tracking techniques and following minor modifications this pretesting research suggested that the videos effectively engage people, gained emotional responses, and stimulated memory encoding (see Gordon and Ciorciari, 2016).

Figure 3.7 Energy+Illawarra Narrative Video.

Table 3.6 Energy+Illawarra narrative videos/facts about energy efficiency.

Energy Use Practices	Narrative Video
1. Using fridges	https://www.youtube.com/watch?v=_RRoyEyr-YE
2. Considering star ratings when buying and using household appliances	https://www.youtube.com/watch?time_continue=2&v=B-Gi-YT1Xbo
3. Lighting in the home	https://www.youtube.com/watch?v=PDL_Yg5V2fk
4. Doing the laundry	https://www.youtube.com/watch?v=OfTXuybRjiE
5. Using hot water	https://www.youtube.com/watch?v=ZtEDu4ksR-Y
6. Heating	https://www.youtube.com/watch?v=KJHGCEr5Hc4
7. Cooking	https://www.youtube.com/watch?v=XltTvoLyqDQ
8. Personal cooling	https://www.youtube.com/watch?v=yw6PbhkVgfY
9. Active cooling - using fans and air conditioning	https://www.youtube.com/watch?v=UBYb-Hn6UMg
10. Using curtains, blinds, shading and awnings to regulate temperature in the home.	https://www.youtube.com/watch?v=ew2akvXhScQ

3.1.7.4 *LCD Brochures*

Branded LCD Brochures containing the videos about energy efficiency practices were manufactured, and these have been extensively distributed in the community in places in which low-income older people use (see Figure 2.9). These include community centres, various service locations, and other relevant spaces and places. This involved 100 LCD Brochures containing the narrative/fact videos about energy efficiency being distributed among the aforementioned 27 different community/health centres and community organisations, and also to project consortium members, policymakers, and media contacts.

Figure 3.8 Energy+Illawarra LCD Brochures.

3.1.7.5 *Small Energy Efficiency Products*

Branded fridge thermometer magnets showing recommended temperature settings for refrigerators and freezers were sent out to the 830 intervention participants at the same time as the Newsletter 1 Everyday Energy newsletter. Remote control sockets that enable people to switch off appliances were issued to the 830 intervention participants at the same time as Newsletter 2 on Winter Warming (see Figure 3.9 for images of these products).

Figure 3.9 Energy+Illawarra Fridge Magnets and Remote Control Power Switches.

3.1.7.6 *Advertising*

- Advertising about energy efficiency narratives and practices, including calls to action directing people to the Energy+Illawarra website and social marketing resources, was undertaken in the local print media involving the placement of nine paid advertisements for the project containing energy narratives and calls to action to visit the project website; six adverts were placed in the Illawarra Mercury, two in the South Coast Register, and one in the Milton-Ulladulla Times (see Figure 3.10 for an example newspaper advertisement). This was supplemented by Facebook advertising. In addition, advertising posters (see Figure 3.11) about energy efficiency narratives practices and including calls to action to visit the website and project materials were distributed in all of the same community/health centres and community organisations as the Newsletters. This involved the distribution of 100 poster advertisements for the project containing energy narratives and calls to action to visit the project website to 27 different community/health centres and community organisations, and also to project consortium members.

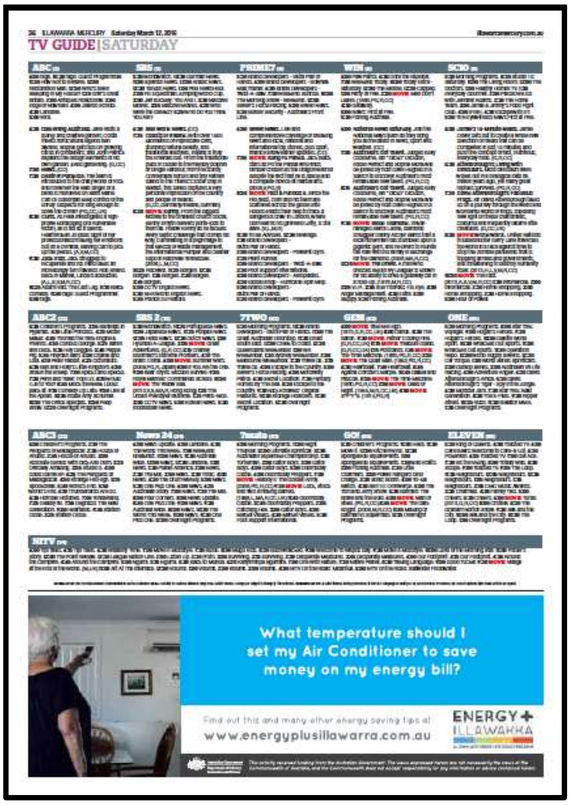


Figure 3.10 Newspaper adverts.

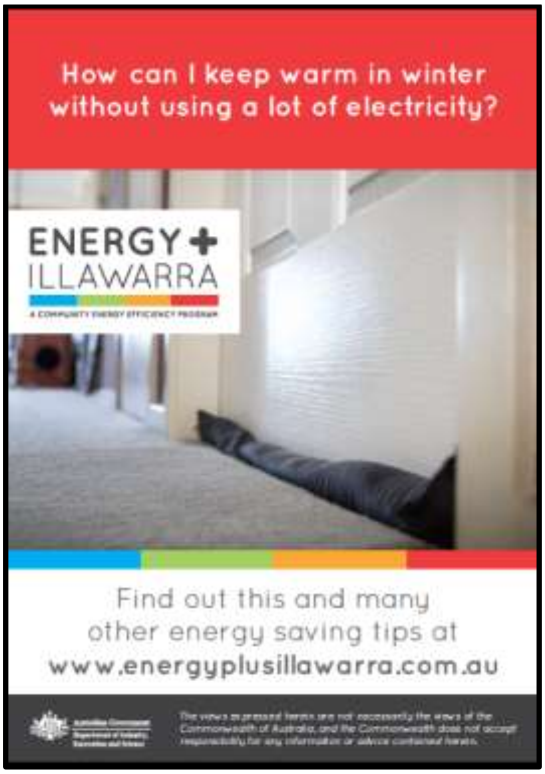


Figure 3.11 Community advert posters.

3.1.7.7 *Project Website*

The project website www.energyplusillawarra.com.au contains information on the project, news items, copies of the newsletters, videos, information on the community events, details on media coverage on the project, links to services such as recycling and energy rebates, facts on energy use practices, and details on the project research findings. See Figure 3.12 for a screenshot image of the website. Between 1st June 2015 when the website was launched and 21st April 2016 the website attracted 1,692 distinct sessions, across 1,109 different users, with an average website visit session duration of 3 minutes and 6 seconds. Visits to the website were split by 65.5% new visitors, and 34.5% returning visitors.

Figure 3.12 Energy+Illawarra Website.

3.1.7.8 *Social Media*

To support the social marketing program activities an Energy+Illawarra Facebook page has been set up: https://www.facebook.com/energyplusillawarra?fref=ts (see Figure 3.13). The page contains links to the project website and other resources, and also contains regular content postings relating to energy efficiency and energy use in the home. Paid Facebook advertising has been used to promote the page in the community. The Energy+Illawarra Facebook page attracted a total of 305 unique user likes, 339 reactions, comments and shares forms of engagement, and 410 post clicks form of engagement from launch on 1st June 2015 to 21st April 2016.

Figure 3.13 Energy+Illawarra Facebook Page.

Links to the project resources have also been promoted using Twitter. Existing Twitter accounts of project team members and their networks including CHI @ UOW, and @AASM_Aus that have strong numbers of followers have been used to promote the project and related materials to ensure a sizeable audience for tweets. See Figure 3.14 for an example Facebook update, and Figure 3.15 for activity on Twitter.

Energy+Illawarra supports energy efficiency in the home, without sacrificing comfort and well-being. It was developed with the community for the community.

The Energy+Keeping Cool newsletter is now available for download from our website! This edition discusses way to keep yourself and your home comfortable through the hot summer, with some great energy-saving tips, and a look at new solar power technologies. You'll see newsletters in community centres throughout the Illawarra and in letterboxes - but if you missed one, click the link below.

Figure 3.14 Energy+Illawarra Facebook Updates.

Figure 3.15 Energy+Illawarra Twitter Activity.

3.1.7.9 *Training and community events*

WEA Illawarra delivered a series of 25 community events in the region to share insights, stories, and provide advice and support for people to use energy efficiently. These events were held in local community venues and details of these were posted on the project website (see Figure 2.17). Further information regarding the wider community skills training trial can be found in Section 4.2.15.

COMMUNITY EVENTS

WEA Illawarra are conducting 2-hour workshops across the Greater Illawarra. You can learn about energy efficiency practises, the latest technologies, and what small improvements in your home can make a big difference.

For more information you can contact:

Graham Neville
0418603171
info@weaillawarra.com.au

Figure 3.16 Energy+Illawarra Website Advertising Community Training Events.

3.1.7.10 *Narrative Conversations*

The project team used the transcripts from the formative research qualitative focus groups to develop a series of narratives – stories from participants about their energy use practices. These narratives are designed to encourage people to reflect on the myths, ideas, and practices of using energy in the home and being energy efficient. They are also intended to encourage people to start a conversation about energy efficiency and reflect on their own practices. The narratives have featured in many of the social marketing program activities such as the videos appearing on the LCD Brochures and project website, and in advertising and posters. Furthermore, transcripts of these stories are being distributed in the community with calls to action to visit the project website, and to have conversations with other people about energy efficiency. An example short narrative is shown in Figure 3.17.

> "I often wonder about silly things like that, what opening and closing the fridge door does to my energy usage".

Figure 3.17 Example short narrative about energy efficiency.

3.1.7.11 *Media Relations and Media Advocacy*

A media relations and media advocacy strategy formed an important component of the Energy+Illawarra project (see Figure 3.18). An initial media release was launched in July 2015 based on the findings of the baseline and formative research which identified that low-income older people are thrifty in their energy use but often at risk to their health, comfort and wellbeing. This generated 21 different news items across AM/FM radio, TV, newspapers and online news media. A series of interviews on ABC Sydney/Illawarra/South Australia/Newcastle appeared, as well as a television news story on WIN News. Details of the project media coverage are provided on the project website.

Figure 3.18 Energy+Illawarra Media Relations activity – news story on WIN News about the project.

3.1.7.12 *Stakeholder Advocacy*

The Energy+Illawarra project recognises that using energy efficiently is not just down to individual behaviour, and requires a supportive environment. Stakeholder advocacy and support forms an important part of the program. Following stakeholder consultation, the retailer Energy Australia (Figure 2.20) have agreed to support the project and adapt project materials such as newsletters and videos for distribution to a broader audience of consumers. In addition, local councils have been engaged on their policies and practices relating to energy efficiency. This has resulted in distribution and sharing of materials, links to the project website being promoted, and input into policy and practices of local councils concerning energy efficiency.

EnergyAustralia

Figure 3.19 Energy Australia – a focus for stakeholder advocacy on energy efficiency.

3.1.7.13 *Policy*

As identified above, engagement with local councils aimed to provide input into policy and practices concerning energy efficiency. The former Southern Councils Region group was an original partner on the project consortium. However, the representative of this group reported difficulties in getting engagement from local councils, and several attempts to obtain meetings and open communications with local councils with a view to sharing insight, learning, our project materials and helping to promote Energy+Illawarra through the council were unsuccessful. However, policy advocacy and contributions to policy discourses with the Australian Government did progress. The project team had numerous meetings, regular telephone, email and face-to-face discussions with civil servants, policy makers and other key stakeholders in policy to share project insights, findings and learning, which helped inform debates on energy policy and programs. This included hosting a forum on energy efficiency in Wollongong attended by policy makers and a range of relevant stakeholders, attendance at the LIEEP program forums, and a planned conference on improving residential energy efficiency to be held at the University of Wollongong in February 2017. Furthermore, the project team have been active participants in the formation of a new and key body, the Group of Energy Efficiency Academic Researchers (GEEAR) with a view to contributing to energy efficiency research, policy and program agendas into the future.

3.1.8 Evaluation - Survey

The questionnaire developed for the baseline and follow-up participant and control group surveys was one of the key evaluation methods for Energy+Illawarra. The study used a longitudinal cohort control study design, with the same cohort of participants who were exposed to the Energy+Illawarra intervention being surveyed at baseline and then at subsequent follow-up time points following the implementation of the intervention, and a cohort of control group participants who were not exposed to the interventions, were also surveyed at baseline and the same follow-up time points to act as a comparison.

The baseline involved a survey of 1,444 low-income older residents (aged ≥ 60 years) in regional NSW, with 830 participants in the intervention cohort, and 632 participants forming a control comparison group who were not exposed to the Energy+Illawarra intervention. As identified earlier random digit dialling was carried out to generate the baseline study sample, with a short telephone questionnaire used to screen for eligibility based on age, and income level (using the Australian Bureau of Statistics income bracket definition of low-income). An interview administered questionnaire survey was then undertaken in participant's homes during the period May-August 2014 by trained researchers using iPads, with responses recorded on the Qualtrics survey software platform. The follow-up survey was then conducted with the same cohort of intervention participants, and control group participants approximately one year later (June-September 2015) following the roll out of the intervention.

Note: a further follow-up survey that is not reported here will be undertaken during June–September 2016 to provide further evaluation of Energy+Illawarra. Those interested in these findings will be able to find an addendum to this current report on the Energy+Illawarra website http://www.energyplusillawarra.com.au/ following completion of the follow-up evaluation survey.

All participants gave written informed consent, and ethical approval for the study was obtained from the University of Wollongong Human Research Ethics Committee. Participants were presented with a $30 voucher as recompense for their time for completing each survey. The survey instrument was developed following extensive consultation of the extant literature, use of existing rigorous and well tested scale items, scale development for the functional value items following the Churchill (1979) procedure, and a process of cognitive pre-testing (n=24).

The survey measured a number of important variables. In the following section the source of survey scale items is given in parentheses. The survey included items that measured participants':

- knowledge about energy efficiency (DeWaters, 2009)
- attitudes towards energy efficiency (DeWaters, 2009)
- functional, economic (Koller *et al.* 2011), emotional (Nelson and Byus, 2001), social (Sweeney and Soutar, 2001) and ecological value perceptions (Koller *et al.* 2011) of using energy efficiently

- energy efficient behaviours (Gadenne *et al.* 2011; von Borgstede *et al.* 2013)
- energy efficiency (measured by recording actual kWh and $ amount of participant's energy bills)
- and perceptions of thermal comfort (Healy and Clinch, 2002; Huizenga *et al.* 2006).

Data was transferred to SPSS for initial cleaning and descriptive analysis, prior to further modelling analysis using MPlus software. The key focus in the evaluation analysis was to assess for any changes in knowledge, attitudes, behaviours, energy efficiency, and perceptions of thermal comfort between survey time point one and survey time point two, whilst controlling for demographics, value perceptions towards using energy efficiently, and the category of survey participant (i.e. whether they received the social marketing intervention only, social marketing plus retrofit, or where in the no intervention control group). Performing this analysis permits an evaluation of the effectiveness and influence of the Energy+Illawarra program.

3.2 Results

3.2.1 Statistical analysis

General linear modelling was conducted to examine whether the three groups (Social Marketing Only, Social Marketing with Retrofits, and Control) were associated with participant changes in the following outcomes between baseline (Wave 1) survey and follow-up (Wave 2) survey:

- Knowledge about energy efficiency;
- Attitudes towards energy efficiency;
- Behaviours – self reported energy efficiency behaviour;
- Perceived emotional, functional, social, economic, and ecological value of using energy efficiency;
- Perceived thermal comfort – in participants' overall home, living room, and bedroom;
- Satisfaction with comfort at home – during summer and during winter.

All models controlled for baseline scores of the respective variable, along with age, sex, education, employment status, and housing status. Post-hoc analyses were performed for significant trends, using estimated marginal means.

Results

The following results relate to participant changes in the knowledge, attitudes, self-reported behaviours, perceived value of using energy efficiency, perceived thermal comfort, and satisfaction with thermal comfort between the baseline (Wave 1) survey and the follow-up (Wave 2) survey. It should be noted that the Wave 2 follow-up survey was conducted as close as possible to one year after Wave 1.

A total of 969 individuals participated in the Wave 2 follow-up, with 955 providing data on the variables of interest. Participants were aged between 60 and 95 years (mean = 70.97; SD = 7.19), and there were more females (n = 578; 60.5%) than males (n = 377; 39.5%). Most participants were retired (n = 825; 86.4%), living in a house (n = 708; 74.1%), and married/partnered (n = 598; 62.6%). Education levels varied among the following categories: < high school (n = 117; 12.3%), high school (n = 367; 38.4%), diploma/trade/certificate (n = 299; 30.8%), and university degree (n = 117; 18.5%).

The breakdown among the three intervention groups are as follows: Social Marketing Only (n = 459; 48.11%); Social Marketing with Retrofits (n = 180; 18.8%); and Control (n = 316; 33.1%).

Mean scores (standard error) on the included variables for each of the three groups are shown in Table 3.7. p values indicated the statistical significance of any effects at the $p < 0.05$ level, that is any p value lower than 0.05 indicates a statistically significant effect.

These results indicated that the Social Marketing Only and Social Marketing with Retrofits groups had significantly higher levels of social value, and ecological value, satisfaction with thermal comfort during summer, and greater perceived thermal comfort in their overall home and bedroom compared to the Control group. The two intervention groups also had more positive attitudes compared with the control group.

The social marketing group also had significantly higher perceptions of thermal comfort in their main living room compared with the control group. Satisfaction with thermal comfort was higher in the social marketing group compared with the other two groups.

No significant effects on self-reported behaviours were identified in association with exposure to the Social Marketing Only, or Social Marketing with Retrofit trials. However, as noted earlier this is not surprising given that the Wave 2 follow-up survey took place while the trials were still in the early stages of roll-out and implementation.

This analysis of the Wave 2 follow-up survey suggests that even at an early stage of implementation the interventions had significant and positive effects on changing attitudes towards energy efficiency. This is important as existing research shows that attitudes are often a good predictor of future behaviour (Azjen and Fishbein, 1977; Kraus, 1995). The analysis also identified that exposure to the interventions had a significant and positive impact on perceived social and ecological value towards energy efficiency among project participants. This is a relevant finding as existing research has found that higher levels of perceived value are a predictor of behaviour among people (Sweeney and Soutar, 2002; Zainuddin *et al.* 2013; Gordon *et al.* 2015). The analysis also found that exposure to the interventions had a significant and positive effect on perceptions of thermal comfort, and satisfaction with thermal comfort. This is particularly relevant as perceptions of thermal comfort are an important indicator of comfort and wellbeing in the home (Chappels and Shove, 2004; Ormandy and Ezratty, 2012), and poor thermal comfort is associated with health harms (World Health Organisation, 1987; Parsons, 2014).

Therefore, this initial survey evaluation analysis indicates that the Energy+Illawarra intervention had positive outcomes relating to attitudes, value perceptions of energy efficiency, and perceived thermal comfort, and satisfaction with thermal comfort. Future analysis of the 2nd follow-up survey (Wave 3) data, which is outside the scope of the present project, will enable further and insightful analysis on the impact of the interventions on behaviour/behaviour change, and on energy consumption. Furthermore, the project identified important qualitative insights about the impact of the intervention on participants' knowledge, attitudes, behaviours, value perceptions, perceptions, satisfaction with thermal comfort, and everyday practices. Some of these insights are reported throughout the remainder of this report in Ethnographic Insights ('break-out' boxes), see for example Insight 3.2.

Table 3.7 Differences in knowledge, attitudes, behaviours, perceived value of energy efficiency, perceived thermal comfort, and satisfaction with thermal comfort between baseline (Wave 1) and 1st follow-up (Wave 2) surveys, between the three groups. P values were derived from general linear models.

	Social marketing		SM + retrofit		Control		P value
	Mean (SD)	% Change	Mean (SD)	% Change	Mean (SD)	% Change	
Knowledge	3.38 (.07)	13.0%	3.40 (.10)	19.0%	3.22 (.08)	7.8%	.119
Attitudes	33.01 (.21)^{a}	131.9%	33.42 (.28)^{b}	136.2%	31.99 (.22)$^{a, b}$	128.4%	**< .001**
Behaviours (self-reported energy behaviours)							
Fill up washing machine	3.67 (.07)	7.4%	3.65 (.09)	6.9%	3.78 (.07)	9.6%	.328
Tumble dry clothes	1.84 (.08)	23.3%	1.82 (.10)	15.3%	2.01 (.08)	24.9%	.155
Turn off lights	4.34 (.05)^{a}	0.1%	4.44 (.06)	2.4%	4.60 (.05)^{a}	7.2%	**< .001**
Standby mode	3.12 (.07)	12.4%	3.11 (.09)	12.2%	3.17 (.07)	7.2%	.808
Unplug phone charger	3.71 (.08)^{a}	2.8%	3.71 (.10)	0.4%	3.92 (.08)^{a}	7.9%	.033
Buy efficient appliances	4.29 (.05)	5.1%	4.22 (.06)	2.9%	4.24 (.05)	2.4%	.374
Low air conditioning/heating	3.27 (.07)	18.7%	3.30 (.09)	14.9%	3.27 (.08)	11.5%	.968
Turn off air con in unused rooms	3.70 (.06)	0.6%	3.76 (.07)	5.6%	3.78 (.06)	4.6%	.400
Value							
Emotional	25.04 (.23)	4.1%	25.28 (.30)	5.2%	24.79 (.24)	3.4%	.358
Functional	19.61 (.16)	3.1%	19.31 (.20)	1.6%	19.47 (.16)	3.6%	.322
Social	13.43 (.15)^{a}	8.9%	13.25 (.19)^{b}	6.6%	12.76 (.16)$^{a, b}$	2.3%	**.001**
Economic	10.94 (.14)	10.1%	11.07 (.18)	11.2%	10.70 (.14)	7.3%	.152
Ecological	12.85 (.09)^{a}	3.1%	12.83 (.12)^{b}	2.5%	12.55 (.09)$^{a, b}$	-0.9%	**.015**
Perceived thermal comfort							
Overall Home	3.29 (.04)^{a}	2.5%	3.24 (.05)^{b}	2.4%	3.10 (.04)$^{a, b}$	-3.1%	**< .001**
Main living room	3.22 (.04)^{a}	3.0%	3.16 (.05)	0.9%	3.07 (.04)^{a}	-1.4%	**.005**
Bedroom	3.48 (.05)^{a}	5.2%	3.36 (.06)^{b}	1.1%	3.17 (.05)$^{a, b}$	-2.0%	**< .001**
Satisfaction with thermal comfort							
Summer	11.45 (.13)^{a}	3.9%	10.99 (.17)^{a}	0.3%	10.88 (.14)^{a}	-2.0%	**< .001**
Winter	10.14 (.16)^{a}	0.2%	9.78 (.20)^{b}	-2.9%	10.52 (.16)$^{a, b}$	4.3%	**.008**

P values are derived from general linear models. All models controlled for age, sex, employment status, housing status, education. Groups with the same superscripts differed significantly at p < .05.

Insight 3.2 The challenges of giving and receiving energy efficiency advice: moral subjects and taken-for-granted-ideas.

The challenges of giving and receiving energy efficiency advice: moral subjects and taken-for-granted-ideas

Many people expressed reluctance to give *advice* to others about how they could be more energy efficient in their homes. According to Sally (70s, retired, living in the community, Shoalhaven), giving unsolicited energy efficiency advice is pointless:

> Sally: *…unless they're interested in listening, there's no point. Because everybody has their own set ideas. I wouldn't like to get in an argument with someone about it. I know about it, and I can suggest it to someone, but I certainly wouldn't make it a big point.*

Sally points to how the personal is embedded in the ways people use energy. Sally points to the importance of acknowledging that each person will have their own set of ideas around domestic energy priorities. Likewise Stephen (65years, retired, community, living with others, Shoalhaven) expressed the challenge of changing strongly entrenched ideas about how to use energy around the home:

> Stephen: *You've got to have an open mind willing to accept the changes, and a lot of people aren't willing to accept changes….*

Furthermore, some responses showed how giving advice to others on how to be more energy efficient at home could be morally loaded and thus the ways people use energy helps constitute people as either 'good' or 'bad'. For example, Tod and Jenna (retired couple, 70s, living in the community, Shoalhaven) would not give advice to others: Tod likened giving such advice to a non-smoker telling a smoker that smoking is bad for them; or 'Bible-bashing'. Tod's wife Jenna showed understanding that every house and situation is different, and said that 'people have their own common sense' and would know that their electricity bill was too high – friends don't need to tell them that. Together, these results underscore the challenges of energy efficiency policy. Domestic energy consumption is understood as common sense, as taken-for-granted. Energy use is entwined with the personal, and increases or decreases to use can be closely aligned with a moral subject.

In a similar vein, the idea of being an energy efficiency 'champion' was a bit ambiguous. Some participants could see themselves as a supporter or 'backer' in their own lives and homes, but not necessarily a promoter of the cause to others. For example, although Susie (70s, retired, lives alone in the community, Shoalhaven) saw herself as a champion of energy efficiency, she was cautious not to go too far advising others:

> Susie: *Oh I usually tell them what I'm doing…I mean I don't sort of say this is what you should do or you shouldn't do, but I do say, you know, like if you're living on your own like I am, and you're going to use heating or air conditioning, to close off what you don't... I close off what I'm not using, well the rooms I'm not using, to contain whatever heat or cold I'm putting in to the house. I mean I don't think I sprout off about it, but I do say what I'm doing, or what I use to help me.*

Similarly, Stephen said:

> *I won't go out protesting about it or anything like that.*

Some conversations about energy efficiency are prompted when visitors to the home notice the project equipment. Stephen said:

> *We like talking about it, 'cause they're all in the same - they're all pensioners like us, all older people, and they're interested in the money savings, but they're also interested in looking after their houses and making sure that they're done right.*

Later, Stephen said:

> *we tell them about the system and what's going on and how we're saving power and they can take what they want of it. … We chat about it and let them go away and make up their own mind. We don't try and push a point of view or anything like that. We just tell them what we've found and let them do their own thing.*

Renee (80s, retired, living in the community, Southern Highlands) did tell people she knew about the tips she'd learnt, but would only 'give advice' to family.

> Renee: *I did give advice to my son about, he said he had to follow those lights, the family around putting off lights. Yeah I have to do that when the grandchildren are here. Advice to others, advice to others, I don't know. Talking about things I suppose, you know, putting them on the right track about what I've learnt and my knowledge, yeah.*
>
> Interviewer: So just telling them what you do.
>
> Renee: Yeah, yeah. I do actually do that, you know. People are amazed, like [home care support worker] with the vegetables. I don't think they're listening but they are. Yeah they do listen.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households. .

Insight 3.3 Examples of participants changing practices as a result of the project.

Examples of participants changing practices as a result of the project

Miles (70s, retired, couple household in the community, Shoalhaven) reported that since joining the project he had begun to:

- Turn off appliances at the power point;
- Use the air conditioner less and make more use of fan with the door open, and;
- Turn off lights/TV when not in room.
-

Yet, being involved in the project has not always led to major changes in household energy use practices. Nevertheless, as Sally (70s, retired, living in the community, Shoalhaven) explained:

> *I think it just brought the issue to a, the front…electricity runs through walls and you switch lights on and it comes on, etc., etc. You don't think anything of it, until it doesn't work. If there's a power cut or something, and then you think, 'oh well, I suppose I'll go do the ironing, oh no I can't. I'll cook a cake, oh no I can't.' So you know, I mean, you go around the house like that in power cut. I know every woman does. If I've got time to do that because I can't do something else, I'll do that. No, I can't because the power's off. Because you rely on it so much. It's very much taken for granted. It's nice that the project*

> *brought it to the fore, and made me think more about it… And tried to live to it.*

Here, Sally articulated the way in which energy, so often invisible, became 'visible' in its absence, or when prompted by a project for which she was randomly selected.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households

Insight 3.4 Examples of participants undertaking independent upgrades following advice or awareness from the project.

Examples of participants undertaking independent upgrades following advice or awareness from the project.

Miles (70s, retired, couple household in the community, Shoalhaven) put the project thermometer he received on the outside of his fridge, and found that direct sunlight on the exterior of the fridge was causing a temperature of 32 degrees. Concerned that this was decreasing the efficiency of his fridge, he installed a blind in the kitchen. Miles also reported that he used the project display monitor to calculate how much energy is used by different appliances. This motivated him to replace an existing pedestal fan with a (reportedly) more efficient Dyson fan.

Jack, (60s, lives with family, community, Illawarra) was not impressed with the quality of the thermometer sent with the newsletters. However, it prompted him to buy two thermal thermometers to monitor his fridges.

> *[The Energy+Illawarra thermometer] magnets don't work properly and if they put magnets in them they've got to make them protrude so they stick on…and these didn't so I didn't use them, I bought two myself…I have the good, good thermal ones downstairs. …It was good from Energy Illawarra to give me this idea to see it. Plus, I started to help someone in a market who gave me the idea also … Because you need to check things, you know, when you have things in markets.*
>
> *…and also I…bought a new fridge and I had another one down stairs and I thought, you know, two fridges, a little bit expensive and such, but we use it because I buy a lot of vegetables…and also I've got a truck so I can go straight into the garage, unload straight into the fridge, and it's really good to see the temperature of the freezer, you know, it's on minus 20 and I can see the fridge actually it goes in two layers. You can have them cooler…at the bottom and warmer at the top which was, you know, it was good for me to know about too. So all in all that little thermometer that Energy Illawarra sent me…I tried it, it didn't work properly, I went and got my own and it's put me on a good track.*

Jack demonstrated how he checks his fridge temperature with his infrared thermometer.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

4 SOCIAL MARKETING WITH RETROFITS TRIAL

Participants in this cohort were involved in the same activities as those in the Social Marketing Only trial, but with the additional activities and evaluation detailed in the following sections.

The development and delivery of this trial was led by the UOW Sustainable Buildings Research Centre (SBRC) in respect of engineering and technology issues and the UOW Australian Centre for Cultural Environmental Research (AUSCCER) in regards to Ethnographic research and evaluation. Key personnel included the following.

SBRC: Professor Paul Cooper (Director), Michael Tibbs, Dr Georgios Kokogiannakis, Clayton McDowell, Laia Ledo Gomis, Craig McLauchlan, Alex Picard-Bromilow.

AUSCCER: Professor Gordon Waitt, Kate Roggeveen and Theresa Harada.

Staff from RDAI and Viridis Australasia played a significant role in the retrofit implementation phase of the trial, particularly Deborah Petkovic, Natalie Burroughs, Stephen Choi and Rory Eames.

4.1 Methodology

The retrofit program methodology was progressively developed over the course of the project and built upon the previous research carried out by the engineering team, including the development of the ‘Illawarra Flame House’ which was the Team UOW winning entry in the Solar Decathlon China 2013 competition, and demonstrated how to carry out comprehensive, net-zero energy retrofit of a typical Australian home.

Of equal importance was the fact that the retrofit program was fully integrated with the Energy+Illawarra social marketing program of work and it built on the findings of the formative research. Successful social marketing behaviour change programs often include distribution, delivery and/or implementation of products, materials, infrastructure and related activities. Thus, in many ways the present retrofit program could be seen as an essential part of the Energy+Illawarra social marketing program.

The engineering and social marketing teams met regularly to help design and deliver the retrofit trial drawing on social marketing principles of being interdisciplinary, research insight based, bottom up, participant centred and multi-component. Team members involved included UOW engineers and building physicists, sustainable building industry consultants (Viridis Australasia) and other consortium members, particularly representatives from the aged care providers.

It was necessary throughout the full timeline of the project to continuously review and adapt processes and delivery methods given changing constraints and new challenges. The primary challenges that required changes in approach were generally associated with ensuring an ongoing and appropriate level of engagement with 200 households in their home environment, necessitating multiple visits to each of these homes to ensure that appropriate data was being collected and coordination of 200 customised retrofit installations at 200 different work sites.

The building retrofit program involved 200 households within the 8,345 square kilometre project area.

Promotion or advertising of the retrofit trial was not publicly highlighted during the project as it was judged that if it was known that some project participants receiving retrofits this may have impacted perceptions and motivation of participants who were only engaged in the social marketing aspects of the project, however, there was no guarantee that some participants may have become aware of the retrofit component.

Data was collected on energy consumption and indoor environmental conditions before and after the retrofits were installed. In this work the project team built on a range of prior research and demonstration projects of the UOW Sustainable Buildings Research Centre (SBRC) including monitoring and modelling of owner-occupied and social housing.

4.1.1 Assumptions and considerations

The following assumptions and considerations were made when designing the approach to the retrofit trial. These were developed during risk management reviews carried out by project team members and ethical reviews carried out by the UOW Human Ethics Committee process.

Sensitivities of older populations and informed consent. Although the participants were on low-incomes and over 60 years old, they were selected only from independent residential homes including independent living units (ILUs) and owner-occupied homes. If during the course of the survey fieldwork a research associate came across a person in ill health and unable to provide written informed consent to take part in the survey then the survey was not carried out and the potential participant was not recruited, thereby minimising the risk of recruiting excessively vulnerable participants.

Sensitivities of indigenous participants. Participants were randomly selected with no targeting of indigenous or other cultural groups, and no questions were asked in recruitment processes that would highlight indigenous or other cultural identity.

Volume of information provided to participants. The overarching aim of this project was to explore ways to remove barriers to adoption of effective energy efficiency behaviours and technology uptake by low-income older people. Therefore, careful, adequate and simple communication of information to reduce overwhelming or confusing participants was a key project goal. The project team worked hard to minimise the information burden on participants in this retrofit program so as to minimise any confusion and frustration that might arise from the amount of information provided.

Equitable processes for selection of participants to receive retrofits. The Social Marketing with Retrofits cohort (nominally 200) was randomly recruited from the main cohort (~830) households of the Social Marketing Only cohort, with a requirement that the Social Marketing with Retrofits quota of ILU participants had to be met.

Maintenance of privacy and confidentiality of energy bills. Energy billing data may contain information that a participant might not wish to share. Participants were informed that their identity would remain confidential, that the project was only concerned with analysing the energy (electricity and/or gas) consumption data over a period from nominally two years before to two years after retrofits.

Maintenance of privacy and confidentiality when conducting Building Characterisation Audits. Internal room dimensions and photographs of buildings were only taken with the consent of a participant. Photographs were used to help with descriptions of building materials and features. Any photographs inadvertently taken of the participants or household members, people or other identifying features such as street numbers were blurred. Rooms were only entered with the consent of a participant.

Participant time needed when conducting Building Characterisation Audits. The building characterisation audit tool and associated visit were developed with the intention to complete one building audit in approximately two hours. Originally these visits were to be completed by a single project team member, however, following refinement of the process to address potential fatigue of team members, reduce the amount of time required in each participant's home, and address other risks, most home visits were conducted by two team members.

Commercial fairness and transparency when recommending, allocating and costing retrofits. The criteria and process used to select contractors to supply and install retrofits followed RDAI procurement policy and guidelines. This ensured that all procurement was transparent and also followed best-practice commercial procurement guidelines. No dispensation was given on the basis that there was a research component to this project or because it was a government trial. The criteria included a preference, all other things being equal, that the project sought to build locally sourced market capacity.

Issues of time and privacy when recommending and allocation retrofits. A building characterisation audit tool was developed by the UOW SBRC research team in consultation with supply and installation contractors in order to capture the maximum amount of information (including measurements and photos) in a minimum number of visits to each home. The intention was to greatly reduce interactions between participants, researchers and contractors. This was also intended to reduce privacy issues with only one set of de-identified photos distributed to multiple potential contractors.

Burden of information when allocating retrofits. Special care was taken in designing the presentation of information for the in-home retrofit package selection 'consultation visit' with the participants. The aim was to explore simple decision pathways for selection of energy efficiency technologies for residential retrofits.

Informed consent and commitment from participants for retrofit installations. A separate agreement form was developed for this home visit to confirm that the participant had an engaging input into the final selection of retrofit components for their home. It was intended that this would empower participants with ownership of actions to greatly boost the effective use of the home improvements installed as well as to secure an agreement that they wished to proceed with changes being made to their property.

Issues of time, privacy, disruption and potential property damage during retrofit installations. As expected, installation of the retrofits caused a degree disruption to participants due to activities of trades-persons in homes, including noise and disrupted access. It was a possibility that contractors may cause damage to existing electricity, gas or water services, or to the existing home – however, this only occurred very rarely. All contractors received training to maximise the effectiveness of the installation for ongoing energy efficiency improvements. Selection criteria during the procurement process required all contractors to be reputable, carry the appropriate insurances and have in place quality assurance procedures. The successful head contractors entered into a legal agreement with RDAI and with the aged care providers who owned the ILU properties. Any staff from the head contractor and installers that were to be on installation sites were inducted into the program in order to orient them to manage the potential vulnerabilities of the older demographic of the participants in an effective and acceptable manner.

Disruption and use of participants' power and water supplies during retrofit installations. Hot water service upgrades required disruption to water and energy supplies. These disruptions were described to the participant during the consultation visit and again clarified by the installer when the installation was scheduled.

Clear information on retrofit ownership handover. This was a legal/commercial issue where participants needed to have a clear understanding of when ownership and responsibility was to be transferred from RDAI to the building owner in order to manage maintenance, warranty repairs, installation faults, etc. This was explained verbally during the consultation visit and documented in an agreement signed by both an RDAI representative and the participant who was also the owner of their home. A different version of these agreements were required where participants resided in an ILU owned by an aged care provider.

4.1.2 Recruitment of participants from the main cohort

This multi-component intervention and evaluation program included a number of potential participant engagement/benefit combinations. Benefits to participants ranged from social engagement through to receiving retrofits of relatively high monetary value, so it was essential to develop a recruitment process that ensured each participant had a fair and equitable chance of being recruited into each component of the project. Participants for the retrofit program were recruited from within the social marketing program on a random basis, i.e. the Social Marketing with Retrofits cohort was a subset of the social marketing cohort.

The retrofit participant cohort, of nominally 200, can be represented by a matrix of six groups as shown in Table 4.1. The horizontal categories separate the participants into trial types, where the "Support Package" was the term used with participants to encompass the additional engagement and feedback associated with ethnography and intensive monitoring components. The vertical category split is by ownership arrangements, i.e. participants living in aged care ILUs owned by our consortium members; or living in community/owner-occupied dwellings. The target was an equal split between ILU and community, however, recruitment within the ILUs proved less productive than expected. The targeted proportional split between ILU and community was kept consistent across trial types.

Table 4.1 Cohort breakdown for the retrofit program.

	Retrofit only	**Retrofit + support package**	**Support package only**	**Total**
Total	170	30	10	210
Aged Care ILUs[1]	69	12	4	85

Owner-occupied	101	18	6	125
1 - Households living in Independent Living Units (ILU) owned by consortium members.				

A unique feature of the Energy+Illawarra Project was the high level of engagement by researchers in implementing interventions first hand. The researchers who installed the intensive monitoring equipment first conducted the recruitment visits in order to properly inform participants and to establish rapport.

4.1.3 Overview of the Delivery of Retrofits to Participant Homes

The following overarching principles guided the approach to the delivery of customised energy efficiency retrofits:

- There was to be a range of retrofit technologies made available;
- There was to be a pre-determined spread of each retrofit technology where possible;
- Retrofits that were known to have a higher cost-effective impact on energy efficiency or thermal comfort were to be prioritised;
- Retrofits were to be fully funded by the project with no contributions required from participants.
- There was to be an agreed range of spending per home on retrofits, i.e. a minimum and maximum spend per home.

The methodology adopted was based on the process and experience of retrofitting a single home in order to maximise the improvement in energy efficiency while also ensuring that thermal comfort was not compromised, or, was improved. Bearing in mind that the project team were working on behalf of participants, the minimum steps required for this process are outlined below.

Selection and installation of a customised retrofit solution for a single home

1. Collect information and data about a home that impacts energy efficiency and thermal comfort.
2. Analyse collected information and data to assess which retrofit technologies are predicted to provide the best energy efficiency and/or thermal comfort benefit.
3. Recommend the priority retrofit technologies that can be installed given a capped budget.
4. Consult with the homeowner and occupier (if different) to ensure that they understand and agree with the recommended retrofits.
5. Prepare a scope of works or specification for each retrofit technology to be installed with the goal that an installer has clear instructions as to the job required.
6. Specialist or complex retrofits, e.g. hot water installations, require that the installer assess the site based on the scope of works to advise if any other factors need to be taken in to consideration.
7. A work order is raised by the installer and approved by the budget owner prior to scheduling work.
8. Installers schedule work as necessary for each retrofit technology specified and in accordance with homeowners’ availability.
9. Work is carried out in a single or in multiple visits depending on the number of retrofits being installed.
10. Inspection and test procedure is carried out along with any other required quality assurance processes.
11. Installer provides invoice(s) for work completed together with any approved variations that were necessary as compared with the original work order.

12. A follow-up Quality Assurance visit or phone call was made to the participant.

Level of participant engagement required

A significant level of interaction between the project and participants was required for the retrofit recommendation/allocation process. The number of home visits as well as the number of phone calls to any given retrofit household over the duration of the project was higher than originally anticipated. This increased level of engagement had impacts on resourcing, budget and project timeframes which are discussed further in the Project Administration, Operation and Processes section. The participant interactions involved in the customised retrofit trial is outlined in Table 4.2.

Table 4.2 Participant interactions for retrofit trial (not all interactions were required for all participants).

Purpose of contact	Mode of contact
Schedule recruitment/building characterisation visit	Phone call*
Recruitment (obtain consent) and conduct building characterisation audit and install iButton temperature sensors	Visit
Schedule consultation visit	Phone call*
Confirmation of consultation visit explaining purpose of visit and provide copy of agreement for advance consideration	Letter
Consultation to present retrofit recommendation, obtain agreement and install agreed minor retrofit options	Visit*
Schedule installer inspection	Phone call*
Installer inspection for work order preparation	Visit
Schedule retrofit installation (multiple dependent on number of trades required)	Phone call*
Retrofit installation (multiple dependent on number of trades required)	Visit*
Quality assurance check to see if work completed as scheduled and participant is satisfied	Visit or Phone call*
Schedule collection of iButton temperature data	Phone call*
Collect iButton temperature data	Visit

* note that in many cases multiple phone calls, emails and visits were required before a successful outcome was achieved.

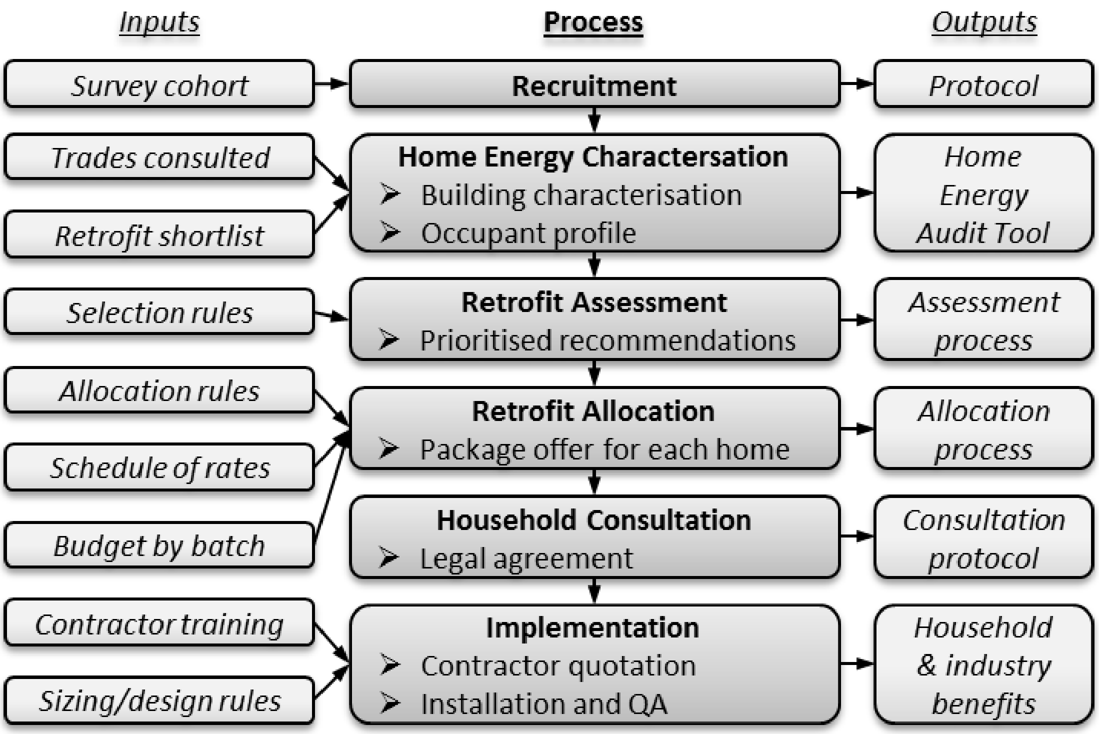


Figure 4.1 Household-centred retrofit selection and implementation process

The retrofit participants were given no incentive to participate in the retrofit cohort, beyond the promise of one or more retrofits being installed in their home, as it was felt that receiving a retrofit at no cost would be viewed as adequate incentive to participate in the trial.

Process Optimisation for Multiple Sites

In order to minimise costs and focus project resources, considerable effort was focussed on planning each phase of the retrofit trial. The following summarises the factors and considerations that the project team found to be essential and in place prior to completion of each step in the customised retrofit program. While similar approaches may be seen in commercial construction projects, the project team identified that this methodology has rarely been applied to energy efficiency upgrade projects. Retrofit Technologies

A wide range of retrofit technologies were initially considered that were judged by the project team to be cost-effective, and in a price range that was appropriate to the budget available for retrofitting of participants' homes in this trial. An review of these possible retrofits was then undertaken with input from specialist trades-persons and consultants.

The outcome of this review was a shortlist of retrofit technologies to be trialled in the Energy+Illawarra project as summarised in Table 4.3.

4.1.4 Building Characterisation and Household Audits

Before retrofits were recommended and allocated, a building characterisation audit was carried out on each home. The aim of this process was to characterise the building, occupancy factors and evaluate basic energy consumption information to provide detailed and high-quality information to input to the householder-centred retrofit decision-making process. This part of the project was carried in three phases:

i) Development of the Building Characterisation Audit data collection tool;
ii) Building characterisation audits carried out; and
iii) Building characterisation reports produced, one for each home.

4.1.4.1 *Building Characterisation Audit Tool*

The action research approach used in this part of the project involved the research team developing a unique comprehensive home energy characterisation tool, then training and managing a team of 15 casual employees to conduct these audit visits enabling collection of a custom, detailed dataset.

The key objective of this building/home energy characterisation tool was to reduce the overall cost of assessing participants' homes and installing the retrofits by collecting sufficient information in a single home visit to facilitate both:

a) A rigorous retrofit selection/allocation process; and
b) Provide sufficient information to contractors prior to on-site inspection.

The alternative, and incumbent, approach was for multiple visits to be made to each home by various contractors/tradespersons to assess the ease of installation and applicability of all possible retrofit options. This would have been a significantly more complex set of activities with the significant risk that contractors/tradespersons may not provide consistent/objective evaluations of participants' homes.

Table 4.3 Summary of retrofit technologies considered for this trial, and those finally selected as members of the shortlist of options for installation in Energy+Illawarra homes.

Category	Specific retrofit	Short listed	Comments
Thermal Envelope	Ceiling Insulation	Y	Seen as likely to be cost-effective and important for improved thermal comfort.
	Sub-floor insulation	Y	Important in some house construction types.
	Draught sealing	Y	Seen by many practitioners as cost-effective, easily installed.
	Wall insulation	N	Considered too disruptive and expensive. External drill/blow-in technologies feasible for future trials.
	Sealing large gaps/holes	N	Considered too labour-intensive/costly.
Window treatments	Internal cellular blinds	Y	Good thermal performance, attractive to participants.
	External shading	Y	However, only a very few homes were trialled. Roller shutters, awnings and fixed horizontal or vertical slats were considered.
	Curtains	N	Considered to be too customised to be easily rolled out in this large trial. Strong householder aesthetic requirements.
	Window film	N	Lack of evidence of adequate benefits – potential to significantly reduce useful winter solar gains.
	Double glazing	N	Research indicated that the cost-benefit is not adequate for retrofitting.
	Insect/security screens	Y	Considered mainly for summer ventilation and comfort.
Hard-wired	Solar hot water	Y	HW retrofits seen as potentially cost-effective

heating, cooling systems	Heat pump hot water systems	Y	HW retrofits seen as potentially cost-effective
	Reverse cycle air conditioning	Y	Primarily used to replace inadequate inefficient heating systems.
Electrical	In-home energy display	Y	Likely high educative impact
	Ceiling fans	Y	Potential to reduce cooling energy use considerably
	Light replacements	Y	Widely seen as cost-effective in other retrofit programs
	AC standby power isolation switch	Y	Experience has highlighted extreme variability in standby power consumption of AC systems up to ~100 watts, which equates to $175/y at $0.20/kWh.
Appliances	Refrigerators and freezers	Y	One of the larger energy consumers in the home, with little opportunity for changes in use/practices to decrease energy
	Heat pump clothes dryers	Y	considered as low priority, unless mobility or accessibility dictated high usage of an existing inefficient clothes dryer
	Pedestal fans	Y	Potential to reduce cooling energy consumption significantly
Minor items	Hot water pipe lagging	Y	Hot water pipes insulated to the nearest wall penetration or first 2 metres from the tank. Valve 'cosies' specified to complement the pipe lagging.
	Low flow hot water fittings	N	Householder likely to have strong preferences on aesthetics/value. No strong evidence of EE benefit.
	Replacement LED light bulbs	Y	Widely seen as cost-effective in other retrofit programs
	Ceiling space downlight covers	Y	Seen as an effective measure to improve building air-tightness
Other	Solar PV systems	N	Not eligible under LIEEP

Existing Australian residential buildings have a wide range of typologies and naturally have many specific local characteristics that are a result of local construction practices, climate, building codes and availability of materials. To provide the necessary building-specific data required to underpin a robust retrofit selection process, a comprehensive Building Characterisation Audit tool was researched and developed and then coded/implemented using a combination of HTML, JavaScript and CSS computer languages. A user-friendly interface was developed for the tool, which was implemented on laptops and tablets and was initially piloted on several non-participant homes in order to ensure that the user interface was adjusted to allow for ease of use. An image of the user interface is shown in Figure 4.2. The data model used for capturing the relevant characteristics of each building is shown on the right hand side of Figure 4.2 and included approximately 1,500 relevant data fields.

This efficient, bottom-up, collection of building characteristics for all retrofit homes enabled the project team to maximise the efficiency and cost-effectiveness of the retrofit recommendation and installation process.

This section will involve walking around the inside of the building and inspecting each room. Please mark the room numbers onto the house plan / sketch. It is advised that you use the navigation panel on the right hand side to switch between rooms and minor appliances capturing both room and appliance data before moving to the next room.

Room 1 Inspection:

Room Type: Please Select Option

Primary Floor Covering: Please Select Option

Using a laser distance measurer (prefered) or a tape measure please *measure and record the room dimensions.*

Room Length (m): -1

Room Width (m): -1

Ceiling Height (m. Note: 2.4m is Standard): -1

Comments: Insert Comments

Figure 4.2 Example screenshot of the Building characterisation tool interface.

The aim was to audit each home only once and in a short time period (1.5 to 3 hours) in order to minimise overall disturbance to the elderly participants. The tool included sections for capturing relevant data from discussions with the occupants (e.g. age of building, ceiling insulation levels for non-accessible attic spaces, year of installation of any potentially existing solar energy systems, etc.).

The second section of the tool collected information on occupant practices (e.g. the time and number of occupants that were home throughout a typical day during different seasons). The auditor was given a data entry point for each of the 24 hours of a day for both heating and cooling seasons, and for both week days and weekends. A comments section was also provided for each season for the auditor to capture any additional comments such as “we are home most of the time but out Wednesday afternoons for shopping”. In this “Time Diary” section, information was also collected on the daily schedules of the activities that could affect energy consumption and comfort levels, e.g. opening windows, use of lighting, cooking, appliances, and heating/cooling systems, and times of showers and sleeping.

The remaining sections of the tool record information specific to the building and the appliances used. Table 4.4 summarises the type of technical data that were collected during a home audit.

Table 4.4 Summary of technical (non-occupant) data types in the building characterisation tool.

Section	Recorded data types
General building	Number and type of spaces (bedroom, kitchen, etc.); types of windows and condition of seals; internal/external type of window shading; number and type of external doors; type of materials for internal walls; external/internal floor types, insulation levels and accessibility for suspended floors; dimensions of eaves; type of dwelling (house, unit, semi-detached, etc.); construction type for walls and roof; roof type and condition (e.g. to enable decisions for the structural suitability of the room for installation of solar hot water systems); type and number of external lights; ceiling insulation type, thickness and condition
External walls	Orientation of external walls and presence of external shading
Major Appliances	Metering details (meter numbers, presence of off-peak meters, gas supply, etc.); PV type, size and orientation; hot water system type and capacity (size); heating and cooling system type, capacity and controls; fridge/freezer details (age, size, energy rating, condition of seals, etc.)
Rooms	Per room: dimensions; presence and location of windows; existence of space heating/cooling system; presence of ceiling fans; types and number of lights; ventilation details (chimneys, wall vents, etc.) and presence of mould
Minor Appliances	Details for a wide range of appliances such as TVs, ovens, washing machines, kettles, etc. (type, brand, nameplate power, etc.)

Provisions were also made to record any health and safety concerns, and reflect on the success of the household audit visits. The final outcome was a rich dataset per household from which a report is automatically generated and used in the retrofit selection process.

4.1.4.2 *Building characterisation audits*

The second section of the building characterisation process involved the implementation of the data collection tool to gather characteristics from 210 dwellings and their occupants. Prior to this each auditor underwent first aid training, training of Safe Work Procedures (SWP), training of code of conduct (Figure 4.3), and took place in a series of pilot audits on real buildings and role-play occupants to provide familiarisation with the procedures and data collection tool.

Each audit team was equipped with a tablet, laser measure, tape measure, digital camera, step ladder, personal protective equipment (PPE), various stationary items, and a first aid kit and cleaning products as precautionary measures.

During the auditing process an average of ~170 photos were taken of each dwelling. These photos facilitated future data validation, additional information during the retrofit recommendation process and were supplied to the installers, when appropriate, to assist in a streamlined installation process.

4.1.4.1 *Building Characterisation Reports*

With the data collection process complete, analysis commenced to provide a summary characterisation report for each of the dwellings. The data collected during the building characterisation audits was imported into a formal database and processed into producing a building characterisation report for each dwelling. This report gave a succinct summary of the dwelling and occupant patterns and preferences in preparation of an analysis of the recommended retrofits. Figure 4.4 shows an example page of the building characterisation report (reports were usually between 12 to 16 pages in length for each property).

Figure 4.3 Training workshop for auditors at the UOW Sustainable Buildings Research Centre (SBRC).

BUILDING CHARACTERISATION REPORT

DWELLING ID: 533
TIME STAMP: 2015-03-05-132527
OWENERSHIP: OWN
LGA: WOLLONGONG

STAFF ID: LUKERD00
STATUS: COM-RET
PROVIDER: COMMUNITY

OCCUPANCY PROFILE			
Max number of occupants (Occ)	Residents	Summer: 2	Winter: 2
Occupation Rate (approx.) (Occ)	Summer WD	222222222222222222222222	
	Summer WE	222222222222222222222222	
	Winter WD	222222222222222222222222	
	Winter WE	222222222222222222222222	
Most Utilised Room (Occ)	Location	SUNROOM	
Desired Changes 1 (Occ)	cant think of anything		
Desired Changes 2 (Occ)	fridge, as the one they have start to rust the doors. But would like one Similar, INSULATION OLD LOOSE FILL		
Living Comments	sunroom or front room depending on weather		
Summer Comments	NULL		
Winter Comments	NULL		

GENERAL BUILDING PROFILE			
Estimated Age of Dwelling (Occ)	SIXTY_AND_OVER		
Occupant Aware of Asbestos (Occ)	possible in ceiling, used to be weatherboard		
Mould Comments	NULL		
Clothes Drying Comments	closeline or hangers inside		
Structure	HOUSE		
No. of Storeys	2	No. of Living Rooms	2
No. of Bedrooms	4	No. of Lounge Rooms	1
No. of Dining Rooms	1	No. of Studies	NULL
No. of Kitchens	2	No. of Ensuites	0
No. of Bathrooms	3	No. of Laundry Rooms	1
No. of Water Closets	1	No. of Garage Spaces	1
Comments	granny flat downstairs disconnected from power8 years ago		
Total Area (m^2)	182.56380000000001	Total Volume (m^3)	480.87670499999996

Figure 4.4 Example page from a building characterisation report.

4.1.5 Retrofit Recommendation Process

The challenge for the retrofit recommendation process was to deliver a set of 200 householder-centred retrofit recommendations to RDAI/Viridis Australasia for allocation and implementation in a short timeframe (e.g. there was insufficient time to carry out in-depth engineering assessments or cost-benefit estimates at this stage of the project). The final retrofit recommendation process, after significant refinement and design, incorporated the list of criteria summarised in Table 4.5 to assess the suitability of each retrofit for each household against the data gathered from the Building Characterization Audit tool.

Table 4.5 Criteria used to select and prioritise recommended retrofits to be potentially applied to each home.

Criteria	*Comments*	*Examples of application to a specific retrofit type*
Building ownership and pre-approval issues	This was considered where the building was not owner-occupied (e.g. ILU and strata).	The existing policy of the Aged Care Providers was not to provide air conditioners or fridges as supply of these items was seen as being the responsibility of residents.
Retrofit suitable to type of building construction	Pre-requisites and co-requisites.	Sub-floor insulation not applicable to concrete slabs; downlight covers combine with insulation.
Technology/appliance already present	Type, adequacy and likely performance of existing unit/technology.	Partial or ineffective draught seals on doors already present. Only direct electric storage hot water systems were upgraded (not gas).
Age of existing appliance/technology	> 10 years old.	Applicable to hot water and fridges.
Structurally sound installation	Adequate strength of mountings to support retrofit.	Roof structure had to be deemed adequate to support a solar hot water system.
Suitable and sufficient space		Roof area available for solar hot water collector.
Accessibility for installation	Safe and workable access (e.g. ceiling access hatch)	≥600mm underfloor height clearance to install sub-floor insulation.
Safety	Installation and operation	Roof access, slope and surface all safe; ceiling height at least 2.4m for ceiling fans.
Orientation and shading		Unshaded north-facing roof for solar hot water; external shading of exposed north/west windows
Local climate	Priorities adjusted for local conditions	Thermal envelope treatments given higher priorities in colder climate zones.
Health	Mobility, respiratory and mould issues	AC prioritized for medical comfort needs. Draught sealing avoid if mould was already present in home.
Householder utilisation	Number of occupants; practices align with retrofit.	Draught sealing less important if windows were generally left open throughout winter.
Thermal comfort	Specifically requested need and perceptions.	External shading more important for households that suffer summer thermal discomfort.
Likely impact on energy bill	Electricity tariffs; existing solar PV effects; etc.	Existing AC standby power measured; number of existing LED light bulbs and hours/day utilization.
Complementary installations	Packaged to link common trades or benefits	Insulate both ceiling and subfloor on a given home; ceiling fans to offset summer cooling energy from AC.

These generic criteria were tailored and rationalised for each retrofit leaving typically 10 criteria for each of the 20 retrofits. The resulting matrix of approximately 200 specific criteria was then implemented in a custom-built Excel decision-support tool. Fields were filled through a combination of auto- and manual-processing of audit tool data and photos. These formal retrofit assessments were carried out by the SBRC/Viridis Australia team and required approximately 1.5 hours to complete for each of the 200 homes. This process was followed by a formal peer review process for quality control.

Note: the original intention of the project team in respect of development of the retrofit recommendation process was to group the short-list of approximately twenty retrofits into a limited number of four to five standardised 'retrofit packages'. However, it became clear that this would not lead to efficiencies in the overall retrofit allocation process, and also lead to very few households being eligible for each ‘retrofit package’. For example, only a relatively small proportion of homes were to be suitable for single retrofit technologies, which meant that even fewer would be deemed suitable for pre-determined ‘retrofit packages’ with a given combination of retrofit types (see Section 4.2.3 for further discussion).

4.1.6 Retrofit Allocation Process

The budget available for the customised retrofits to 200 homes was obviously limited and the project team developed a holistic and rigorous strategy to ensure that:

- the total budget would not be exceeded;
- retrofits were recommended and allocated that retained the principles of a customised approach;
- budget was spread as fairly as possible between participants;
- there was an appropriate level of contingency budget set aside to cater for unforeseen variations and on-site issues.

The technical recommendations were released from the SBRC research team to RDAI for allocation in batches of homes, i.e. recommendations were reviewed in groups of homes, either on the basis of type of ownership or geographic location. Originally, it was planned for all 200 recommendations to be released at one time in order to help simplify the budget allocation and ensure an equitable spread. However, none of the tasks required for installation of a retrofit *per se* (e.g. consultation with the householder, preparation of work orders, etc.) could commence until the recommendations were made available. A progressive release of recommendations for batches of homes was therefore carried out, so as to allow the retrofit allocation/implementation team to start their work as soon as possible.

A finite budget was set for each batch which was determined considering the number of homes in the batch and the estimated allowed spend per home. There was a target range of budgets per home, which set the range of achievable scope of work for each household. A minimum of $700/home was set, with a maximum of $6000/home and an average budget of approximately $2200/home. This was intended to trial a range of retrofits options.

The intensively monitored homes, i.e. those that had a high level of monitoring equipment installed and ethnographic assessments carried out during the project, were left to the final batch. The intention behind this was that any savings that could be made (due to other participants not taking up retrofits offered) could then be applied to this final batch. This increased the opportunity to install a more thorough retrofit, i.e. a higher level of customisation, in those homes that were being intensively monitored.

A detailed description of the Retrofit Allocation Methodology can be found in Appendix F.

4.1.7 Home Owner Retrofit Consultations

Consultation visits were carried out by representatives of RDAI at the home of each participant that was to receive a retrofit. While the primary purpose of these visits was to obtain a formal agreement to proceed with retrofits to a home, they also served to again reinforce the participant-centred approach of the project, helped people understand why particular retrofits were being recommended and how they may help them be more energy efficient and/or comfortable.

An example of the covering letter and the agreement that were sent prior to the meeting can be found at Appendix G. Once an agreed time was arranged, each consultation involved the steps detailed below.

1. The project representative described the purpose of the visit and gave an update of the progress of the project to date
2. The retrofit(s) to be offered to the participant were described to the participant and any questions answered. Where applicable one or more product brochures were left to provide information on the retrofit(s).
3. If the participant did not agree to the retrofit(s) offered, then the next best alternative (if available) was offered. If no retrofits were acceptable to the participant then the participant would no longer be part of the retrofit trial.
4. The project representative went through the content of the formal agreement to proceed with the retrofit(s) and answered any questions.
5. The formal agreement was signed by the participant that signified their approval to have the retrofit installed in their home as part of the project.
6. A copy of the signed agreement was left with the participant for their records.

Consultations with Aged Care Asset Owners

It was planned that approximately 50% of participants in the retrofit trial would reside in ILUs of the consortium aged care partners – IRT Group, RFBI or Warrigal. These asset owners were significant stakeholders in the retrofit trial, and in the outcome of the installations in their properties. They also provided significant cash contributions to the cost of the installations. Therefore, additional levels of consultation were planned to cater for and address any concerns and manage the expectations of the asset owners throughout the process.

Numerous meetings were held with representatives from each aged care provider to attain agreement with the methodology of allocation of budget, identify each organisation’s requirements associated with installation processes and quality assurance and cater for policy restrictions that may restrict the types of retrofits that could be installed and how they were installed.

It was important to also consult with each asset owner regarding the set of recommended retrofits prior to the consultation with the resident. This gave the asset owner the opportunity to clarify and, where necessary, edit specifications that may have had unwanted asset maintenance impacts prior to setting expectations with the resident.

4.1.8 Implementation and Quality Assurance

The logistics associated with implementing the installation of multiple retrofits at 200 separate homes demanded an extremely high level of administration, communication, coordination and prior experience for this to be executed within the very limited time available and addressing risk and quality requirements. A subject matter expert in retrofit construction projects was required to develop scopes of work for each site and coordinate the installation through to “final completion” at each site. This role was outsourced by RDAI to Viridis Australasia and their experience and expertise in other commercial and residential energy efficiency projects was a rare and key resource to the successful completion of this trial.

Procurement of services and products prior to known requirements for each retrofit

The challenge with procurement for this trial was due to the necessity of conducting it concurrently to the execution of the home audits. This was directly a result of earlier delays in the project (refer to Section 6.1).

An Expression of Interest was sent to 28 preferred suppliers. Evaluation of responses determined Programmed Facility Management (PFM) to be the preferred contractor for supply and installation of all major retrofits. Project team members carried out some minor work, i.e. non-trade specific work during the consultation visit, and some refrigerators were sourced and delivered by Bunnings Group.

The preferred approach was to have all requirements and specifications of retrofits known and documented prior to engaging any contractors and establishing an agreed schedule of rates. These rates needed to cover the cost of the product itself, time to deliver and install, time to travel to site, management overheads and any required removal and disposal of existing systems, e.g. hot water systems. Best efforts were made to minimise time and management overhead costs while also minimising the risk of delivery. An agreed schedule of rates was established to enable the budget allocation process to be applied, however for more complex installations, the final cost could only be determined once the site was assessed by an experienced installer. For example, adequate access may have been a factor that required additional equipment and therefore added to installation costs.

Construction and Installation Services Agreements

An agreement was established between RDAI and the head contractor PFM to supply and install retrofits to all the independently owned homes engaged in the trial.

The costs of the retrofits that were installed at each ILU were paid for by a combination of funds from the LIEEP grant funds and the relevant aged care provider, i.e. the owner of the property. To ensure all work was carried out at their sites to the satisfaction of the owners and to cover any possible liabilities arising from the installations, a three-way agreement was established between the grant recipient (RDAI), the head contractor (PFM) and each aged care provider.

Induction of installers

Any person that was required to be on site at any participant's home for the purposes of a retrofit installation was required to attend an induction session. The objectives of these sessions were to:

1. Introduce the objectives of LIEEP and the expected outcomes of the project.
2. Explore and discuss the current levels of awareness of installers regarding household energy efficiency.
3. Explore and discuss how the installation process can affect energy efficiency and how, in particular their conversations during an installation can influence a participant's level of acceptance or satisfaction with a retrofit.

4. Provide instructions around project procedures and conduct.

Installations

Once the agreement with each participant was signed during the resident consultation process, a scope of works was developed for each home and supplied to the head contractor. In response to each scope of works, a work order was raised, and once approved the work could begin.

Quality processes

It was determined that 20% of installations were to be inspected as a sample that provides representative indication of the work, appropriate likelihood and magnitude of the risks involved. A sampling matrix was developed based on the following factors:

- What the work is and how complex it is;
- Accessibility;
- Consequences of failure;
- Disruption to residents;
- Consequential damage to resident property (or other property);
- Threat to safety of workers and other people;
- Availability of resources.

For homes that were not inspected in person, an attempt was made to call all participants that received retrofits. Quality discussion points included:

- Confirmation that the work was completed;
- Time keeping of the installer;
- Professional manner of the installer;
- Provision of warranties, manuals and contact details;
- Worksite safety;
- Quality of finished product;
- Explanation and usage of items.

4.1.9 Evaluation of Energy Use and Indoor Environment

4.1.9.1 *Energy Billing Data*

To facilitate quantitative evaluation of the impact on energy consumption, authority was gained from participants to obtain their electricity and gas billing data directly from energy distributors for the region: Endeavour Energy for electricity and Jemena for gas. The data was nominally collected for two years before the interventions through to two years after the interventions. In practice the data collection period for the retrofit cohort was centred 2 years either side of recruitment (the 'date of authority') and was mandatory for participants wishing to continue participating in this cohort. Authority to release this billing data for the social marketing cohort was obtained from participants on a voluntary 'opt-in' basis as the project team judged that there was a significant risk of participants from this cohort withdrawing from the program if sharing billing data from the distributor was made mandatory. A fixed period of 4 years was specified to provide consistent data evaluation period across this cohort.

A very substantial effort was required to establish the appropriate contact person within both the electricity and gas distributors for the region. Once the relationship was established the effort to develop and implement a data sharing arrangement that was satisfactory to all parties was complex and time-consuming, and this introduced significant delays to data sourcing and analysis. In hindsight, it would have been valuable for the Department of Industry Innovation and Science to be actively engaged in facilitating these relationships and standardising data collection formats and procedures across the projects. This could have helped to mitigate the sustained and focussed effort of all projects across LIEEP to settle the many ethics, legal and technical issues.

4.1.9.2 *Indoor Temperature Monitoring*

Indoor temperature was logged in the main living area of each home of the retrofit cohort from the day of the Building Characterisation Audit. A pair of ‘iButton’ DS1922L temperature sensors was installed side-by-side on an internal wall, in a position that avoided heating and cooling from devices and direct sunlight throughout the day, and at a height of approximately 1.1m above floor level. Logging at hourly intervals with 0.5°C resolution provided a data capture memory capacity of 11 months before a second visit to the home was required to download the data and reprogram the iButtons. One iButton was configured to capture data on the hour and the second was offset to capture at half past the hour. This provided half-hourly time sampling with some sensor obsolescence in the event of one iButton failing.

Figure 4.5 Typical installation of iButton temperature sensors to monitor living room temperatures.

4.1.9.3 *In-Home Monitoring*

Each of the approximately 30 randomly chosen intensively-monitored homes had a comprehensive Jetlun™ energy and thermal comfort monitoring system of wirelessly networked sensors installed. Electrical energy consumption (real power) was logged every minute from switchboard circuits and around 5 major appliances in the home. Up to six air temperature and humidity sensors logged data every 5 minutes, while reed-switches were used to monitor how people used windows and doors to ventilate their homes. Hot water flow and temperature were also logged. A gas consumption meter was installed in one home, which logged flow at a 10-litre resolution. Photos and descriptions of the most important monitoring devices are provided in Appendix H. The system communicated through a ZigBee wireless network to the central data logger, which used a 3G Router to email data every 24 hours to the research team.

4.1.9.4 *Building Air Permeability Assessment*

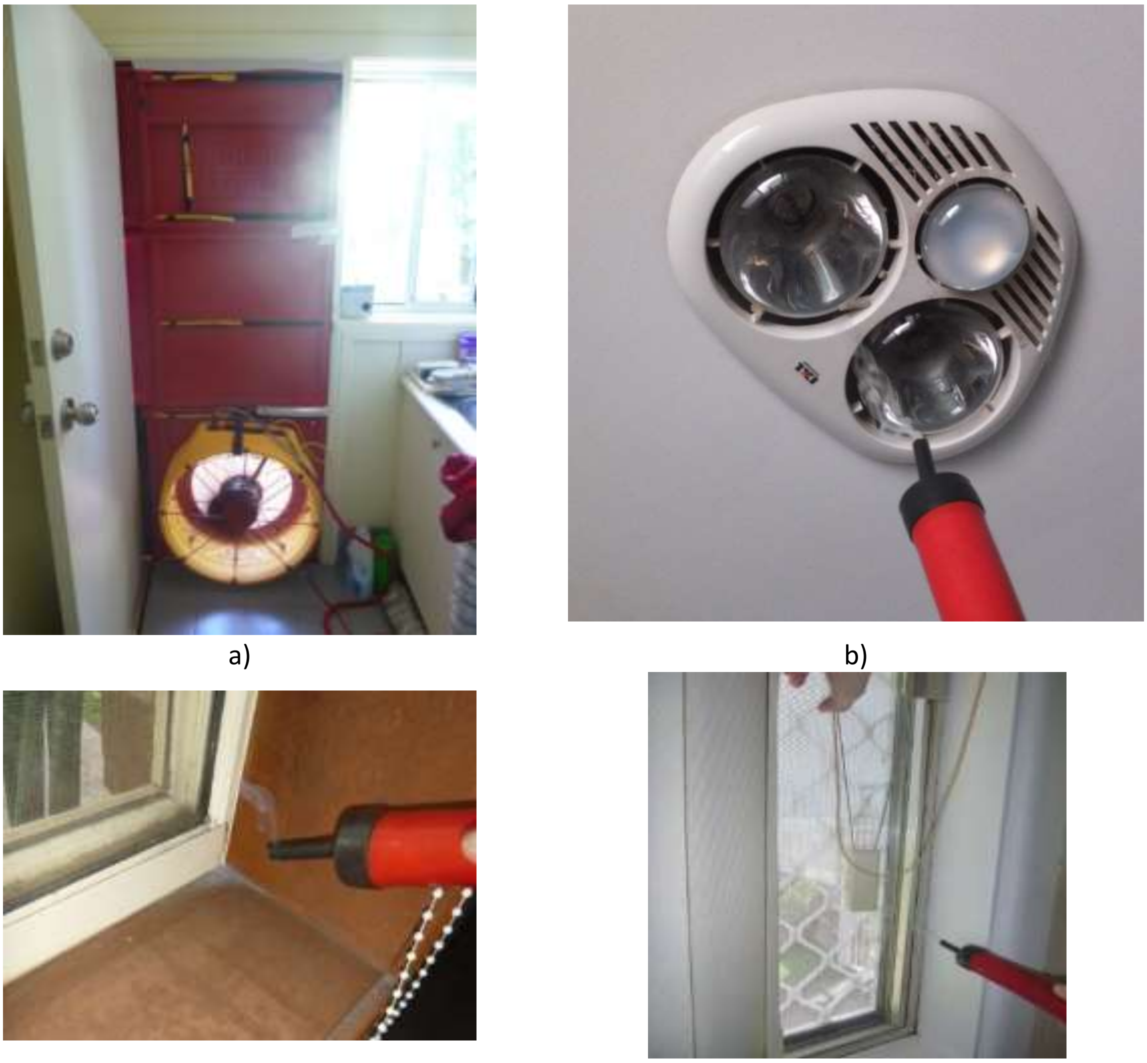
The air-tightness of buildings can have a significant impact on energy consumption and thermal comfort. The conditions, for example, in houses with high air leakage rates are affected by the unwanted heat losses in winter and heat gains in summer. To this end, an assessment of the air permeabilities of a sample of 14 intensively monitored properties was conducted via a blower door test (Figure 4.6) in order to establish a baseline for the current air permeability status of residential houses in the area and identify relevant issues that could be resolved during retrofitting. The tests were conducted according to ISO 9972:2015 (2015).

The technique used enables pressurising and depressurising the building to several outdoor-indoor pressure differences, while measuring the required airflow to maintain this pressure difference. Retrotec™ 'blower door' equipment was used to carry out the tests. The specifications of the fan were a maximum flow of 2690 L/s and minimum flow of 3.8 L/s at 50 Pa, with a flow accuracy of ±5%.

The procedure entailed testing the home as "building in use", where any intentional openings such as windows, doors, attic hatches, etc. should be closed, whilst other unintentional openings that cannot be sealed, e.g. wall vents, chimney, etc. should remain open/unsealed. To assess the effect of the leakages, a qualitative and quantitative testing was carried out. The qualitative testing involved setting the pressure at 50 Pa whilst conducting a walk through the home with a smoke pencil to identify the location of the leakages. The most common locations for air leakages were around the toilet extraction fan and window frames or were the result of bad construction practices during the building of the dwelling, e.g. holes within cupboards, or penetrations in the envelope for services. Examples of leakage paths are shown in Figure 4.6b, c and d. Once the smoke pencil testing was completed and potential air leakage locations were identified, a quantitative assessment was undertaken by pressurising the building again to 50 Pa and recording flow rates with and without these leakage sources sealed.

4.1.1 Evaluation - Household Ethnographies

The first round of household ethnographies, prior to retrofits, were conducted with 37 households between December 2014 and July 2015 while post-retrofit ethnographies were conducted from December 2015 to March 2016. Table 4.6 shows the distributions of participating households by project activities and housing tenure. Potential participants were recruited from those people who completed the energy efficiency survey, and indicated a willingness to participate in future research. Potential participants were randomly contacted by telephone followed by a home visit by UOW staff.



a)

b)

c)

d)

Figure 4.6 Air permeability test assessment: a) set up of the fan secured to the laundry door using the Retrotec™ hard panel frame, b) 'smoke pencil' showing leakages through the ceiling fan , c) smoke demonstrating the leakages between the window frame and structure, and d) smoke pencil showing leakages through the window frame.

Table 4.6 Interviews and home video-insights completed prior to retrofits.

	Energy Upgrade & Intensive Monitoring	Intensive Monitoring only
Independent living units	10	4
General community	18	5

(Total 37)

4.1.1.1 *Phase 1: Before retrofits and social marketing program*

The first household ethnography had three elements: i) Getting to know you; ii) Home video-insights; and iii) Follow-up conversation of home video-insights. The first element was conducted from November 2014 to January 2015; the second element from November 2014 to early February 2015; and the final element of follow-up conversations of home video-insights with 15 of the participant households from June and July 2015. Table 2 shows the distribution of follow-up conversations by housing tenure.

Table 2. Follow-up conversation of home video-insights completed.

	Upgrade & Intensive Monitoring	Intensive Monitoring only
Independent living units	5	2
General community	6	2

(Total 15)

Rationale for mixed-method household ethnography

Mixed-method household ethnography provides insights into how energy is consumed/saved in and through household activities/routines/movements that enable people to make a room or building feel right (that is homely/comfortable) or not. Hence, the mixed-method qualitative methods combined semi-structured interviews (Appendix I), home video insights (Appendix J) and follow-up conversations around the home video-insights.

Semi-structured interviews are a well-established method to gain insights into the different ideas that inform everyday practices. The semi-structured interview was divided into two parts: i) Getting to know you; and ii) Sketch of the floor plan. The semi-structured interview was designed to open-up a conversation about the participant's personal history, the participant's relationship with the house as home, and their understanding of energy efficiency. The sketch of the floor plan was designed to provide insights into how energy is consumed to sustain comfort in and around the home at different times of year.

The aim of the home-video insights was to provide an opportunity for participants to tell and show researchers how they make, or seek to make, each room in their home 'feel' right. By adding video it was possible to document not only participant narratives of their practices and sensory experiences, but also what their bodies show us what it is like to live in and continually renew their houses as homes. Conducting home insights allowed the use of the materials and memories of the house itself as prompts and props. Home video insights were structured into two parts: i) a tour of each room; and ii) re-enacting everyday routines (which may have focussed on kitchens, dining, lounge, laundries, a bedroom, hallways).

1. *Room insights – making rooms 'feel' right*

The video-insights provided moments to avoid questioning around energy related questions, to prevent participants from positioning themselves in relationship to 'green' moralities. Video methods provided opportunities to reveal the compromises, constraints and contingencies of how energy is enrolled to create and maintain different rooms to 'feel' right for particular home-making activities. Video-insights focussed on seven rooms – kitchen, dining, lounge, bedrooms, hallway, laundry and bathroom.

2. *Asking participants to enact everyday routines*

Everyday routines involve multiple activities that emerge in relation to participants' understanding of the contingencies/innovations of the material, social and sensory home. Asking participants to enact everyday routines offered insights into the ways that people use energy to accomplish their aims of creating a particular sensory aesthetic in their home. Additional insights are provided to moments when activities that involve energy consumption would begin/end. During the home video-insights attention focused on a number of regular household activities: doing the laundry, washing-up the dishes, arriving home on a winter's day after grocery shopping, staying home during the day in winter, staying home in the evening in winter, getting-up in the morning in winter, going to bed in winter.

Follow-up conversations around the home video-insights

Review of edited video clips with participants was a way of co-producing the analysis and interpretation from the home video tours. Review of the edited video clips provided possibilities for clarification around why participants thought particular practices were sensible in how rooms were set up to work and the contingencies, constraints and compromises in making rooms comfortable – that is 'feel right'.

4.1.1.2 *Phase 2: After retrofits and social marketing program*

Semi-structured interview

Semi-structured interviews were deployed as method to investigate with participants their understandings and experiences of the Energy+Illawarra program.

Semi-structured interviews were conducted immediately after the retrofits, during January and February 2016. Attention focussed on the processes and outcomes of the project. Hence, the semi-structured interview was divided into seven sections: project impressions; energy ideas; energy efficiency upgrades; energy practices; your home comforts and wellbeing; unexpected outcomes; and final questions. The first section focused on what participants (where relevant) had learnt from their experience as a participant from the marketing, building characterisation, home consultation, and installation of the energy efficiency upgrade. The second explored any changes in their ideas of energy. The third explored the advice they had been provided on energy efficiency upgrades to their home. The fourth investigated energy practices, and if they had changed through engagement with the project. The fifth asked questions around changes to their home comforts and wellbeing. The sixth investigated unexpected outcomes of having been involved in the program. The final few questions explore the advice participants would give to other people and the government around energy efficiency and wellbeing and comfort (See Appendix I). The distribution of participants by housing tenure is shown in Table 4.7.

Table 4.7 Numbers of final interviews completed.

	Upgrade & Intensive Monitoring	Intensive Monitoring only
Independent living units	6	2
General community	15	4 of possible 5

4.2 Results and Discussion

4.2.1 Household and Home Energy Characteristics

The following section outlines the results of the key characteristics of participants' homes and practices as captured using the Building Characterisation Audit tool.

4.2.1.1 *Occupant characteristics*

The households characterised in this study typically were made up of one or two occupants with only twelve households having three or more occupants. It was found that owner-occupied homes were more likely to have 2 occupants, and ILUs were more likely to be single occupant homes (Figure 4.7).

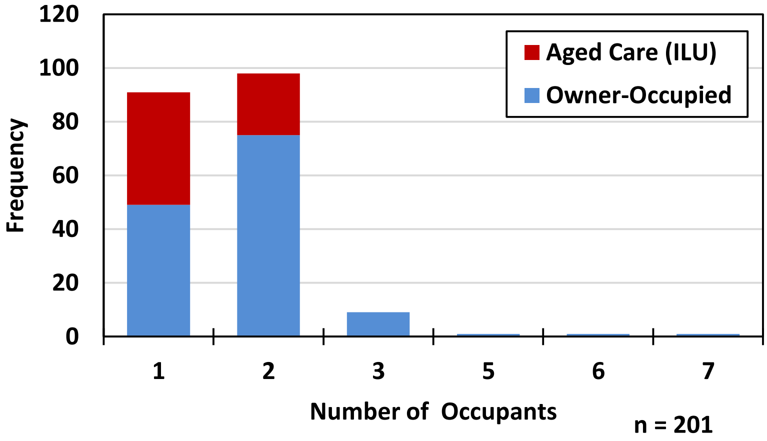


Figure 4.7 Frequency distribution of number of occupants in households.

The participants were asked to report on the typical periods when they were at home throughout weekdays and weekends for both summer and winter periods. From their responses it was concluded that most of the houses (approximately 75%) in the retrofit cohort were occupied for the majority of time for both weekdays and weekends and both summer winter periods (Figure 4.8). It should be noted that this was a measure of a typical day; it did not suggest that the occupants never leave the home at these time, and houses with more than one occupant may be occupied for the majority of the time with different occupants at home during different times of the day.

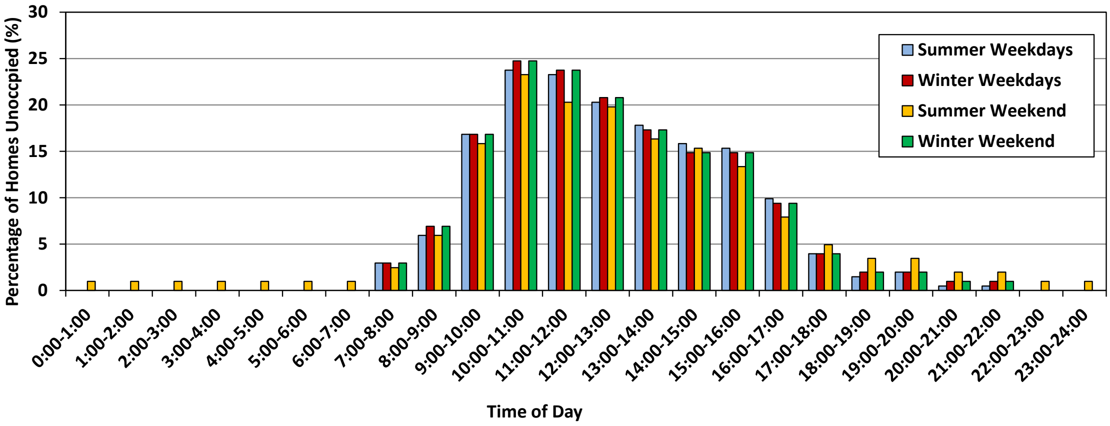


Figure 4.8 Occupant-reported unoccupied periods throughout a typical day.

The occupants were also asked if they used active heating (gas, electrical, wood stove, etc) or cooling (air conditioner) and the typical operating times, as shown in Figure 4.9 and Figure 4.10. The results illustrate that occupants typically use heating in the living room in the late afternoon and evenings with a smaller group using heating for the morning period. Heating of the bedroom only identified in a small number of houses, with less than 10% reporting the use of bedroom heating.

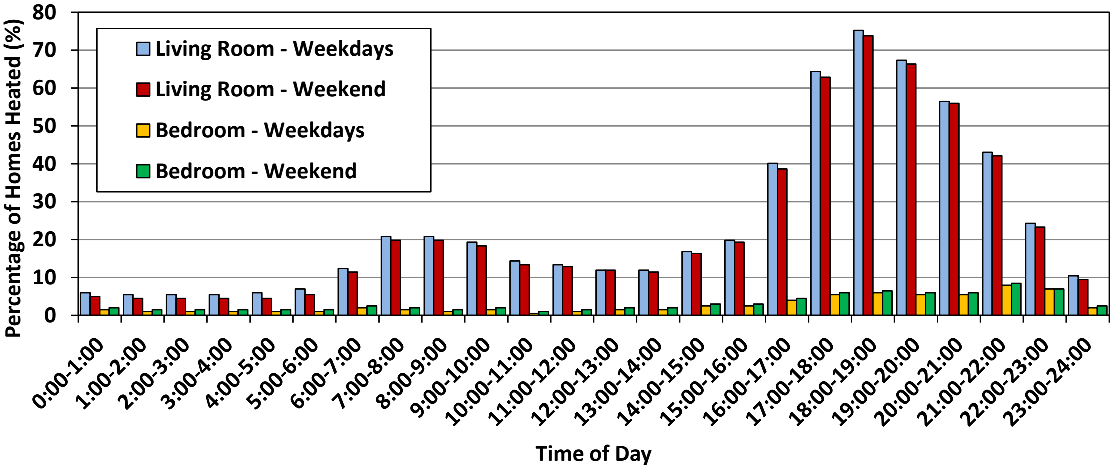


Figure 4.9 Occupant-reported times when active heating systems were used.

It was found that cooling was used primarily during the late afternoon through to the evening for the living room with a small number of occupants operating cooling for the bedrooms overnight.

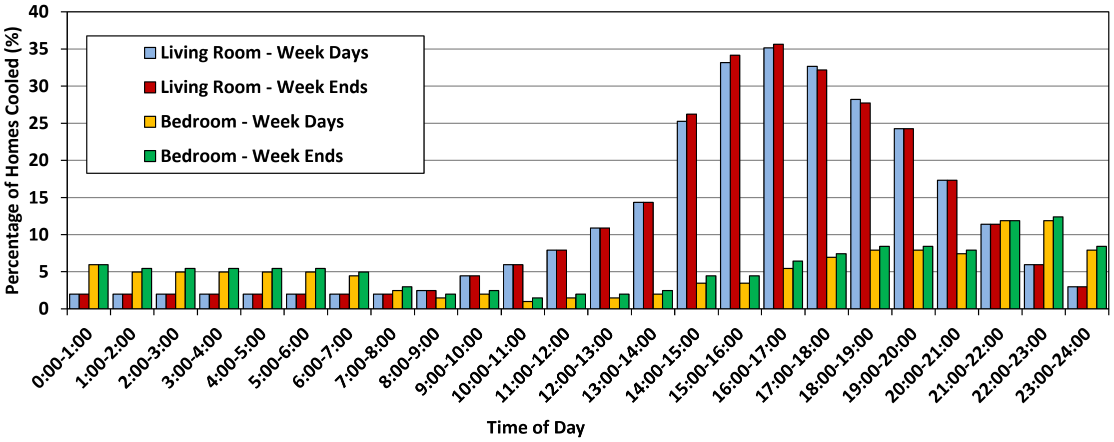


Figure 4.10 Occupant-reported cooling times when cooling (air conditioning) was employed.

The occupants were asked about the times of the day that they would typically open their living room and bedroom windows in both summer and winter periods. This data was converted to the percentage of homes which had windows open each hour of the day and the results are presented in Figure 4.11. Participants tended to report having their windows open more in summer than in winter, which aligns with climate and thermal comfort band data presented in 4.2.2.1. The relatively small percentage variations in open windows through the day suggested that the majority of occupants may not have operated their windows at all during a typical day. A separate analysis of the percentage of homes reporting windows being either 'never open' or 'always open' throughout a typical day is presented in Table 4.8. The final column in this table combined the percentage of windows 'always open' and 'never open' to confirm that the majority of households self-report as not operating their windows during a typical daily thermal cycle in summer or winter for bedrooms or livings rooms.

During summer it was observed that for the majority of occupants the bedroom windows were always open whereas during winter there were two distinct groups: those with the bedroom windows always closed (40% of the retrofit cohort) and those with the bedroom windows always open (33% of the retrofit cohort).

For the relatively small proportion of participants who were recorded as actively operating their windows through both the daily and seasonal cycles, they tended to report opening their windows in winter for shorter periods during the middle of the day; and in summer, windows tended to be opened from early morning and generally not closed until around bedtime. This suggests some effective practice of night purging, though the data was self-reported for a “typical day” in summer with no distinct data for practices on very hot days, so night purging practices cannot be confirmed.

These reported behaviours demonstrated effective strategies by a proportion of participants for seasonally adjusting natural ventilation practices in their homes for thermal comfort and fresh air. However, it is noted that a very low proportion of households self-reported as actively operating their windows through the daily outdoor temperature cycle to capture thermal comfort and energy saving benefits at appropriate times without suffering the losses associated with always leaving windows open. Further, it was found that almost 20% of homes typically have the living room windows always closed during summer and 10% of the homes typically have the living room windows always open during winter.

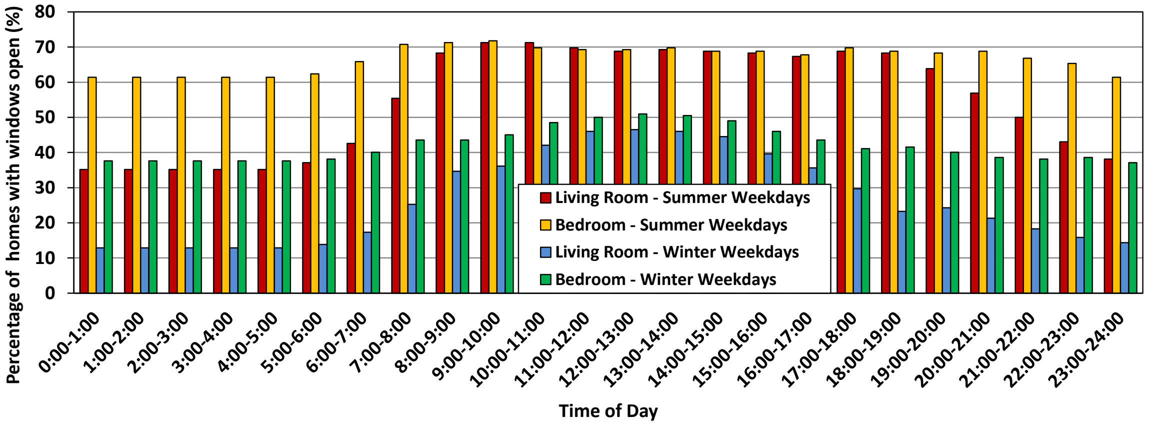


Figure 4.11 Fraction of homes with windows self-reported as being open during a typical day in summer and winter for living rooms and bedrooms.

Table 4.8 Percentages of homes with windows self-reported as being either always open or always closed in summer and winter for living room and bedroom.

Season	Room type	Windows never open (% of homes)	Windows always open (% of homes)	Windows fixed open or closed (% of homes)
Summer	Living room	19	32	51
	Bedroom	17	53	70
Winter	Living room	46	10	56
	Bedroom	40	33	73

These observations were identified as a significant opportunity for the social marketing and behaviour change program to facilitate knowledge and influence behaviours to improve the experience and enjoyment of naturally ventilated homes by householders in the region. A substantial interdisciplinary focus produced an “Energy+Summer Comfort” newsletter and a video entitled “Energy+Keeping comfortable”. Example diagrams from this video are presented in Figure 4.12. The development of these materials is just one example of the householder-centred approach adopted in this project, by starting with the window opening habits recorded in the building characterisation and household audits; and the dynamic interdisciplinary collaboration to produce an integrated multi-component intervention that was insight-driven.

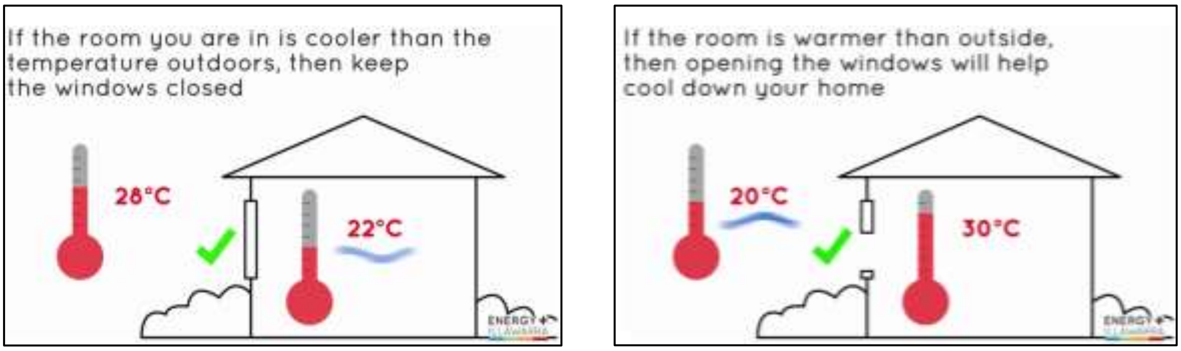


Figure 4.12 An extract from the “Energy+Keeping Comfortable” video developed by the interdisciplinary team for the social marketing intervention, showing participants how best to regulate indoor temperature through window opening practices.

4.2.1.2 *General Building Construction Characteristics*

A summary of the data collected and analysed on the building stock occupied by participants in the trial is provide in Figure 4.13 to Figure 4.22.

The general construction characteristics of the owner-occupied homes were quite different to those of the aged care ILU homes. The aged care homes were typically 20 to 30 years old (Figure 4.13), 2 bedroom units or semi-detached houses, with a floor area of approximately 60m^2, of brick construction with slab on ground floor (Figure 4.17 and Figure 4.18).

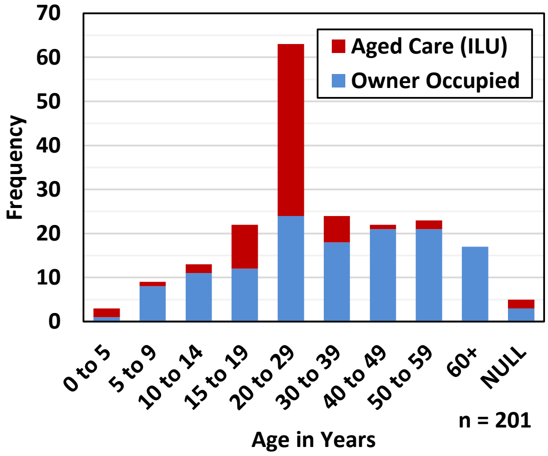


Figure 4.13 Age of homes as reported by occupants for owner-occupied and aged care ILUs.

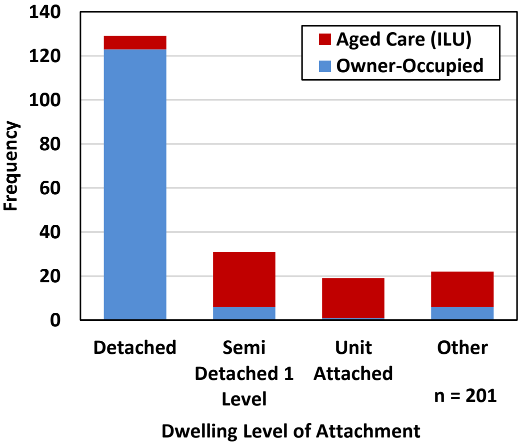


Figure 4.14 Attachment level of homes for occupied and aged care ILUs.

Owner-occupied homes had a relatively even spread in age, most commonly being 20 to 60 years old (Figure 4.13). The most common configuration was 3-bedroom detached houses, with a floor area of approximately 90-160m^2 and the most common construction being brick veneer with slab on ground floor, but the variety and spread being much greater than for the aged care homes. Overall, the majority of homes were found to be of heavy construction type with brick and double brick representing almost 75% of the cohort (Figure 4.17).

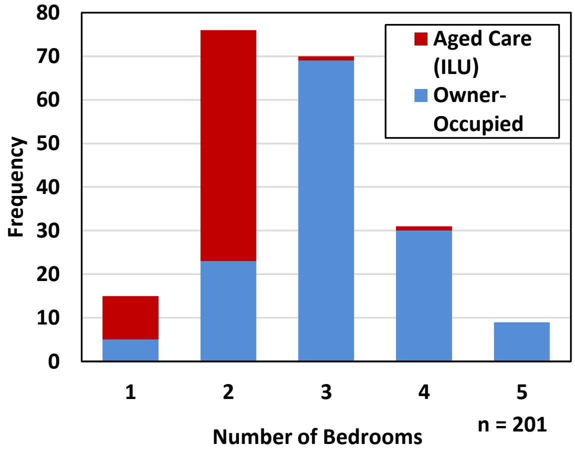


Figure 4.15 Number of bedrooms.

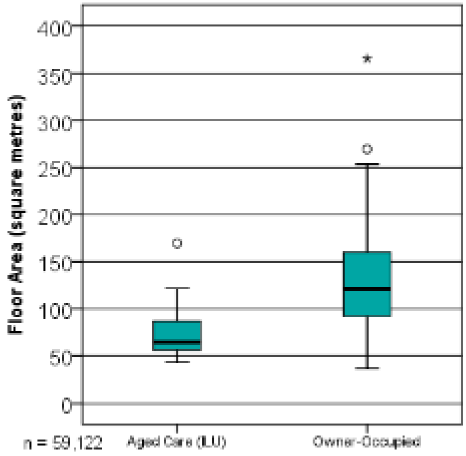


Figure 4.16 Floor area of homes.

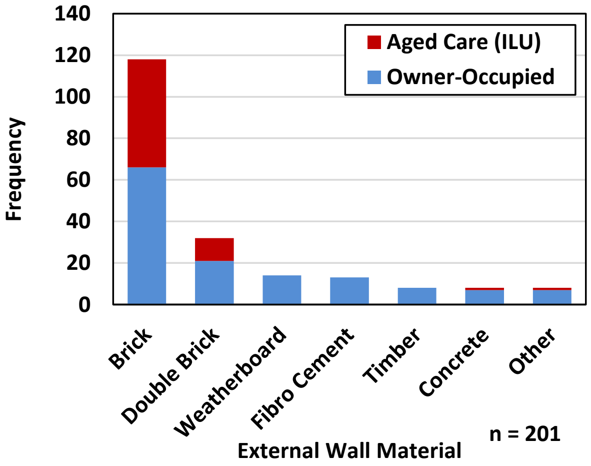


Figure 4.17. External wall material of homes.

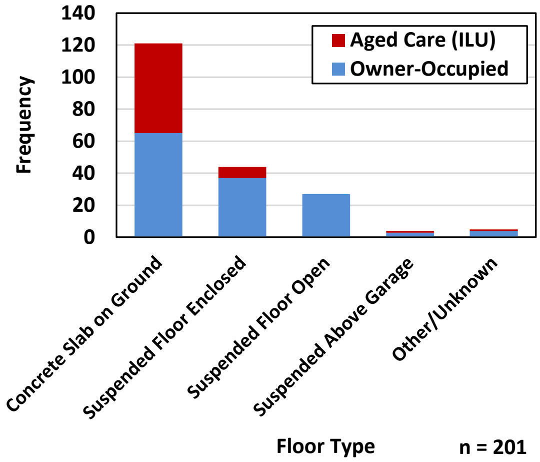


Figure 4.18. Floor types of homes.

4.2.1.3 *Insulation*

With 60% of homes being concrete slab on ground construction, subfloor insulation retrofit opportunities were limited to the remaining homes with suspended floors. It was found that the vast majority of homes with suspended floors did not have any form of subfloor insulation (Figure 4.19). Although the retrofitting of subfloor insulation would have been beneficial in these homes in terms of energy savings and thermal comfort, care was taken to ensure that it is practically feasible to do this. After consultation with TAFE Illawarra Building Trades, a minimum access-height threshold for fitting subfloor insulation was specified as 600mm. Introducing this preresite reduced the number of owner-occupied homes with adequate access to just over half that of the total homes with suspended floors (Figure 4.20).

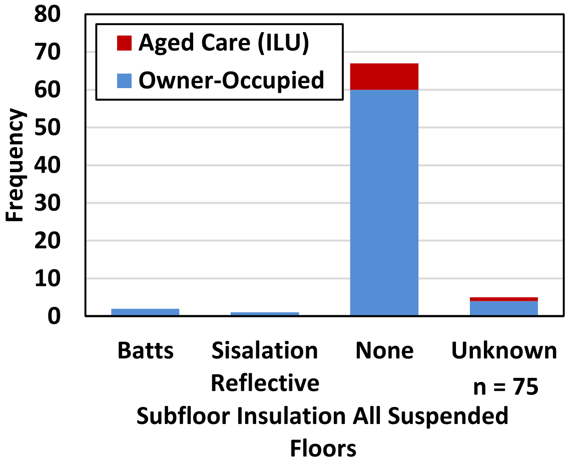


Figure 4.19. Presence of subfloor insulation within suspended floor homes.

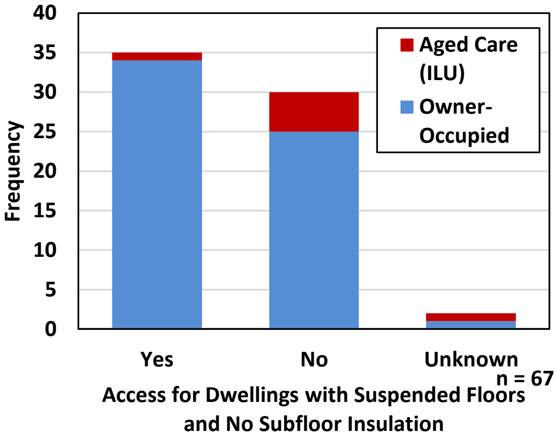


Figure 4.20. Number of homes with adequate access to allow the installation of subfloor insulation, for homes with suspended floors and no subfloor insulation.

During the building characterisation audits occupants were asked if they were aware of the presence of any ceiling insulation and, where feasible, the auditors inspected the ceiling cavity. It was found that 8% of homes had no effective ceiling insulation. Twenty-nine percent of homes were occupied by participants who were uncertain as to whether their ceiling was insulated, and which had ceiling cavities there were not safely accessible for inspection by the auditors. The ceiling insulation in these homes was therefore characterised as "Unknown" (Figure 4.21). Nonetheless, if the "Unknown" ceiling insulation cases are excluded from this part of the analysis then 88% of homes have some effective ceiling insulation. Reflective insulation (typically under the roofing as sarking) was present in similar proportions (Figure 4.22).

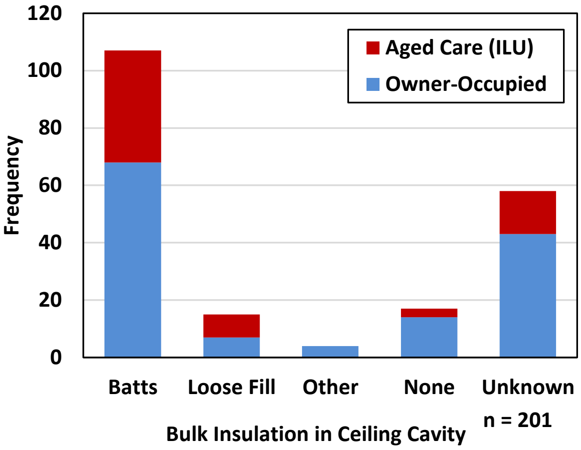


Figure 4.21 Presence of bulk insulation within the ceiling cavity either as inspected or reported by occupants.

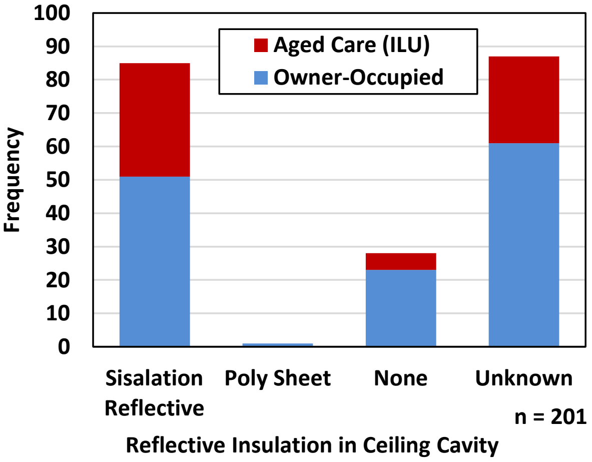


Figure 4.22 Presence of reflective insulation within the ceiling cavity either as inspected or reported by occupants.

4.2.1.4 *Hot Water Systems and Electrical Appliances*

Hot water systems were found to be overwhelmingly of the electric storage type at 49%. Given the inefficient nature of these systems, this situation represented a significant retrofit rollout opportunity (Figure 4.23). The next most prevalent type of existing hot water system was solar installed on 16% of the houses, followed by gas storage and gas instantaneous, with the combined proportion of gas water heating systems totalling 27% (Figure 4.23). The size of the hot water storage tank sizes as a function of the number of occupants is presented in Figure 4.24. As expected, it was found that houses with 1 to 2 occupants had smaller storage tanks and houses with 3 or more occupants typically had a larger storage tank (Figure 4.24).

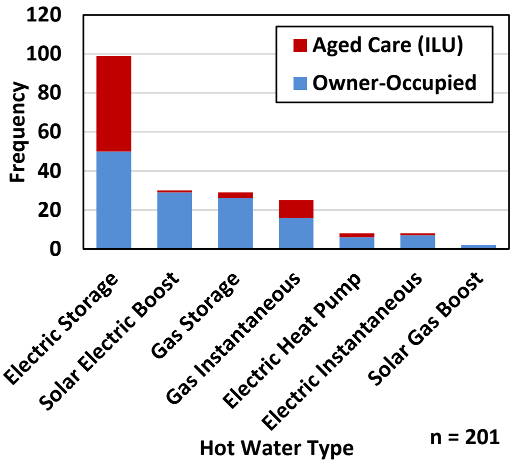


Figure 4.23. Type of hot water systems.

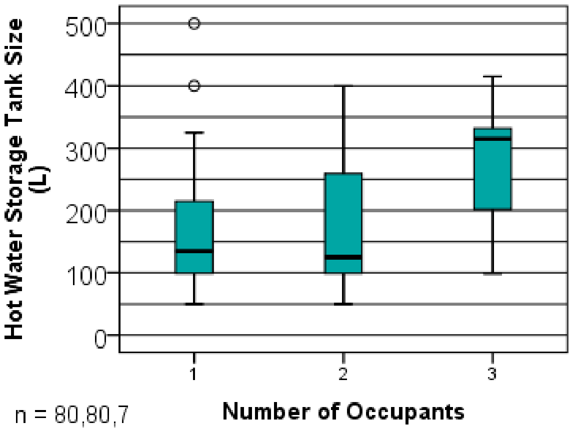


Figure 4.24. Distribution of hot water storage tank sizes by number of occupants of households.

The prevalence of the various types of space heating and cooling systems is shown in Figure 4.25 and Figure 4.26, respectively. The data shows that reverse cycle, 'split' air-conditioning systems are the most prevalent heating and cooling devices for both owner-occupied and aged care homes.

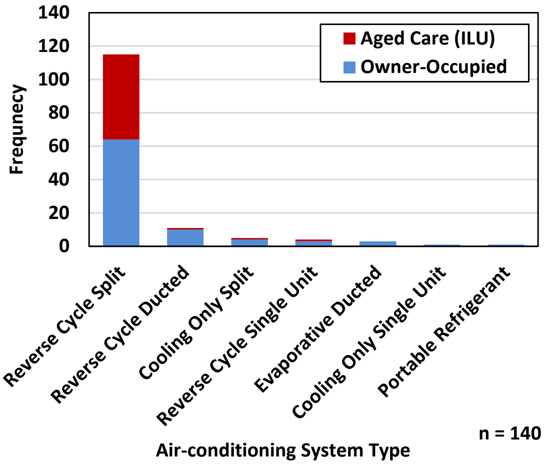


Figure 4.25. Distribution of space heating types in living rooms.

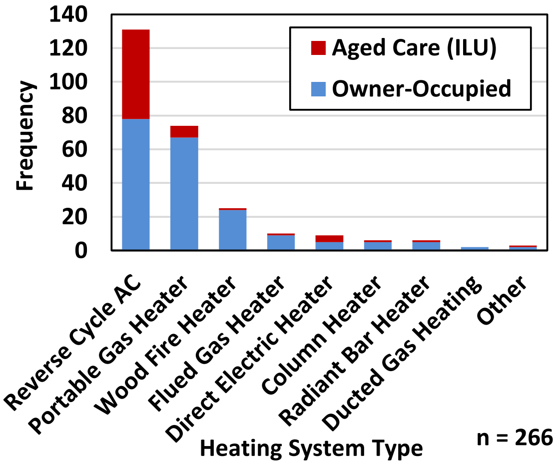


Figure 4.26. Distribution of space cooling types in living rooms.

The building characterisation audits identified the quantity and type of lights within each home and the results are presented in Figure 4.27. It can be seen that CFL bulbs have become the most prevalent light globes, however, many incandescent bulbs were still present but these may have been located in areas of the home with less frequent use. LED globes were found to represent the smallest proportion (aproximately 5%) with a very small number found within aged care homes.

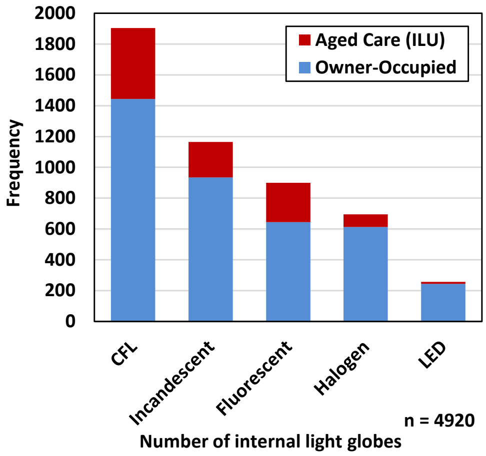


Figure 4.27. Distribution of light globes for internal rooms.

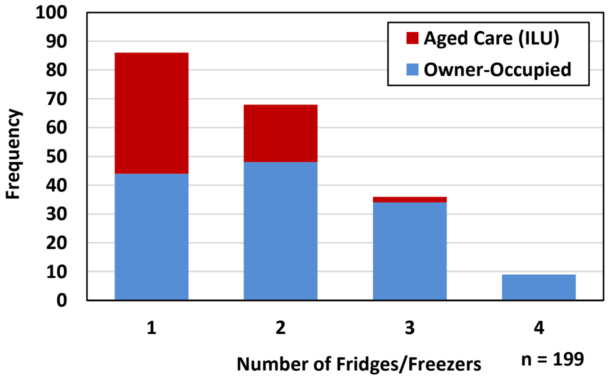


Figure 4.28. Number of refrigerators and freezers operated per household.

Details on refrigerators and freezers were captured and the number per household is presented in Figure 4.28. It was discovered that owner-occupied homes frequently own 2 or more refrigerators/freezers and aged care homes typically own 1 or 2.

4.2.2 Energy and Indoor Environment in Energy+Illawarra Retrofit Homes

4.2.2.1 *Impact of climate on utility bills*

Climatic conditions vary from one location to another and naturally such variations need to be taken into account when investigating the potential impact of energy efficiency interventions on utility bills. The different climate zones in the vicinity of the geographical area of this project are shown in Figure 4.29.

One quantitative way to account for the changes of climate conditions across different locations and periods of time is to utilise the Heating Degree Days (HDD) method for winter periods and the Cooling Degree Days (CDD) method for summer periods to take an initial step in normalising relevant billing data. This is the method that the UOW will use to analyse the future (post-retrofit) energy bills of our participants.

Degree-days are the summation of temperature differences between a defined reference temperature and the outdoor dry-bulb air temperatures over time. The reference temperature is often known as the ‘base temperature’ or as the ‘balance-point temperature’. This base temperature is defined as the value of the outdoor temperature at which, for the specified value of the interior temperature, the overall building heat loss is equal to the heat gain and therefore the heating (or cooling) systems do not need to run in order to maintain comfort conditions (ASHRAE, 2013). A detailed description of the degree-days method and some ways to determine the base temperature are given in the CIBSE Technical Manual 41 (CIBSE, 2006). The Degree Days methods have been mainly applied in heating energy assessments but descriptions are also seen in prior literature for cooling applications. The method is based on the assumption that heat loss from a building is directly proportional to the indoor-to-outdoor temperature difference and therefore that the energy consumption of a heated building over a period of time should be related to the sum of these temperature differences over this period (CIBSE, 2006b). The usual time period is 24 hours, hence the term degree-days, but it is possible to work with degree-hours. A base temperature of 24°C for summer and 18°C for winter was employed in this study following the practice of the Australian Bureau of Meteorology (BOM).

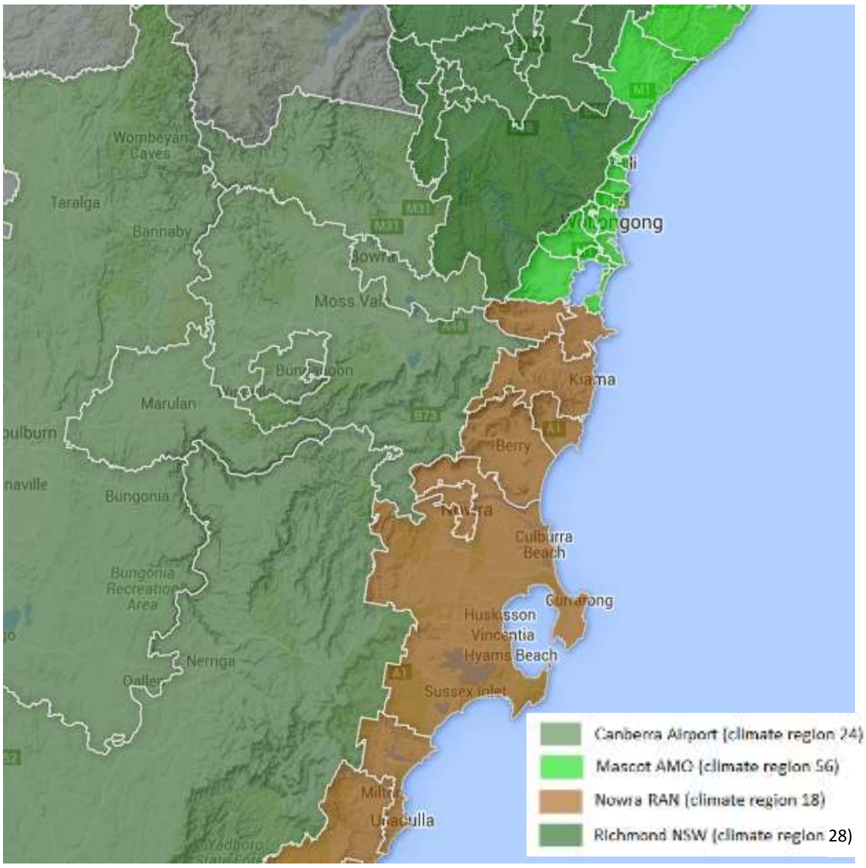


Figure 4.29 Illawarra region climatic zones as specified by the Nationwide House Energy Rating Scheme (NatHERS, 2016b).

The SBRC researchers on this project sourced and processed BOM data to develop a summary of the climatic conditions in the Illawarra region, represented by Albion Park, Nowra and Moss Vale weather stations as shown in Table 4.9 below. Recent data relevant to the present project was analysed and the results in Table 4.9 include CDD, HDD, mean annual outdoor temperature, days with maximum outdoor temperatures above 30°C and 35°C, days with minimum outdoor temperatures below 14°C, and days with significant risk of frost (air temperatures below 2°C).

For the Illawarra Region it is clear that HDD values are consistently much higher than the corresponding CDD values. Annual HDD values are ten times larger than CCDs in Albion Park and Nowra and are 30 to 40 times higher in Moss Vale. This difference indicates that the temperatures below 18°C are considerably more frequent than temperatures above 24°C. Similarly, frost risk days are more frequent in Moss Vale, with only a limited number of frost risk days in Albion Park, and in Nowra they are almost non-existent. Days with temperatures above 35°C are relatively rare in all three climate zones. In other words, extreme cold temperatures are more frequent than extreme hot temperatures for Albion Park and Moss Vale.

Table 4.9 Climatic conditions for Albion Park, Nowra and Moss Vale for 2013, 2014 and 2015.

Location	Year	CDD	HDD	Mean Annual T	Number of Days with			
					Max T>30°C	Min T<14°C	Max T > 35°C	Min T< 2°C
Albion Park	**2013**	94.4	995.8	17.0	13	248	3	5
	2014	63.7	934.3	17.1	10	224	0	10
	2015	92.2	1008	16.9	16	223	6	9
Nowra	**2013**	121.4	1100.4	16.8	22	259	4	0
	2014	97.3	1045.7	17.1	29	229	2	1
	2015	115.1	1181.9	16.8	26	236	9	0
Moss Vale	**2013**	72.8	2066	13.4	20	316	6	40
	2014	59. 5	2054.4	13.6	14	306	2	40
	2015	49.2	2165.1	13.1	9	309	1	59

4.2.2.2 *Household fuel types*

To facilitate the analysis of energy bills, the houses were classified according to the fuel types used. The different fuel types present within the retrofit cohort are displayed in Figure 4.30. Homes that used a combination of electricity and gas, or only electricity, were the most prevalent of the fuel combinations and accounted for 68 and 67 of the 201 homes respectively. Solar PV was found to be present in 35 homes and combustion stoves or fireplaces were present in 23 homes.

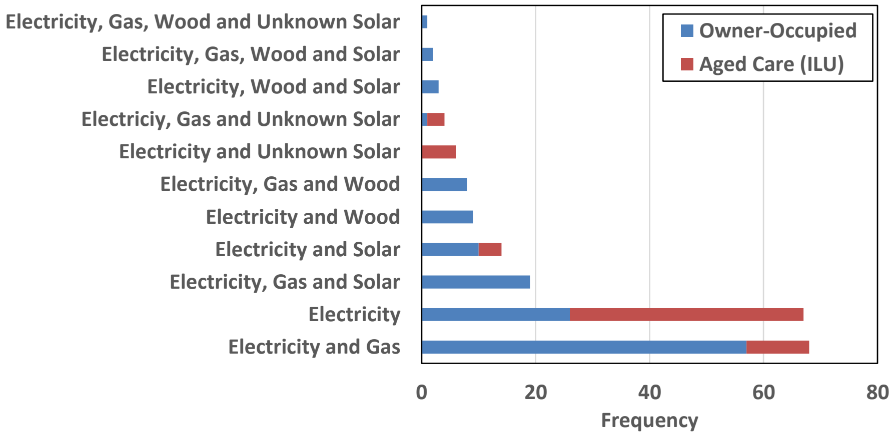


Figure 4.30 Distribution of fuel combinations for owner-occupied and aged care ILUs (n = 201).

4.2.2.3 *Benchmarking Household Energy Use*

Gas and electricity billing data was not obtained until March 2016 (just after the completion of the retrofits in February 2016), and was sourced from the local energy distributors for the period from March 2013 to March 2016 after extremely lengthy negotiations with the distributors and other related activities (including revisions to ethics approvals, contacting of individual participants, etc). Although insufficient time had elapsed from the installation of retrofits to allow an assessment of the impact of the retrofits on energy consumption to be carried out, this data nevertheless provided vital information on the energy consumption characteristics of the Social Marketing with Retrofits cohorts, which is reported below. An analysis of the energy impacts of the retrofits will be made later in 2016 and reported in an Addendum to the current report.

The electricity and gas data was processed to obtain the seasonal and annual electricity and gas consumption for each home and the electricity consumption values were compared to the Australian Government Energy Made Easy benchmarking tool (AER, 2016).

In the Illawarra the distributor collects region energy consumption data at three monthly intervals with meter read dates falling at any period during these intervals. This inhibits the direct separation of the data into seasons, and this issue is referred to as 'billing lag' (ACEL Allen, 2015). To mitigate the effects of this lag on results and to enable a direct comparison to the energy benchmarks to be made, the methodology applied in the ACEL Allen Consulting report was employed (ACEL Allen, 2015). This method calculates the mid-date of the billing period and assigns the season of this date to this billing period.

The benchmarking tool required an input of postcode, number of occupants, presence of mains gas connection and presence of swimming pool. The tool then provided a seasonal and annual benchmark of the total kWh and kWh/day for electricity consumption under the conditions provided. It should be noted that gas consumption benchmarks for each post code were not publicly available for this study and therefore this section focusses only on electricity consumption.

For the Illawarra area the benchmarking tool was found to separate the study area into two climate zones rather than the three NatHERS zones mentioned above in Section 4.2.2.1 (ACEL Allen, 2015).These two zones will be used as the basis of the following discussion and their respective post codes and descriptions can be below in Table 4.10.

Table 4.10. Benchmark climate zones (ACEL Allen, 2015).

Climate Zone	Postcode Range	Description
1	2500 - 2534	Warm temperate climate
2	2539 - 2579	Mild temperate climate

The data collection and analysis used to generate the benchmark employed a series of controls to avoid demographic bias and to ensure the sample remained representative of the Australian population. One such control included limiting the sample to include no more than 5% of people of 65 years or older (ACEL Allen, 2015). In contrast the sample collected in this project exclusively targeted a population of low-income people aged 60 years and older. Thus some difference is expected between the benchmark and this project but the analysis below provides an evaluation of how this sample of low-income people aged 60 and above differs from the broader Australian population.

Houses that use wood fuel have been included in the analysis below, however houses with solar photovoltaic have not been included. This action was taken because the electricity data provided by the local energy distributor does not identify whether a home with PV solar installed is 'gross' or 'net' metered and this means that it is not possible to determine actual household electricity consumption *per se*.

In summary the process followed for the analysis of the electricity consumption benchmarks was as follows:

- Gather historic electricity data from the local energy distributor.
- Process electricity data into seasons by calculating the mid-date of the billing period and assign the season of this date to the relevant electricity bill.
- Obtain seasonal electricity benchmark data from the Energy Made Easy benchmarking tool (AER, 2016) with postcode, number of occupants, presence of mains gas connection and presence of swimming pool as the benchmarking tool inputs.
- Filter out houses that have PV solar installed.
- Calculate the variation between the electricity data and benchmarks by subtracting the benchmark values from the historic electricity data.
- Produce a series of box plots to illustrate the differences between climate zones, ownerships and fuel combinations.

Prior to comparing with the benchmark values noted above, an analysis of the absolute average daily electricity consumption values was performed for Climate Zones 1 and 2; results are shown in Figure 4.32. The 'box plots' have been separated to cover houses with and without gas and each provides the median, maximum, and minimum values of the daily average electricity consumption together with the first and third quartile consumption ranges. The houses located in Climate Zone 1 were found to have similar seasonal medians, of approximately 10 kWh/day, however the houses with gas were found to have a larger spread of consumption values than those without gas. In Climate Zone 2 it was found that houses without gas generally have a larger daily electrical consumption than those with gas.

Note on 'Box Plots'. Box Plots provide a powerful visualisation tool for the display of statistical analysis data, as illustrated in the following figures. A graphical explanation of the various features of a generic Box Plot is shown in Figure 4.31.

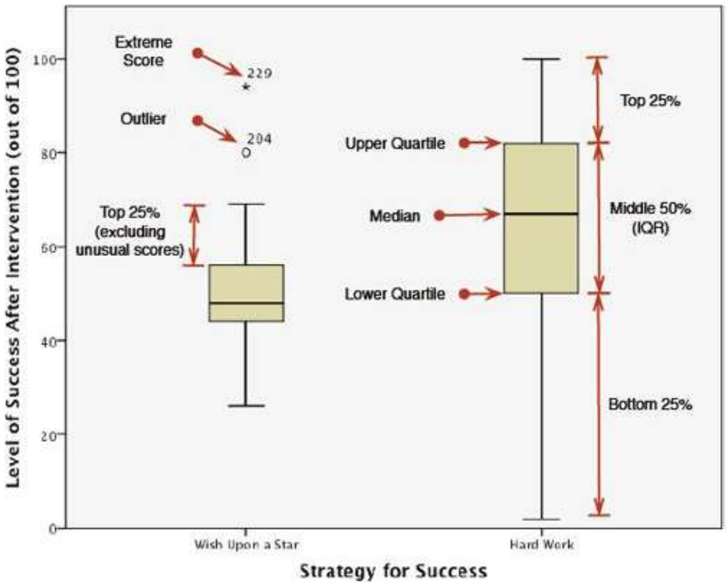
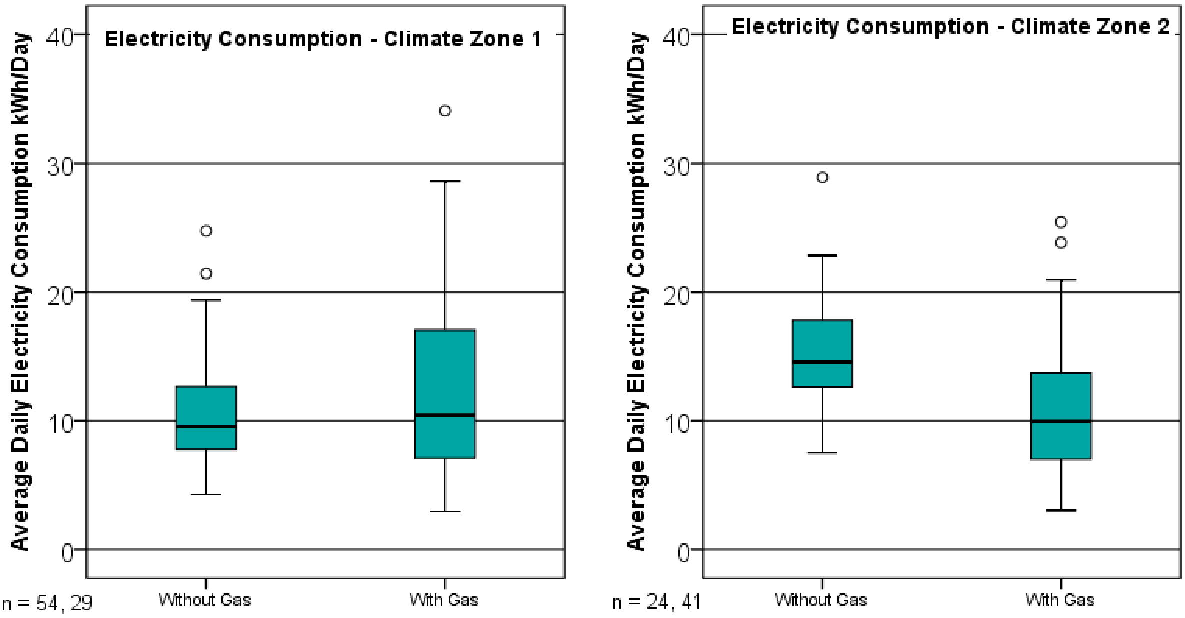


Figure 4.31 Graphical description of the features of a generic 'Box plot' (Field, 2014).



a) b)

Figure 4.32 Average daily electricity consumption for houses with and without gas a) in Climate Zone 1 (n = 54, 29), and b) in Climate Zone 2 (n = 24, 41).

A comparison was made between the seasonal average daily electricity consumption and the benchmarked values for the whole of the retrofit cohort and is presented in Figure 4.33. A key finding from this comparison was that:

- The majority of the houses of in the overall retrofit cohort used less electricity during each season as compared to the benchmarked values (Figure 4.33).

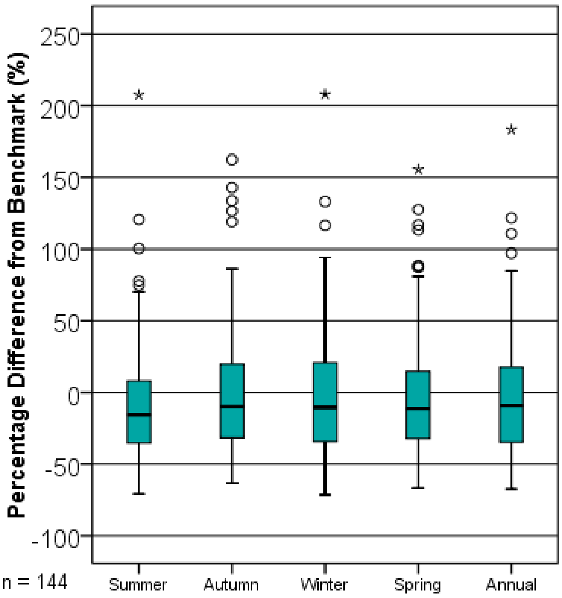


Figure 4.33 Percentage variation of the average daily electricity consumption from the benchmarked values (AER, 2016) for the whole retrofit cohort (n = 144).

This analysis was further explored by separating the aged care ILUs from the owner-occupied houses, and is presented in Figure 4.34. This revealed that:

- Over 75% of the aged care houses used less electricity than the benchmark values;
- Aged care houses had a median annual electricity consumption 22.5% below the benchmark values.
- Owner-occupied houses had a median annual electricity consumption that was 0.45% below the benchmark values.

Insight 4.1 Energy Guilt and Anxiety.

Energy Guilt, Anxiety and Fear

Throughout this project, talking about how the way energy is enrolled to maintain home has led to discussions about guilt, anxiety and fear. Anxiety, guilt and fear provide important insights to how our participants live in the world. Some talked about their guilt of using more energy, particularly in times of sickness. For example, Renee's (80s, retired, living in the community, Southern Highlands) deteriorating health means that she spends much more time at home than in the past. To sustain her house as home she uses energy to power a radio, DVD player, TV as well as a heater. Renee expressed a sense of guilt about her bills:

> *I use much more than I did before, because… I like a voice in the house, because of my age and I'm deteriorating you know, with sickness. I like the radio going, and I like to watch, I watch much more daily. Once that television didn't go on until the evening. Well now because I'm at home a lot more, I watch DVDs......Because my lifestyle has changed. And I must say that I feel very guilty about using a lot more electricity because I'm at home. But then I have to… like, during the winter for instance, I would never have put that gas on because I had a gas bill of $700. And in the first instance when I used that years ago. So I avoided that, and I had the wood fire. And sometimes I had electric blanket to get into bed. But this winter, because of my home and because I've been ill, I just can't worry about the price of it…*

Guilt in this case does not work towards energy efficiency. Instead, guilt gives clues to how Renee evaluates energy consumption in relationship to her health. Guilt for using energy at home is withstood as an act of self-care because she is ill.

Anxiety is a key theme around domestic energy use. Anxieties surrounding energy consumption might be understood in terms of a concern for diminishment of personal health that is then transferred onto increased energy bills. For example, Renee explains her anxieties of using a heater to keep warm in winter:

> I: *Does it make you anxious about the bill?*
>
> Renee: *It does, it makes me anxious about doing it [using a heater], you know, having to do it [switch the heater on]. About doing it, I'd rather not do it. But it also makes me anxious about the bill.*

Renee is worried that not turning the heater on would further affect her health. This worry is transferred onto bills. Narratives of high-energy bills only increase her anxiety. After hearing from a woman who was shocked by a $1000 bill last winter, Renee said:

> *came home and I thought: "Oh my goodness"., But, mine was only 300 and something, and I was delighted, absolutely delighted…But I don't know, but I found that last winter because I spent a lot of time in the home, and because it was so cold, I just had to put it on whether*

> *the cost was or not, you know I just had to do it. And feeling guilty about it too, you know, and feeling terrified of getting the account. Absolutely terrified of getting the account, you know.*

Renee's anxieties of energy use are embodied in the routines of maintaining house as home for her sick body. To help ease her anxieties she emphasised the frugality of her practices in comparison to others. Such results point to how guilt, anxiety and fear may work together against energy efficiency. Instead, participants to reduce anxiety and fear of receiving a higher energy bill may simply switch off heating to reduce fuel bills rather than energy efficiency. However, this too can be stressful. As Joe (70s, retired, Illawarra) explained:

> *Joe: …the cost per use per gain, I suppose, is what we're looking at with efficiency…I don't use things sometimes because of the cost. Therefore, I don't think I'm getting the value for money that I should be out of what I own.*
>
> *I: So what's an example of that that you might actually not turn something on?*
>
> *Joe: Well, normally if I work on the computer I'd have the music playing. But I don't because, yeah. I might use cold water when I would normally use hot water. I would probably store my washing and ironing up and do it once every 10 days except perhaps twice every 10 days. So that means that it's a big job every 10 days rather than the lighter job every five days, those sorts of things. I'll cook up one big pot of food and freeze it.*
>
> *I: And are those things that you would prefer not to be doing?*
>
> *Joe: Well, you've got to be thinking about things like that all the time because of the cost. So that's a stress on living, as I see it, because if you didn't have to worry about those sorts of things, you'd be thinking about other things.*
>
> *I: Yes.*
>
> *Joe: So for older people, anything that can reduce stress is a good thing. And I don't think that's very well understood.*

Underpinned by anxiety to pay, Joe's current energy saving practices of 'turning off' worked against personal comfort and increased stress due to financial concerns. His comments point to the challenges of challenges of changing some older people's practices from switching-off appliances altogether to balance household budgets, to energy efficiency.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

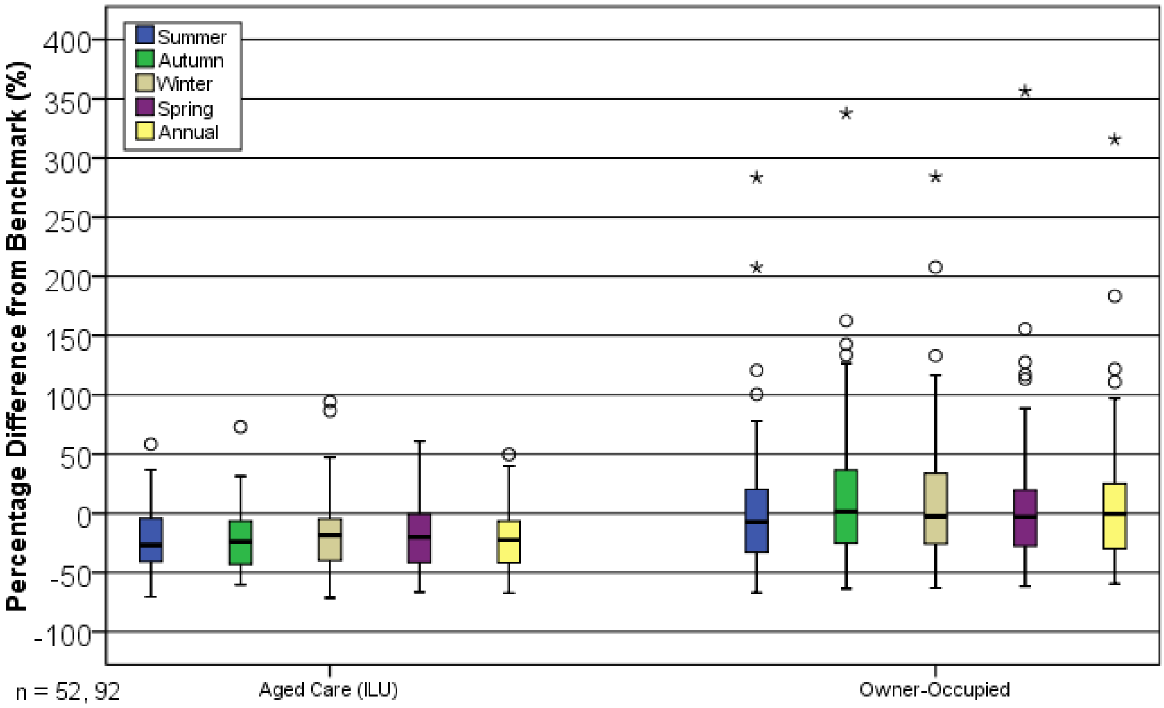


Figure 4.34 Percentage difference between average seasonal electricity consumption and benchmark values (AER, 2016) (n = 52, 92).

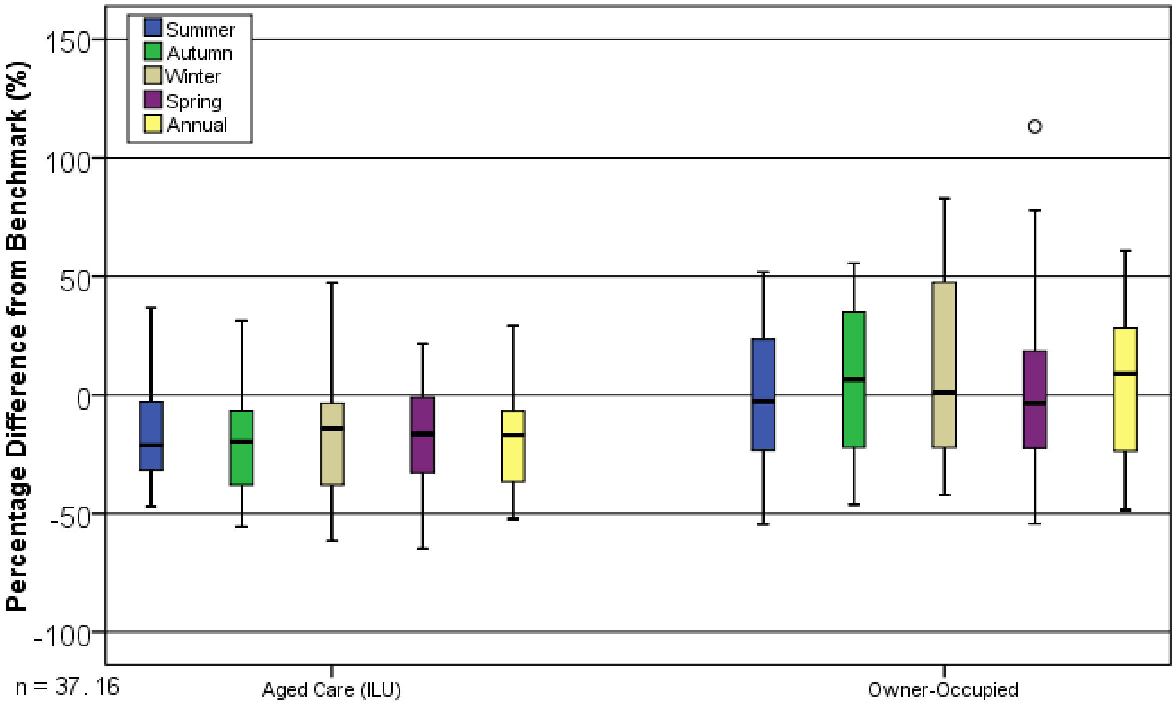


Figure 4.35 Percentage difference between the average seasonal electricity consumption and benchmark (AER, 2016) for houses without gas in Climate Zone 1 (n = 37, 16).

This sample was further explored by disaggregating the participants into the two climate zones and whether or not they have a gas supply. The results for Climate Zone 1 for houses without a gas supply are presented in Figure 4.35 and confirm the previous findings from Figure 4.34 that aged care ILUs have lower electricity consumption than the benchmarks. The consumption is higher in the owner-occupied houses are less pronounced with the median values being below the benchmark for both summer and spring but above for winter and autumn, with an annual median consumption of 8.9% above the benchmark (Figure 4.35).

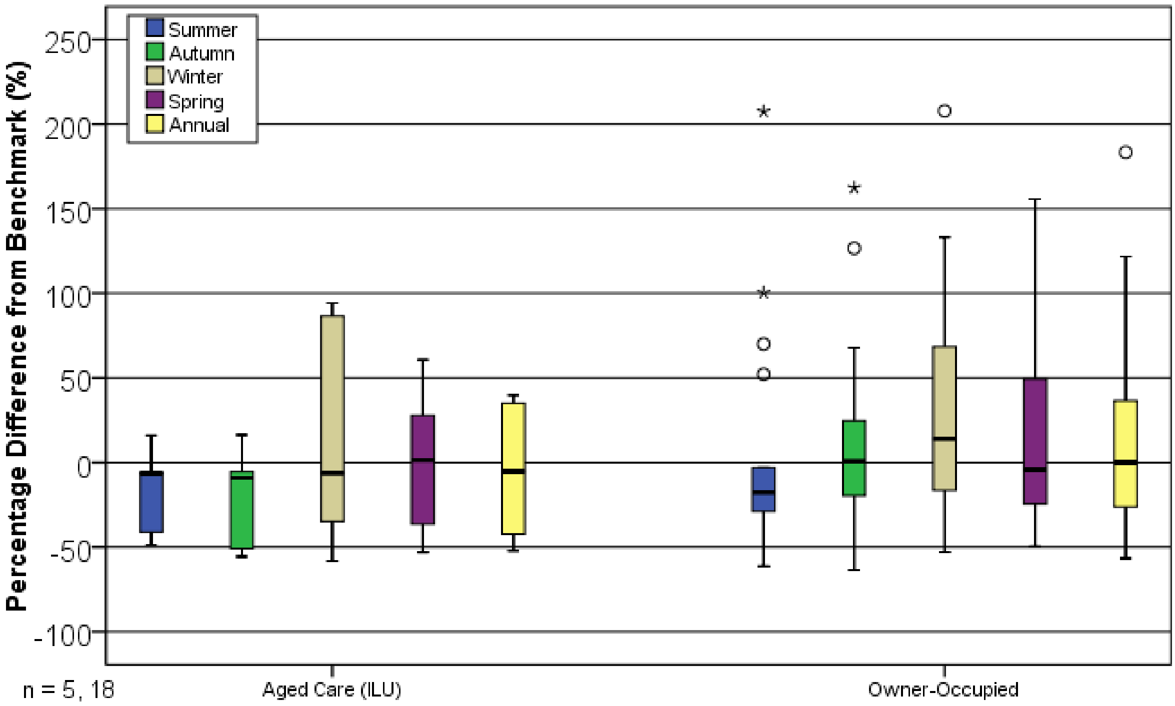


Figure 4.36 Percentage difference between the average seasonal electricity consumption and a published benchmarks (AER, 2016) for houses without gas in Climate Zone 2 (n = 5*, 18). *Note small sample size.

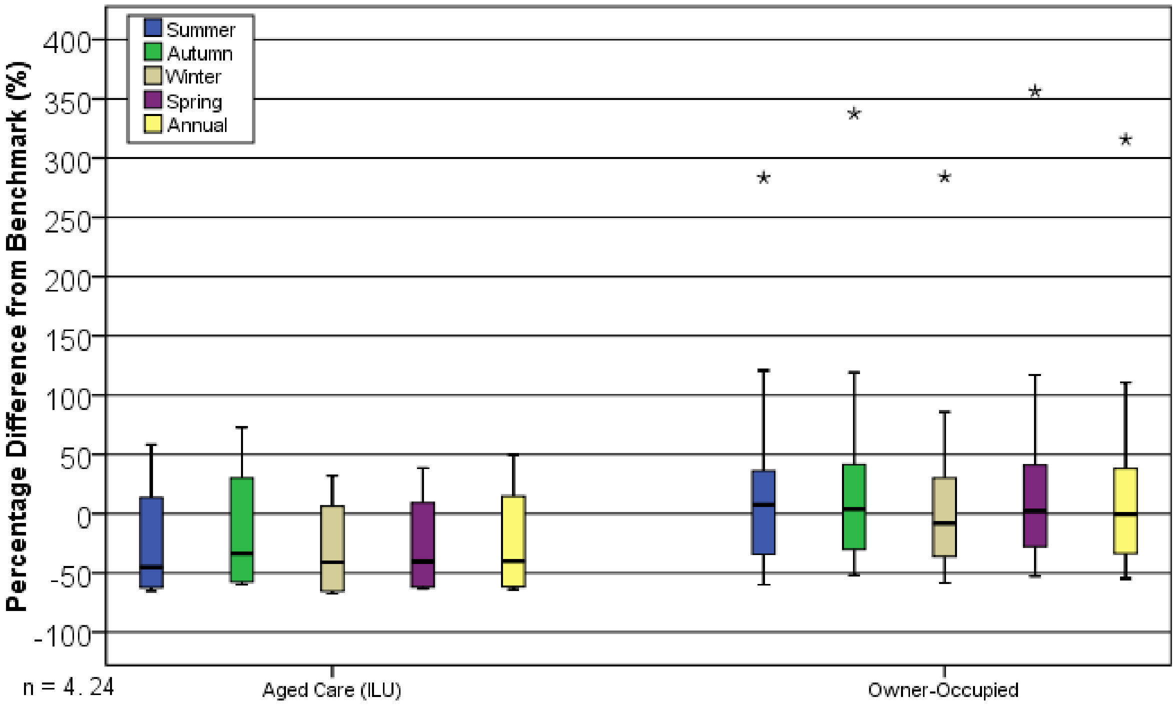


Figure 4.37 Percentage difference between the average seasonal electricity consumption and a published benchmarks (AER, 2016) houses for houses with gas in Climate Zone 1 (n = 4*, 24) *Note small sample size.

The results for houses without gas and within Climate Zone 2 are presented in Figure 4.36. The sample size for the aged care houses was only 5 and thus it is difficult to draw conclusions. Within the owner-occupied cohort almost all the houses used less electricity than the benchmark for summer but electricity consumption increased in the winter months resulting in the majority of the sample using more electricity in winter than the benchmark values (Figure 4.36). The lower consumption in summer and higher consumption in winter balanced out the annual consumption and resulted in a median, which was approximately equal to the benchmark for the owner-occupied houses.

The analysis above was repeated for houses with gas and results for Climate Zone 1 are presented in Figure 4.37. The sample size for aged care houses is extremely small and thus it is difficult to extract any conclusions. The owner-occupied houses used marginally more energy in summer and marginally less electricity in winter when compared to the benchmark values and resulted in an annual median, which was approximately equal to the benchmark.

In Climate Zone 2 the sample size for aged care houses was small but all of the houses were found to use consistently less electricity than the benchmarked values (Figure 4.38). The majority of the owner-occupied houses with gas were found to use less electricity than the benchmark values for all of the seasons with the exception of autumn and resulted in an annual median value that was 3.5% less than the benchmark value.

When synthesising the findings above it was found that in the coldest climate of the Illawarra region (Zone 2 in Table 4.11), heating was the dominant energy load and is the likely reason for the higher energy bills in winter than the benchmark values for those without gas.

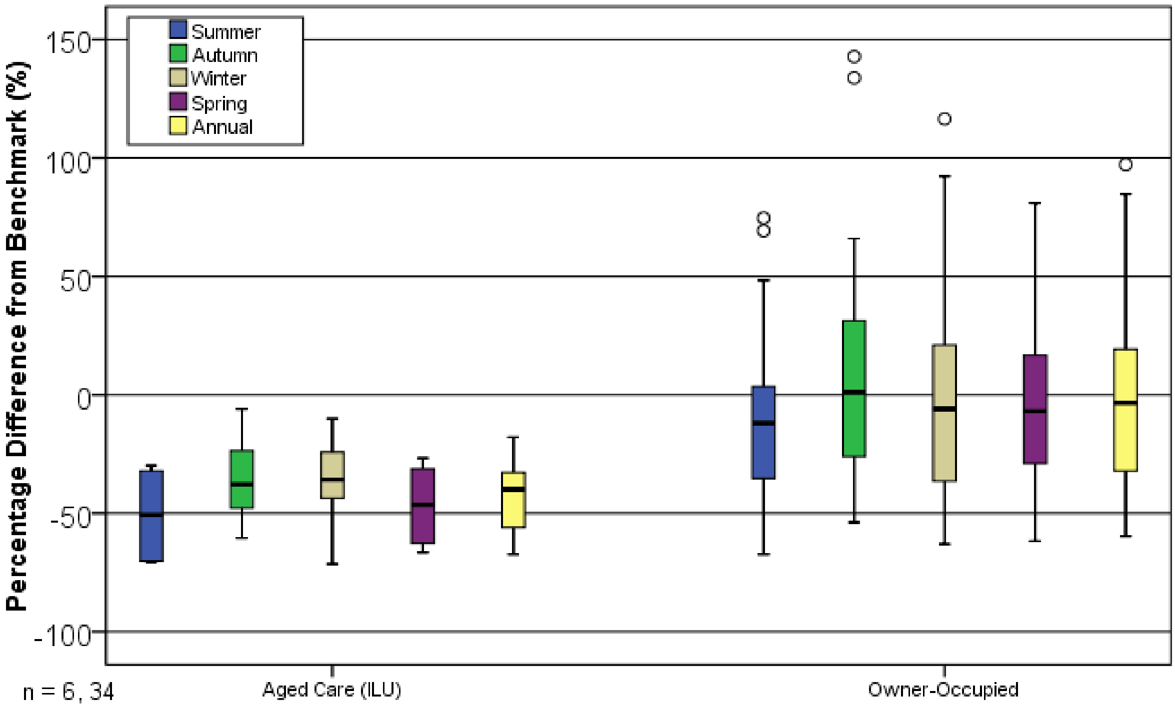
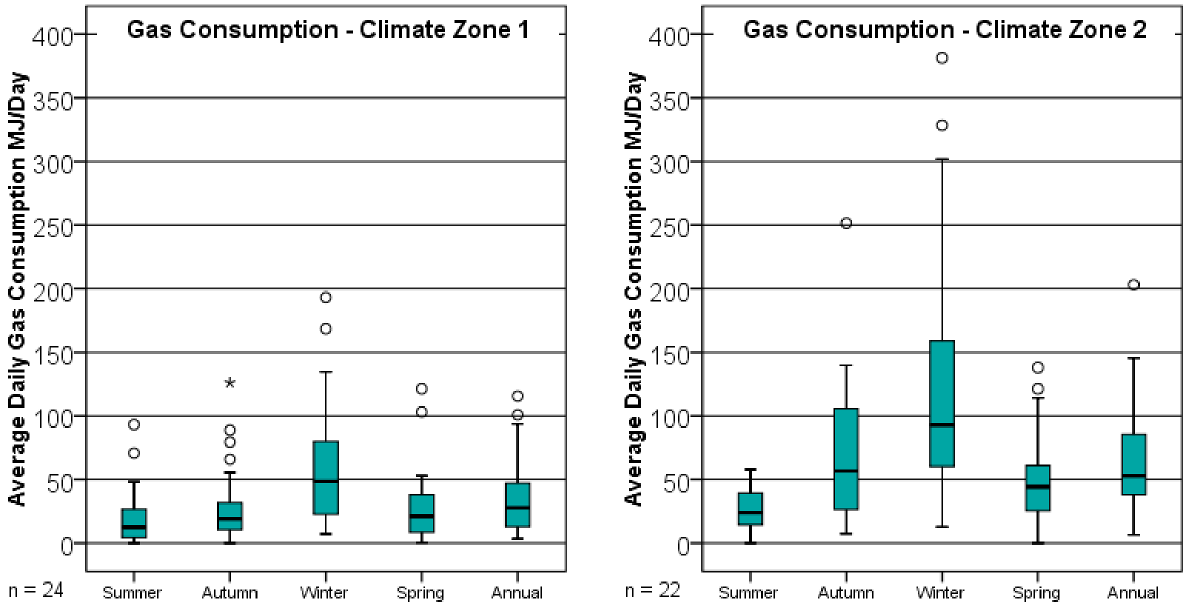


Figure 4.38 Percentage difference between the average seasonal electricity consumption and a published benchmark (AER, 2016) for houses with gas in Climate Zone 2 (n = 6*, 34) *Note small sample size.

The absolute average daily gas consumption values for both Climate Zone 1 and 2 are shown in Figure 4.39. As Climate Zone 2 experiences a higher number of heating degree-days HDD, it was expected that gas usage would be higher than for Climate Zone 1 homes, and this was indeed the case as shown in Figure 4.39 with gas usage peaking in winter.



a) b)

Figure 4.39. Average daily gas consumption for houses: a) in Climate Zone 1 (n = 24), and b) in Climate Zone 2 (n = 22).

Insight 4.2 Energy Efficiency as not wasting.

Energy Efficiency as not wasting

For many participants, energy efficiency was ***not*** understood in terms of productivity, or doing the same with less, or maintaining a sense of comfort, but in terms of not wasting. To be energy efficient was not to waste energy and therefore to save money that could be spent on other items. Energy efficiency as not wasting was therefore closely tied to reducing anxiety and managing household budgets wisely. To be energy efficient was often tied up in a range of practices and stories that were employed to differentiate themselves from younger generations, who were positioned as wasteful. For example, through conversation with the interviewer and each other, 'Denise' (80) and partner 'Chris', from the Shoalhaven region, revealed an embodied sense of thrift and non-wasting.

> *Interviewer: … energy efficiency, can you just tell me what it means to you?*
>
> *Chris: Well I suppose it means that you use electricity so that the cost of it is at a minimum, yeah. I think that's about, I would say.*
>
> *Interviewer: Alright, so to keep the cost down?*
>
> *Chris: To keep the cost down, yeah.*
>
> *Interviewer: Do you agree with that Denise?*

Denise: *Yeah.*

Chris: *And that it works correctly...*

… then

Interviewer: *'Anything else Denise, energy efficiency, any ideas?'*

Denise: *No, I just, I don't know because I don't think I waste it. So I guess leaving a heater on all night or something or the fan going when you walked out the door or things like that.*

Interviewer: *So they're things you wouldn't do?*

Denise: *No, I wouldn't do that and I don't know why. I just, that's automatic, I would turn them off…*

Chris: *Yeah.*

Denise: *…not something that I think, 'oh that's going to cost me x amount of dollars'. I don't think that way, I just think 'that's a waste'. [laughs] But we tend to do, use what we need to use. We don't think, 'oh we're not going to turn that on again are you', you know, we don't think like that.*

Interviewer: *You use just enough, is that what you're saying?*

Denise: *Yeah.*

Chris: *Yeah, just enough.*

Denise: *But I'm not out to save what I use. I'm out to do whatever I want to do that needs to be done...*

Later in the interview, the interviewer asked: '…when did you become aware of energy efficiency?'
Denise: *Am I? [laughs] I don't know whether I ...*

Interviewer: *I thought you were aware, Denise, you told me you switch everything off when you go out so ...*

Denise: *Well I do it automatically. I don't think about it. I'm not aware of probably, well that doesn't sound real good if I'm not aware of what I'm doing. [laughs]*

Chris: *No, I think we both...*

Denise: *You're just drummed into because you grew up without it.*

Chris: *I was just going to say that, and also in those days you were, you didn't waste anything in our early days. Nothing was wasted. You made sure you didn't*

> *drain the tank dry by making sure you turned the tap off. I mean, even if you didn't turn it right off and it only dripped, people don't realise how much water was wasted with a drippy tap and so we learnt to economise with our resources ...*
>
> *Denise: I think you just grew up with it.*
>
> *Chris: ... way back as kids, yeah, so it sort of carried over...*
>
> *Denise: Well you did it automatically without even thinking about it, you know, oh there's a tap dripping, turn it off properly, so yeah [laughs].*

Here, Denise indicated that she didn't really connect with 'energy efficiency' because she didn't feel that she wasted energy, while at the same time her priority was to get done whatever needed to be done – she was 'not out to save what I use'. Because she considered herself to be automatically non-wasteful, she was unaware of her actions. Practices of not wasting energy and water resources were embodied ways of living in the home for this couple. This discussion brought their embodied knowledge to the fore. More generally, this narrative points to the importance of the sets of ideas that people think about their energy practices. Second, this narrative point to the importance of habitual, embodied knowledge in how energy is enrolled in particular ways to make and sustain houses as homes.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

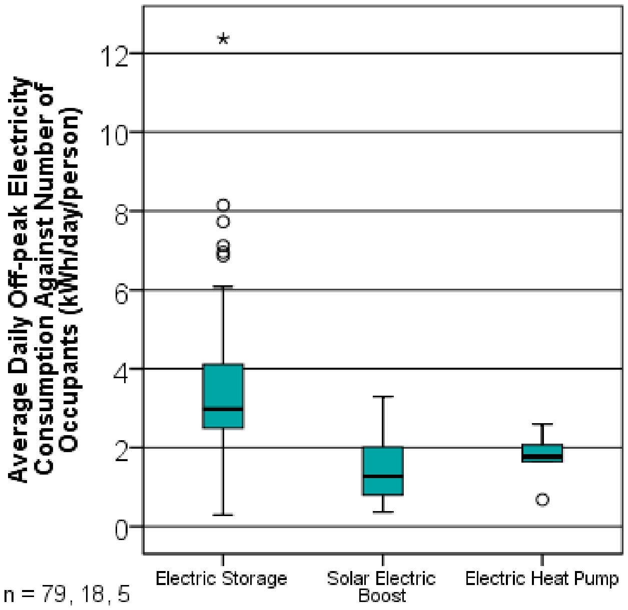


Figure 4.40. Average daily off-peak electricity consumption against number of occupants for various hot water systems.

4.2.2.1 *Energy used for hot water*

Electricity used for domestic hot water heating could be determined directly from bills for houses with 'off-peak' meters. The average daily hot water electricity consumptions were then normalised against the number of occupants in a given dwelling and plotted in Figure 4.40 for the various types of electric hot water systems present in the cohort. A key finding from Figure 4.40 is that:

- With the exception of a few outliers, it is clear that houses with a solar hot water system (with electric boost) use considerably less electricity for hot water than the houses with electric storage systems.

4.2.2.2 *Indoor environment and thermal comfort*

As stated in Section 4.1.9.2, indoor air temperatures were collected at half hour intervals in approximately 170 houses. The iButton temperature sensors were installed during the combined recruitment and Building Characterisation Audit visits from February to May 2015, with 11 months of data storage memory available. Data was retrieved during January and February 2016 and the iButtons reprogrammed, so the available data covered the period of March 2015 through to January 2016. To illustrate the different patterns observed for the thermal conditions inside these houses, two examples are plotted in Figure 4.41a and b for the same period of the year. It can be seen from Figure 4.40 that the occupants live in spaces that have very different indoor temperatures. In the home presented in Figure 4.40b the occupants do not use any heating despite the cold indoor conditions. In both cases of Figure 4.40, the indoor conditions rarely exceed 20˚C.

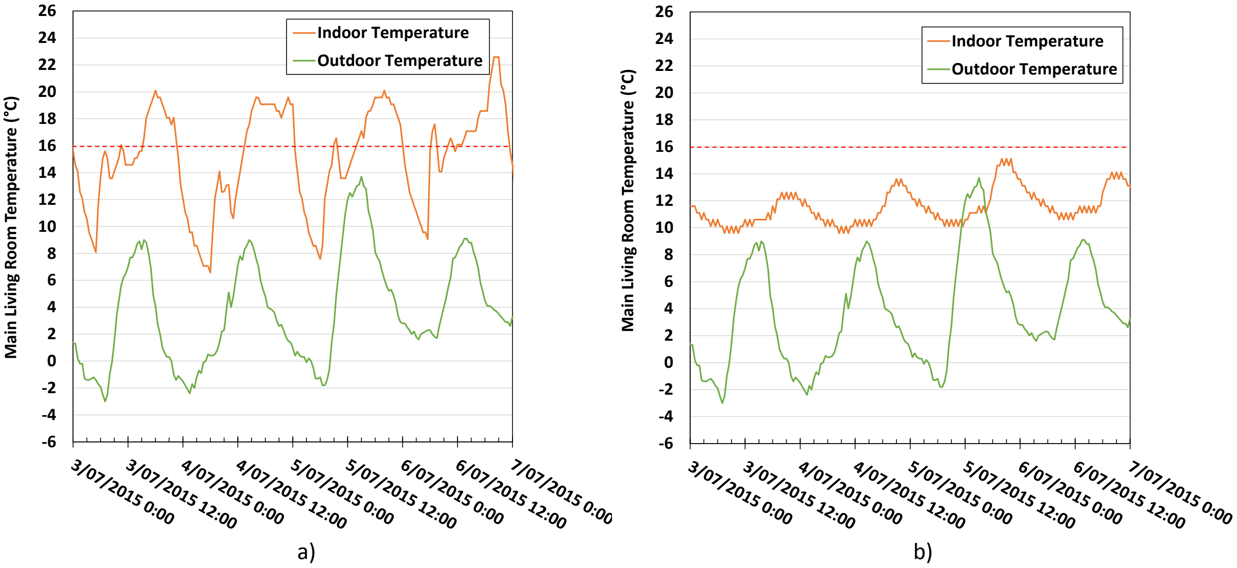


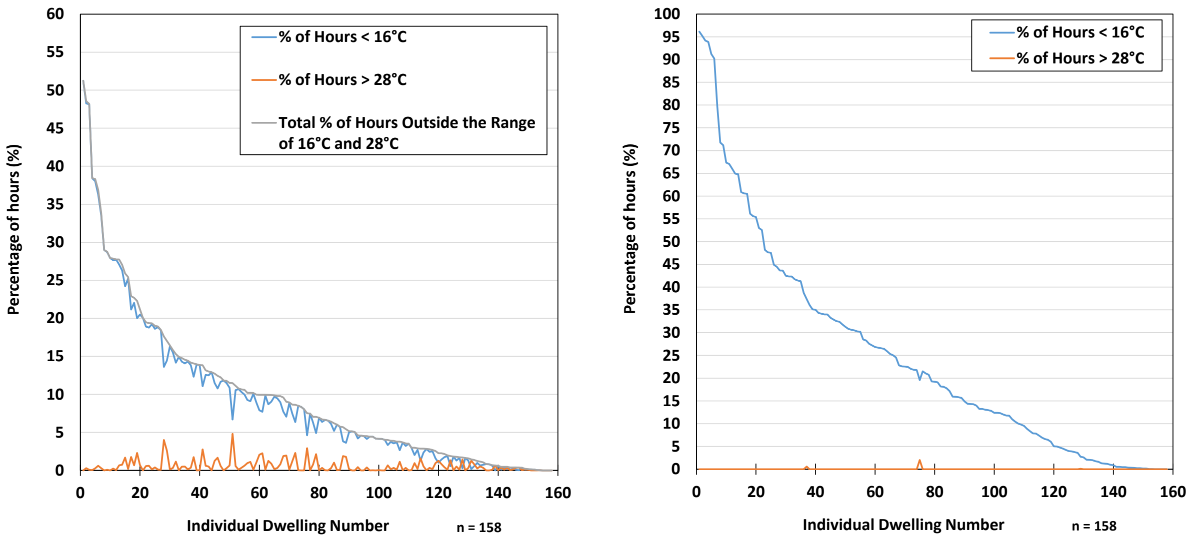
Figure 4.41. Sample of main living room temperatures during a cold period in Moss Vale from 3/07/2016 to 06/07/2016 for: a) a heated dwelling; and b) an unheated heated dwelling.

Indoor air temperatures outside a range of 16^{o}C to 28^{o}C are likely to cause significant thermal discomfort, which in turn is often linked to health problems, in particular for elderly people (e.g. Acil Adams, 2015 and Collins 1986). The overall percentage of time that living room temperatures fell below 16^{o}C and were above 28^{o}C for the 158 houses is displayed in Figure 4.42 for March 2015 to January 2016 and for the winter season from June to August 2015. It can be seen in Figure 4.42a that occupants of a significant proportion of houses experience relatively cold indoor temperatures (below 16°C) for long periods throughout the year. An investigation of the indoor temperatures over the winter period (Figure 4.42.b) revealed that:

a) Approximately half of these homes exhibited temperatures below 16°C for at least 20% of the winter: and

b) A considerable number of homes (approximately 10% in Figure 4.42b) exhibited temperatures below 16°C for very long periods in winter (over 65% of the total period).

While summer overheating did not seem to be a significant issue for the majority of houses that were monitored (Figure 4.42a), it should be noted that the measurements did not cover an entire summer period. Conclusions as to the risk of overheating in summer should not therefore be drawn without further investigation via measurements over longer periods.



a) b)

Figure 4.42. Percentage of hours in the main living room when temperatures exceeded 28°C or were below 16°C (n = 158): a) from March 2015 to January 2016 and b) from June to August 2015.

The intensive monitoring equipment was employed to further investigate indoor temperatures and heating practices in two different climate zones with three snapshots.

A cold period during winter is shown in Figure 4.43 where it can be seen that the indoor temperature is increased after the ducted air conditioning system was turned on. However, it is observed that despite the heating system being on, the indoor temperatures were mostly maintained between 15°C and 20°C. On a particular day of this case study (23rd of May) the indoor temperature dropped below 12°C, although it is unknown whether the occupants were in the house that day. These low indoor temperatures highlight the importance of heating homes in the climate zone of the study.

Cold indoor temperatures are also seen in Figure 4.44a, where the indoor and outdoor temperatures over the last two weeks in autumn 2015 are shown. Despite three consecutive nights with external temperatures below 5°C, the heater appears not to have been turned on and indoor temperatures ranged from 9°C to 14.8°C. The examples above provide evidence that there are houses in the Illawarra region where indoor temperatures are very low in winter, and where low-income occupants choose not to use a heating system to heat up their houses.

On the other hand, occupants of another house (Figure 4.44b) regularly used their heating system during the same period and in the same geographical area as for the above mentioned case. However, in this case there was a relatively conservative use of the heating system with indoor air temperatures being always below 21°C and the heating system appears to have been used for only short periods of the time.

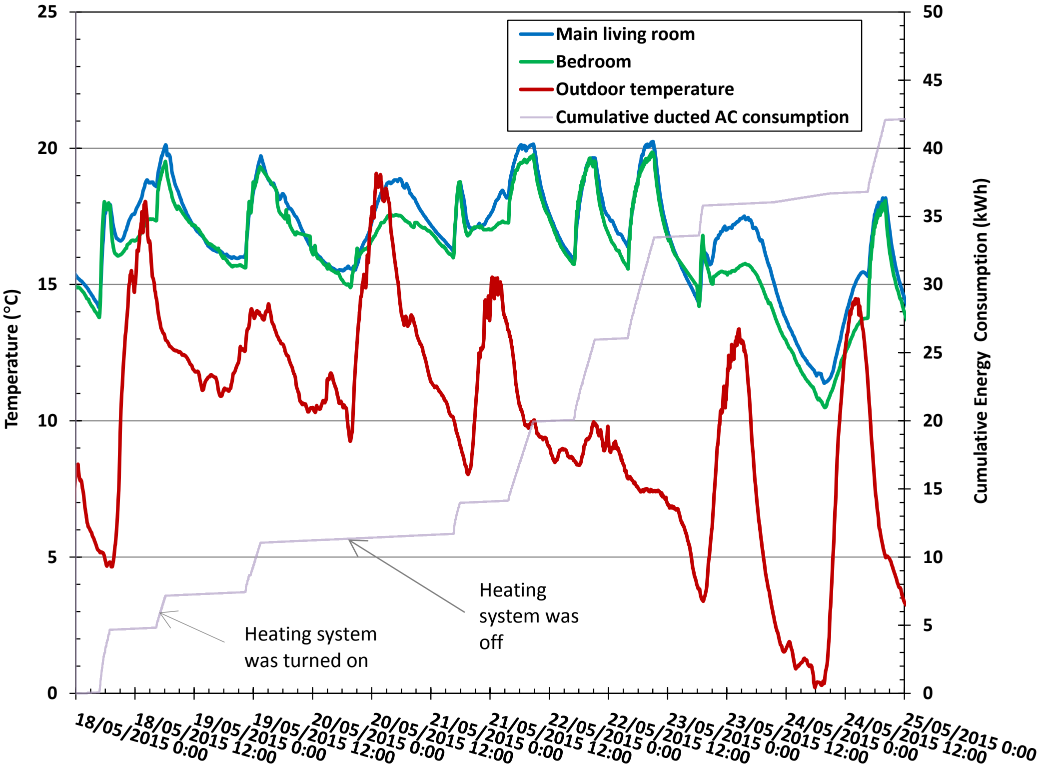
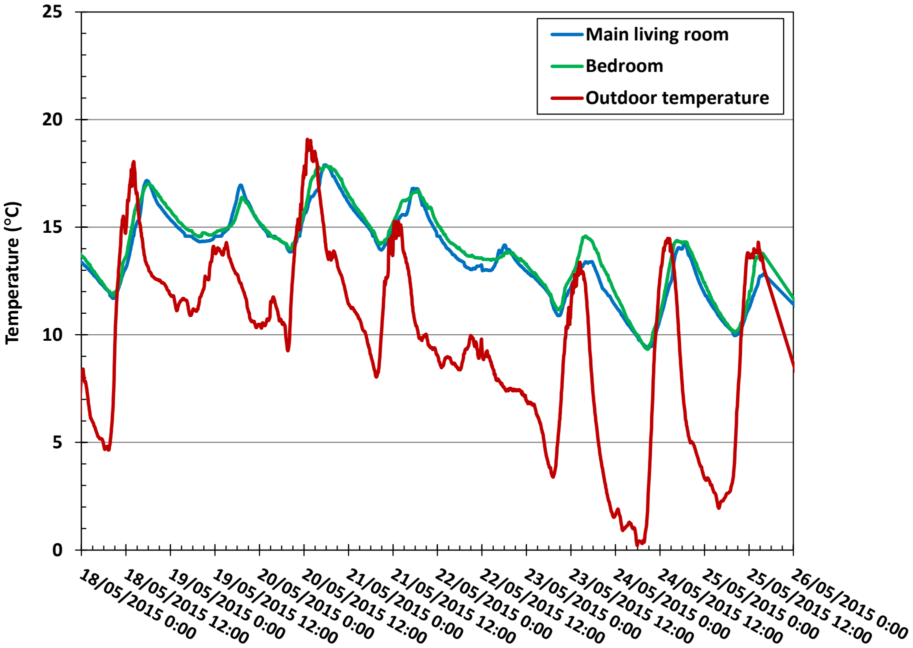
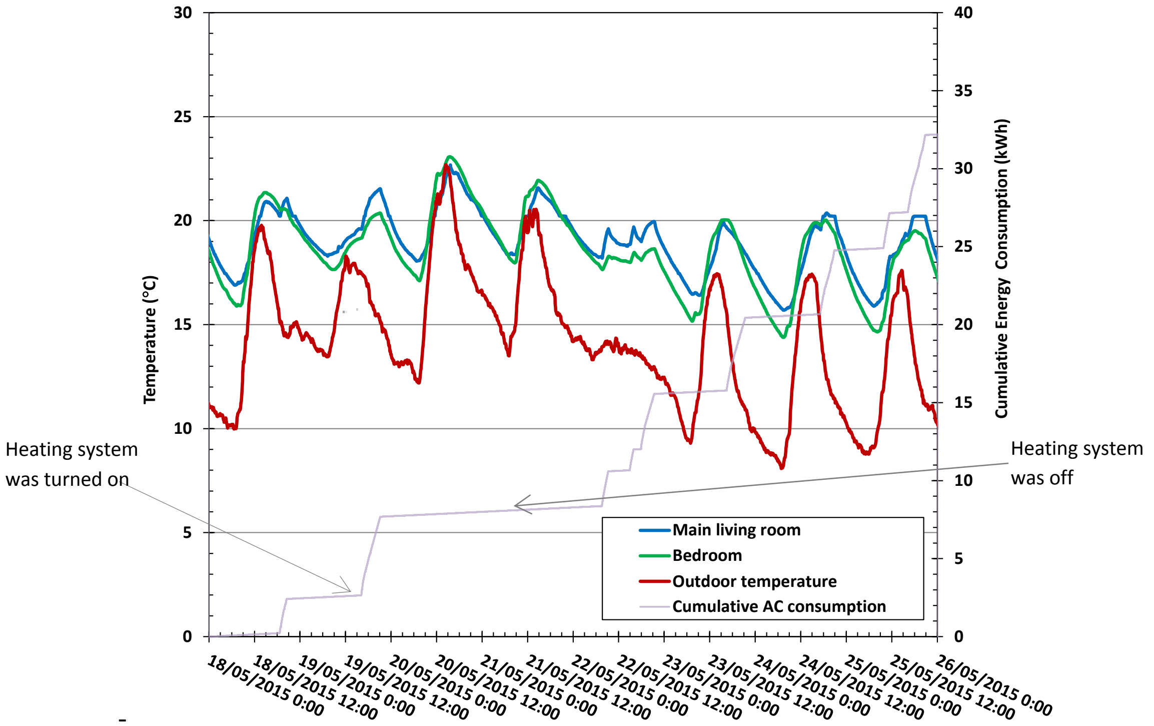


Figure 4.43 Indoor and outdoor air temperatures from 18 to 22 of May 2015 in Climate Zone 2. The right-hand axis show the cumulative energy consumption of the ducted air-conditioning system for the same period.



a)



Heating system was turned on

Heating system was off

b)

Figure 4.44. Indoor and outdoor air temperatures from 18 to 26 of May 2015 in Climate Zone 2: a) home apparently without heating being used; and b) a home with heating being. The secondary axis represents the cumulative energy consumption of the heating system. A steep slope indicates that the system was switched on, while a slope close to zero indicates that only standby power was used with heating turned off.

Insight 4.3 Comfort is so important for the ageing body.

The ageing body, anxiety and fuel poverty

The ageing body has particular implications for how participants use energy. Despite a shared set of ideas thrift, their ageing bodies often necessitated using domestic appliances, particularly heating. For some this increased a heightened sense of anxiety through a lack of control over energy bills. For examples, Renee (80s, retired, living in the community, Southern Highlands) talked about the heightened anxiety of energy bills having poor health. Through engaging with the trial she had increased her sense of control over energy bills despite in her failing health. Renee explained:

> *Interviewer: So, do you think your feelings changed, from before the project to now? So before the project were you feeling in control or out of control?*
>
> *Renee: Before the project I don't think I was as… my disability wasn't as acute as it is now, you know. My disability now as getting older and my body's changed, and therefore I just got to live the best I can, you know, with trying not to… as much comfort as I can, and acceptance of my body.*

Joe (70s, retired, Illawarra), talked about stress created by energy bills. Joe said:

> *Joe: because of the cost per unit of electricity, I'm not allowed to use my house the way I should as someone my age.*
> *… in a way, because of doing the solar [in a previous home], [energy efficiency has] always*

> *been important to me. But now it's become a problem to me. And that's the difference.*
>
> *Interviewer: And would you say that's since you moved into this home?*
>
> *Joe: …Since I became a pensioner. Even with the solar it was an issue but it's now a problem to me, as distinct from a concentration on trying to be efficient. I am compelled to be as efficient as I possibly can...*

Like many of our participants he understood energy efficiency as either not using energy to save costs or as switching to renewable energy to save costs, rather than doing the same with less. He outlined how his anxieties of how he employed energy to sustain his home heightened being on the pension.

Macy and Jason knew of others living in fuel poverty. Macy explained:

> I do know that some people can't afford to heat all their homes… They can only heat one room where they sit.

They went onto express future fuel poverty concerns for themselves, because they kept their home warm with a wood fire using wood collected by Jason.

> Jason explained:
>
> *Because like Macy said, there are people in this town who can't afford heating. We know that. I'm lucky, I'm still able enough to go and get wood. But how long can I - with a heart attack and heart condition like I've got - heart disease - how long can I keep going and getting wood? … So I'm going to be in that situation with them. And that's what's happened. A lot of them old people can't go and get wood any more. And who knows? The time might come when they banish wood heaters all together. And they've tried it in the past. So what are we looking at? And what are we going to …"*

Here, Jason's personal strength and capabilities to provide firewood pose another dimension to the ageing body. Jason and Macy are concerned for the day when they will have to buy expensive firewood or resort to another form of heating.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, *rather than representative of all older low income households.*

4.2.2.3 *Summary: Energy and indoor environment evaluation*

The results in this section provided the basis for understanding the current thermal comfort conditions and the energy consumption of the studied households. This, in turn, could potentially aid in informing future energy efficiency policy or future research trials. Key findings from this section include:

- The climate of the Illawarra region is dominated by heating requirements rather than cooling.
- Half of the monitored households experienced living room temperatures below 16°C for almost a quarter of the time between March 2015 and January 2016.

- Some homes experienced living room temperatures below 16°C for almost the whole winter, i.e. 95% of the time from June 2015 to August 2015.
- Intensive monitoring of homes indicated that for some homes minimum indoor air temperatures reached as low as 9°C, yet despite these temperatures a heating system did not appear to be turned on.
- Through comparing electricity consumption data to the Australian Government Energy Made Easy benchmarking tool (AER, 2016) it was found that over 75% of the Independent Living Units used less electricity than the benchmarked values, whereas the owner-occupied homes were found to have similar consumption values as the benchmarks.

On investigating the variation in energy consumption for various climate zones and fuel combinations, it was found that owner-occupied homes without a mains gas supply, and that were located in the coolest climate zone, used a greater amount of electricity for the autumn and winter periods as compared to the local benchmarks, but less for the spring and summer periods. This pattern was not observed for houses with a mains gas connection and could be attributed to a number of reasons such as poor thermal performance of the building envelope, occupant behaviour, type of heating, etc. Further investigation is therefore required to understand the possible causes for the high use of electricity in winter for houses without a mains gas supply.

4.2.3 Retrofit Assessment and Recommendation Process Results

Overall the retrofit program methodology developed over the course of this trial was demonstrated to be efficient and successful. To the knowledge of the present authors, this project was the first in Australia to successfully deliver an energy efficiency retrofit program with a substantial level of investment per home in retrofit technologies (between approximately $450 and $10,000 per household), and with a broad portfolio of retrofit technologies on offer.

One of the key outputs from this project, particularly through the development and use of the Building Characterization Audit Tool, has been the development of a much better and in-depth understanding of the nature of the building stock in the Illawarra Region and ways in which different house typologies can be retrofitted. The Building Characterization Audit visits and ethnographic research has also provided a very detailed understanding of how people use their homes and of their perceptions of proposed and installed retrofits.

The results of the retrofit assessment and recommendation processes clearly showed that a one-size-fits-all approach to energy efficient retrofits (i.e. where only a single retrofit technology, or a very limited number of technologies, are offered to the community) for low-income, older participants in the Greater Illawarra region would not be likely to succeed. This was evidenced by the relatively low fraction of households that particular retrofits were suited to.

The outcomes of the householder-centred assessment process for each retrofit for each home is plotted in Figure 4.45 and shown as the proportion of homes recommended for each type of retrofit following the Building Characterisation Audits. Retrofit options are sorted here in order of most frequently recommended to least recommended, based upon high priority recommendations. Lower priority recommendations were generally not included in the first round allocation process of retrofits, but were used as alternative retrofit options for the participant consultation discussion should participants not agree to the high priority recommendations.

The key implication of the results presented in Figure 4.45 is that a one-size-fits-all approach would have limited success in projects aiming to roll-out a portfolio of residential energy efficiency retrofit technologies. The most frequently recommended retrofits were given a high priority recommendation in only approximately 60% of homes. The four most frequently recommended retrofit systems being hot water pipe lagging, door and window draught seals, in-home energy displays and lighting upgrades. These four options were suggested for 50-60% of homes, with the next most frequently recommended retrofit type being applicable to only 22% of homes.

The highly recommended results have been separated into owner-occupied and aged care ILUs and the results are presented in Figure 4.46. Supply of fridges was generally not held to be the responsibility of the aged care providers so fridges were not included in the short-list of retrofits for two of the three aged care providers. The slab-on-ground construction of some multi-storey units meant that sub-floor insulation was irrelevant and ceiling insulation was often found to be already present and to an acceptable standard.

In-home energy displays were treated as a retrofit technology trial. These were installed at the same time as the other retrofits and were not used by the project team for collection of energy consumption data. Although these displays could have been recommended for most homes, a nominal target of 50% homes was deliberately selected to compare any possible differences between homes with and without displays fitted.

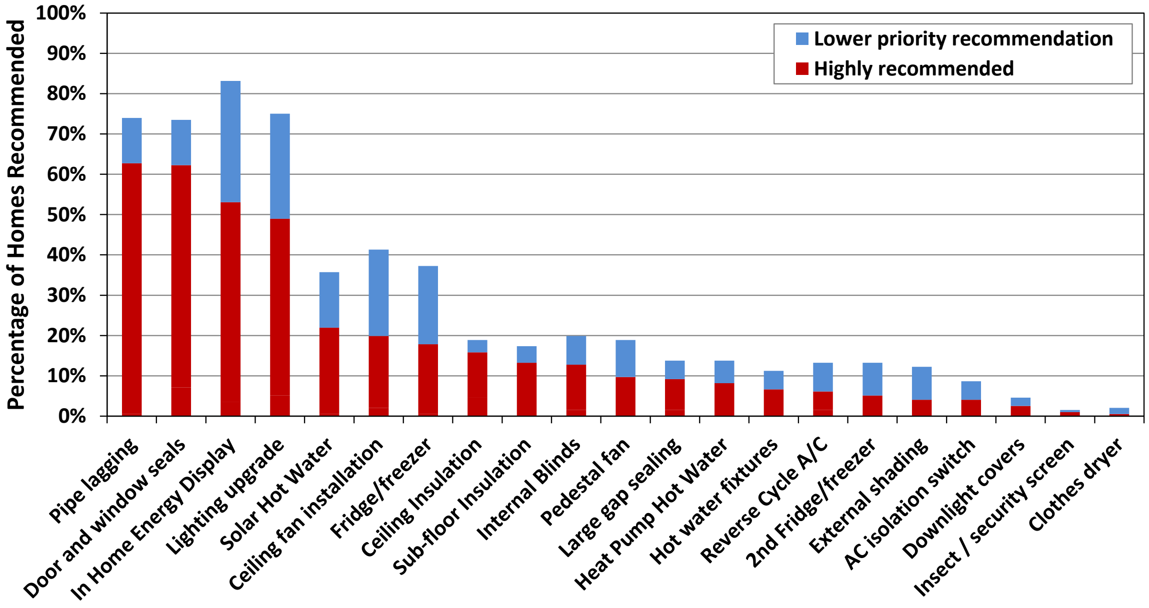


Figure 4.45 Proportion of homes recommended for each retrofit for the total retrofit cohort prior to consultation with occupants.

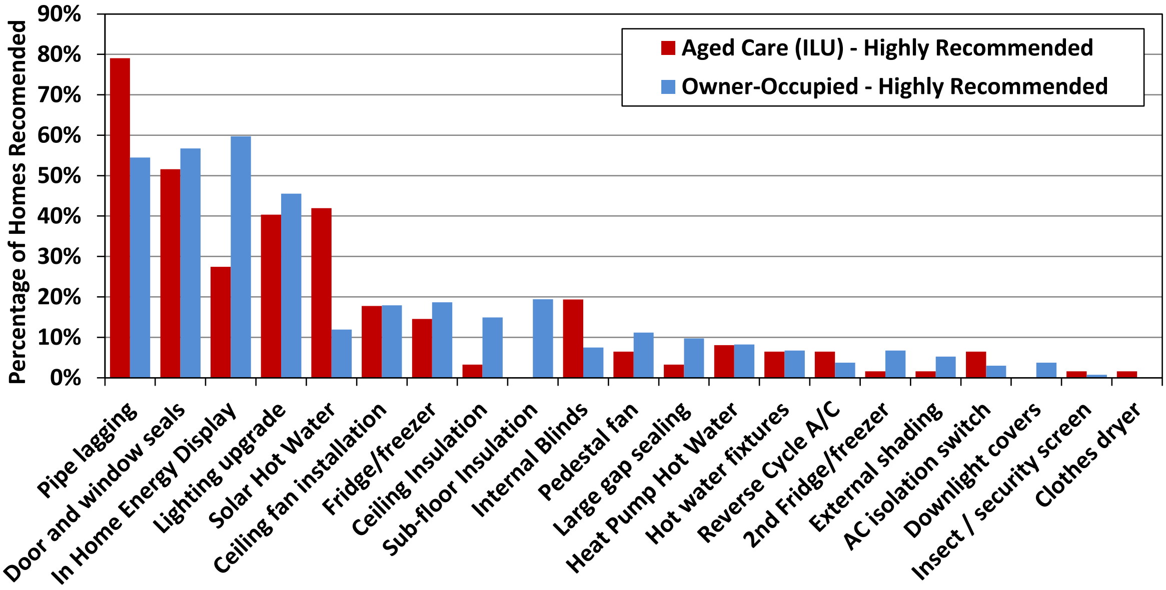


Figure 4.46 Proportion of homes recommended for each retrofit.

The Wingecarribee LGA had the coldest climate within the geographical area of the project and the results for this LGA are presented in Figure 4.47. These results show an increased prevalence of thermal envelope recommendations, such as door and window draught sealing, sub-floor insulation and internal blinds as compared to other LGAs due to the colder climate zone.

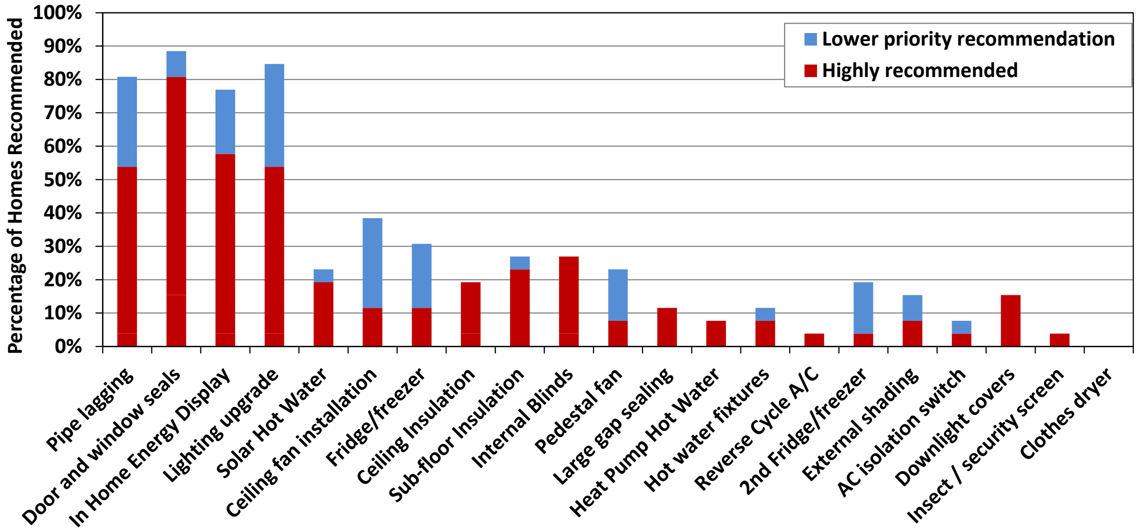


Figure 4.47: Proportion of homes recommended for each retrofit for the colder Wingecarribee LGA climate.

4.2.4 Retrofit Allocation Results (Retrofit budgeting and house by house allocation)

The proportion of households in the retrofit cohort that had particular retrofits 'highly recommended' from the retrofit selection process is compared to the proportion of homes with retrofits actually installed in Figure 4.48. Some particular retrofits (pipe lagging, draught stripping and light bulb replacements) were installed during the 'consultation visit' and these had a high level of acceptance by participants, with around 75% of these recommendations being implemented. The number of hot water systems installed was limited largely by the higher cost of this retrofit and the restricted total budget available for the retrofit trial of the project. A high proportion of participants that were recommended ceiling fans and fridge/freezers accepted these retrofits.

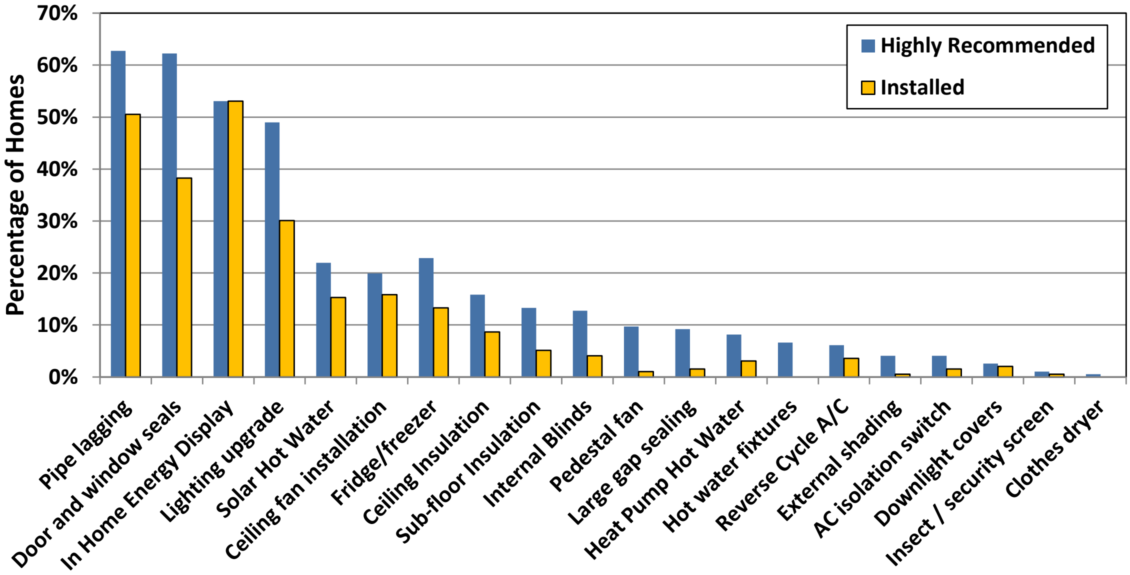


Figure 4.48 Retrofits implemented in homes compared to the number that were highly recommended.

The differences between the highly recommended and installed percentages can be attributed to a number of factors such as budget constraints, occupant decisions not to accept the offered retrofit or the retrofit was found to be technically unfeasible after detailed on-site contractor inspections.

4.2.4.1 *Integrated consultation/installation retrofits*

A limited range of low cost, simple installation retrofit options, such as hot water pipe lagging, external door and window draught sealing and LED light bulb replacements were applicable to 50-60% of households. It has been demonstrated that these three retrofits could often be effectively installed during the household consultation visit. This integrated consultation/installation process:

1) Eliminated the need for multiple inefficient visits by various trades for brief, low-skill quotes and installations;
2) Delivered immediate and tangible benefits to the household; and
3) Brought the installation of these simple retrofits forward into the immediate, rich, interactive context of the consultation visit, which helped make apparent the positive impact these retrofits would have on the participants.

4.2.5 Evaluation of Specific Retrofits

The following sections provide commentary, on and evaluation of, the specific retrofit technologies and associated processes implemented in this trial. Information that has influence this discussion includes: qualitative information from the ethnographic evaluation activities; feedback from a forum of all project team members who had multiple face-to-face interactions with participants; other qualitative evaluation by team members; and the quantitative data collected by the researchers.

4.2.6 Insulation

4.2.6.1 *Ceiling insulation*

(Recommended for 16% and implemented in 9% of homes).

Uncertainty on the part of participants as to the existence and condition of ceiling insulation in their home was found to be a significant factor in limiting the effeciency of implementation of this relatively high value, high return retrofit. With only 8% having confirmed with no effective ceiling insulation, a surprisingly high 29% of homes having “Unknown” ceiling insulation represented a significant potential missed opportunity for this trial, since an “Unknown” result was ineligible for retrofit recommendation. This strict eligibility criterion was set in the context of managing 200 households with tight time and budget constraints to avoid duplicate investigation costs and time by the audit team or by the contractors, and with 20 alternative retrofits to select from. This was still “Unknown” after asking the occupants and trying to inspect the ceiling cavity. A 1.8m step ladder was available in the audit kit. An improved, robust, safe and convenient method for inspecting a much greater proportion of ceiling cavities is recommended.

Only one participant declined an offer of ceiling insulation due to worries following the ‘pink batts’ program. Despite this, of the households offered this retrofit only 50% accepted with reasons listed as: a recent self-funded installation between the audit and consultation; concern about weight in the ceiling with old electrical wiring and the age of the house (note that the project readily accepted the desires and decision of participants, once information and any assurances were provided); loose asbestos was discovered and the participant was unable to fund the removal; 2 participants were satisfied with their existing insulation, which had been assessed as very poor and incomplete; one other had fear about repeat occurrence of an installer putting a foot through the ceiling and refused to proceed; 2 households were not happy with the poor access to shallow roof spaces.

Finally, one household had decided against insulation during the building of their home and were concerned about insulation causing overheating in summer.

In the following insight, Rex and Marina trust their embodied knowledge over scientific advice of the expert. More work is required to understand how lived experiences of thermal comfort may trump the scientific recommendations about the energy efficiency benefits of insulation.

Insight 4.4 Resistances to insulation: Bodily judgements over scientific expert advice.

Resistances to insulation: Bodily judgements over scientific expert advice

Among the intensively monitored homes, insulation as an energy efficiency upgrade elicited different responses.

Bodily judgements of thermal comfort were an important form of resistance to insulation. One couple, Marina and Rex (retired couple, 70s, house in the community, Shoalhaven) chose not to accept ceiling or sub-floor insulation as, despite the advice received about the benefits. They were not convinced these retrofits would improve their thermal comfort. They were concerned that although the house might take longer to warm up on a hot day, it would also take longer to cool down. Marina said:

> *Marina: Brick is a good insulator I believe, and I think it retards the cooling down*

> *process and I have a feeling that the insulation would do the same thing, and that's when we need it to be cool really, because the house doesn't get extraordinarily hot in the day time. On hot days it's hot in the evenings isn't it? It's hot in the night, and I didn't really believe that the insulation would be good in that way. I don't know. I might be wrong, but yeah.*

The couple did not accept the advice in the project because, as Marina explained: "I wasn't really convinced that it would make a huge difference." And, she went on to say:

> *that I think that hadn't been my experience… I think A… has got insulation hasn't she? I don't really know. B… has got it. We don't notice that their house is a lot cooler than ours do we?*

Rex also explained:

> *we were a bit concerned about it that once it's all insulated all through that it might be slower to heat up, but slower to cool down because of the layer of, see in the roof cavity you've got all the hot air and of course the insulation stops the hot air from sort of making your ceiling hot and making you hot, but on the other side of the coin it might slow down the roof cavity. It's sort of holding the heat in the top level and I'm not convinced that it would cool down.*

They also compared it to other houses, and their experience visiting those homes. Marina said:

> *Marina: Let's say from experience; a lot of people have insulation. I don't think I've ever been into a house and said, "Oh, this is a lot cooler than our house." And they say, "Oh yes, we got insulation in the roof." I don't think that's ever happened, so I've never had the impetus to put it in. A lot of people have insulation but I haven't heard a lot of people say that it's much better than it was before.*

Rex acknowledged that "we could be proven wrong scientifically."

Marina and Rex demonstrated their embodied understanding of their house in terms of how it performs thermally, including compared to other houses; how they live in it; and their own thermal tolerances and needs. Their own lay knowledge was more important to their decision than the advice provided by the project team. These were reason enough to reject an offer of free home insulation.

Note: This insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

Rex and Marina expressed particular concern that their home may have been slower to cool down on a summer's evening if insulation were installed. Figure 4.50 illustrates a home that showed an average indoor temperature rise of 1°C after receiving a ceiling insulation retrofit. This was an initial surprise to the project team and ironic in light of Rex's acknowledgement that "we [participants] could be proven wrong scientifically".

Notice that the reasons Rex and Marina gave for rejecting the offer of free home insulation were centred on thermal comfort in summer without reference to winter impacts. Yet the climate data in

Table 4.9 indicates that winter heating is an order of magnitude more prevalent than summer cooling for the Shoalhaven climate zone. This may be attributed to the seasonal context both of this conversation and of the retrofit consultation being summer. It would be interesting to explore in further research the significance of the seasonal context on the retrofit decision making process for householders.

Figure 4.49 Typical examples of: a) ceiling space prior to insulation retrofit; b) completed underfloor insulation retrofit.

In conclusion, with ceiling insulation being recognised as one of the most convenient and low cost improvements to the thermal envelope of homes, it was not a surprise that ceiling insulation was found to be already present in 92% of homes (see 4.2.1.3). However, an unexpected resistance was observed in householders that still do not have any effective ceiling insulation present. The seasonal context of offering this retrofit should be considered since the benefits are expected to be more tangible and immediate to occupants during winter. Opportunities for further improvements to the building thermal envelope will largely need to be explored in other areas of the envelope.

4.2.6.2 *Subfloor insulation*

(Recommended for 13% and implemented in 5% of homes).

Project costings for retrofitting subfloor insulation to suspended subfloors was noted as being much more expensive than ceiling insulation and typically a more difficult installation as the bulk materials needed to retain their own shape and be held up in between the floor joists with often quite restricted height access. Although it was found that the vast majority of homes with suspended floors did not have any form of subfloor insulation, only half of these were assessed as having adequate height access to reasonably carry out this retrofit.

Since occupants come into close thermal/physical contact with the floor, more so than the ceiling, this retrofit offers some additional benefits when compared to ceiling insulation, especially in respect of thermal discomfort in feet/legs in winter. Depending on the type of insulation used, subfloor insulation may have the additional advantage of reducing draughts through poorly sealed floorboards. Care should be taken to first confirm that no existing subfloor mould exists. Although the subfloor insulation will tend to increase the under floor surface temperature, the ventilation to these surfaces may be greatly reduced and potentially worsen any existing mould issues. Acoustic attenuation was noted as a positive outcome by three households immediately after installation of this retrofit.

4.2.6.3 *Analysis of insulation retrofits using temperature signatures*

This section provides two initial case studies to illustrate our findings in respect of the effects of ceiling and subfloor insulation retrofits on indoor temperatures. The method of 'temperature signatures' was applied for this purpose, where the measured half-hourly indoor air temperature data from the living room is plotted against the outdoor air temperature (Figure 4.50 and Figure 4.51). These scatter plots provide useful information both visually and quantitatively on the trends of the indoor air temperature as a function of outdoor conditions. The gradient of the best-fit linear regression to the data provides an indication of how well the building envelope and thermal mass operate from a thermal point of view, i.e. a relatively low (flatter) gradient indicates a more stable indoor temperature.

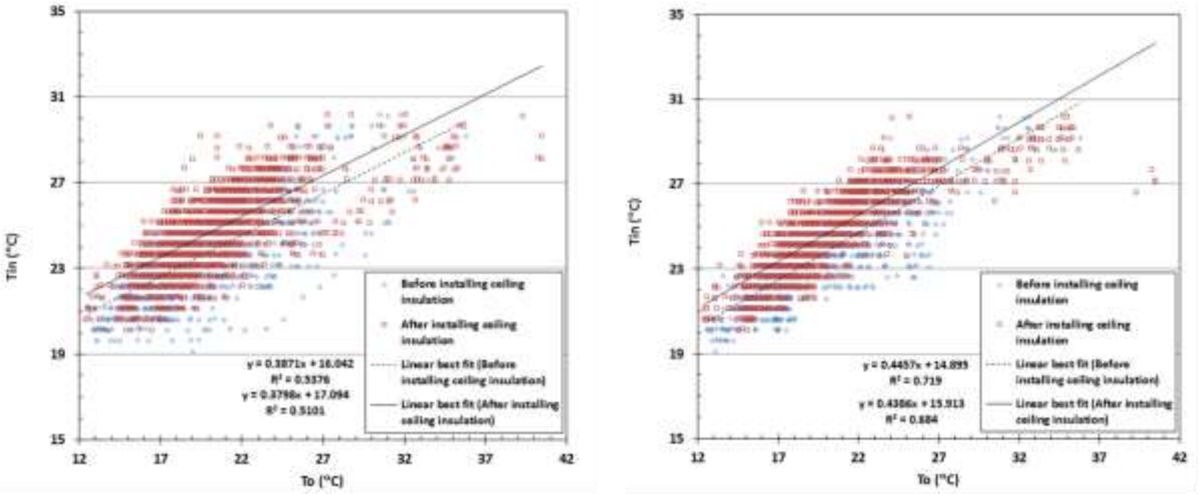
Ceiling Insulation In Figure 4.50a the Case Study A building in Climate Zone 1 has been selected and the blue data points show the indoor temperature as a function of outdoor temperature before the retrofit, for the period from 1st to 31st of October 2015, while the red data points represent the temperatures after retrofitting with ceiling insulation for the period of 5th of November to 31st of December 2015. A cross correlation analysis was undertaken to calculate the approximate effect of intrinsic thermal mass of the buildings, and a time lag between outside and inside temperatures of approximately 3 hours was found for this specific house. The temperature signatures when accounting for the 3 hours of time lag were also plotted in Figure 4.50b.

It can be seen from Figure 4.50 that the ceiling insulation resulted in an apparent increase the indoor temperatures of order 1°C. This could be attributed to the fact that when the insulation was installed the heat gains from solar radiation and internal activities were retained in the space for longer periods. The ceiling insulation retrofit was therefore also likely to be beneficial in winter, but given the short period of the measurements in this study it is recommended to continue this analysis for a winter season.

Underfloor Insulation. Similarly, Figure 4.51 presents indoor temperature as a function of outdoor air temperature for a Case Study B building in Climate Zone 2 where subfloor insulation was installed. The blue data points cover the period from 1st of October to 1st of December 2015 before the installation of subfloor insulation, whilst the red data points show the temperatures from 8th of December 2015 to 15th of January 2016 when the subfloor insulation was installed. In this case study, it was concluded from Figure 4.51 that the indoor air temperatures increased after installing subfloor insulation on average by approximately 2°C.

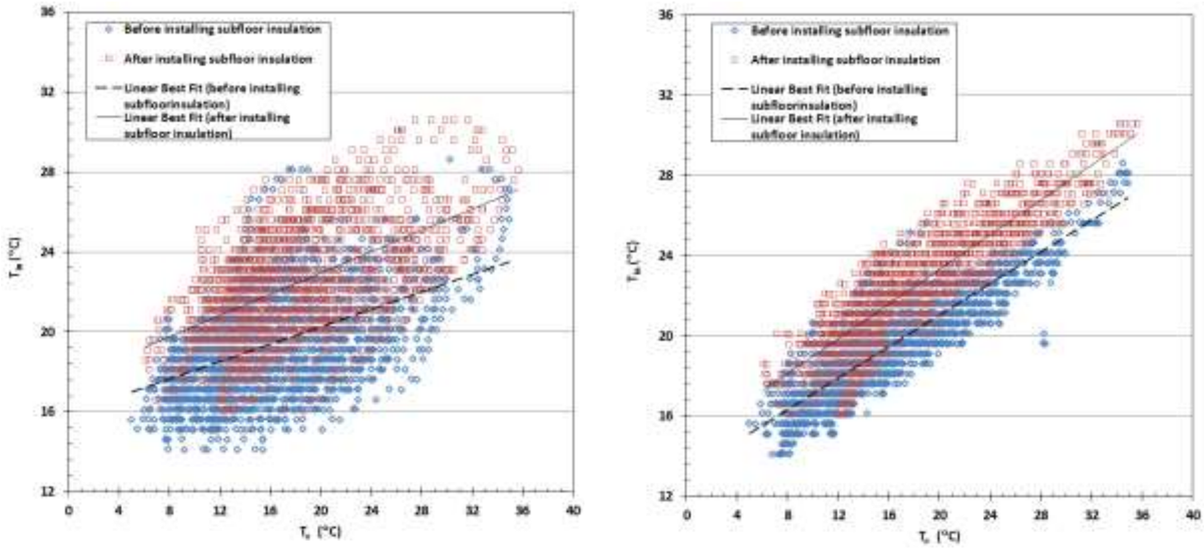
It should be noted that the scatter of these plots is typical of that observed when using the 'temperature signature' analysis technique. The SBRC research team will report further analysis of this data in due course.

It is clear from the data reported in this section that installation of ceiling and subfloor insulation retrofits have a significant influence on indoor thermal comfort conditions.



a) b)

Figure 4.50. Indoor air temperatures as a function of outdoor air temperatures before and after installing ceiling insulation for Case Study A for the periods 1/10/2015-31/10/2015 and 5/11/2015-31/12/2015 respectively: a) raw data, b) measurements adjusted to account for time lag from effect of thermal mass.



a) b)

Figure 4.51. Indoor air temperatures as a function of outdoor air temperatures before and after installing sub-floor insulation for Case Study B during the summer period: a) raw data, b) measurements adjusted to account for time lag from effect of thermal mass.

4.2.6.4 *Cost-effectiveness and co-benefits of insulation retrofits*

The case studies from the previous section were used to calculate a “cost effectiveness ratio”, i.e. ratio of the amount spent on the ceiling or subfloor insulation retrofit to the improvement in indoor air temperature of the primary living room spaces. The temperature signatures detailed in the previous section were employed to quantify the differences between the air temperatures before and after the retrofit and for the specified periods of the measurements. This was achieved by calculating the shift in the air temperature best-fit linear regression equations (shown in Figure 4.50 and Figure 4.51). The capital costs used in these case studies were obtained from the retrofit installation work orders. For future practical cases, costs could vary between different contractors and types of insulation and so the results presented are specific to the case study building and the present project. The resulting cost-effectiveness ratios are listed in Table 4.12.

Table 4.12 Direct cost-effectiveness ratios shown in terms of increment of indoor air temperature from pre- to post-retrofit of ceiling and subfloor insulation (using work order costs only) in Climate Zone 1 and Climate Zone 2.

Retrofit type for two case studies	Cost-effectiveness ratio ($/°C)	Cost-effectiveness ratio ($/°C per m^2 of insulation)
Ceiling insulation R2.5 (Climate Zone 1)	$702/°C	$20/°C per m^2
Subfloor insulation R2.5 (Climate Zone 2)	$3474/°C	$28/°C per m^2

The indirect benefits from the recorded increase of the indoor air temperature are not accounted in the cost-effective ratio calculated above. For example, increased indoor temperatures in winter could result in improved occupant health and a reduced utilisation of the healthcare system (Howden-Chapman *et al.* 2007; Platt *et al.* 2007; World Health Organisation, 1987).

The two case studies above provide a snapshot of the effects of installing ceiling or subfloor insulation. At the time of writing, temperature monitoring of the homes that received these retrofits is ongoing and further assessment of the cost-effectiveness of these retrofits will be presented in future publications.

Note: it must be emphasised that the above calculation is only done to fit reporting requirements for the project. Quantification of direct and indirect benefits on case by case basis would require longer periods of measurements and a continuous analysis of the building use patterns of the home owners (e.g. a detailed frequency analysis of the window opening patterns, use of blinds, etc.). The figures shown in Table 4.12 should not be misinterpreted or extrapolated beyond these specific case study homes. Drawing generic conclusions for the cost-benefit of insulation retrofits is a non-trivial task as the nature of the problem is non-linear, with many independent variables; for example the cost savings and temperature improvements from insulation would depend on building typology, type of insulation, occupancy periods, climate, etc. Combination of a number of research methodologies over a significant period of time and detailed modelling analysis should be encouraged in future projects to account for the interactions between some of the variables that affect the quantification of direct cost benefits.

4.2.7 Fridges and Freezers

(Retrofits recommended in 18% of homes and implemented in 13%).
A total of 38 fridges/freezers were replaced under this project: 26 fridge/freezer combination units, 10 freezers and 2 fridges.

Fridges are quite different from most other electrical appliances in the home in that they generally remain powered on without householders interacting with them at a power switch. They may consume a considerable proportion of a household's energy. This large fraction of household consumption is often not known by the householders, nor are they aware of opportunities to conserve energy by changes in behaviour. Fridges/freezers have previously been reported as consuming approximately 5.9% of Australian household energy (YourHome, 2016). The findings from presented below suggest that this percentage is likely to be higher for the older low-income households in the present cohort, and that awareness of fridges/freezers as considerable consumers of energy is low. This emphasises the importance of addressing refrigeration energy consumption in vulnerable households.

Low participant awareness of the energy consumption of fridges/freezers was indicated by higher than NSW average numbers of fridges per household *and an observed under-reporting of numbers of fridges in surveys*.

The proportion of households that *self-reported* as having two or more fridges was 37% (see Figure 4.28), which was higher than the NSW average of 30.5% and the Australian average of 34% (Australian Bureau of Statistics, 2014).

It is particularly noteworthy that following the Building Characterization Audit of participants' home is was found that participants had often under-reported the number of fridges/freezers they were operating as compared to the Evaluation Survey results. In fact, the proportion of households that *were audited* as having two or more fridges was 57% (see Figure 4.28), 20% higher than the self-reported fraction.

When unexpected additional fridges were identified during an audit, auditors reported typical participant responses as indicating that they had forgotten about the fridge/freezer, since it was 'only a drinks fridge', or 'didn't have much in it'. As an example, a single-occupant household, with otherwise frugal energy consumption (anecdotally reported rarely using a heater in winter in the colder Climate Zone 2), operated 4 fridge/freezers (2 fridge/freezer combination units and two freezers). The participant's freezers were fully stocked with an annual bulk purchase prior to Christmas. These indicators suggest that there is low awareness of fridges/freezers as substantial energy consumers in the home, especially the energy impact of operating multiple fridge/freezers.

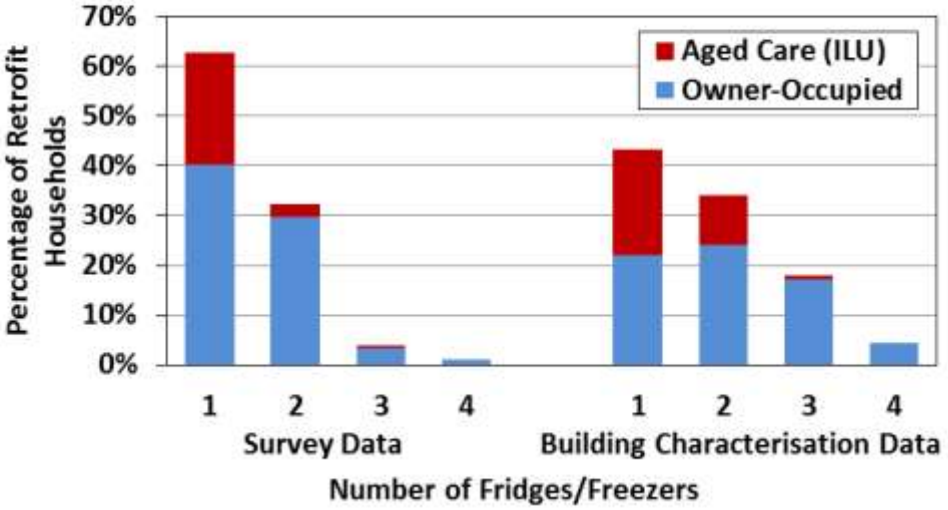


Figure 4.52 Number of fridges/freezers within homes for owner-occupied and aged care Independent Living Units (ILUs), comparing survey data against audit data for the same cohort.

One barrier to the uptake of retrofit fridges/freezers is the "waste not, want not" mind set, identified in the social marketing formative research, in which householders discussed being reluctant to dispose of an old fridge that still works. This barrier was addressed in the social marketing materials by highlighting the recycling facilities for obsolete fridge/freezers. The social marketing, geography and engineering teams worked closely together to develop two pages for a newsletter (see Figure 4.54) and video to present behaviour change and fridge replacement opportunities in accessible formats that were tested in focus groups.

Figure 4.53 Examples of refrigerator/freezer retrofits.

ENERGY+
MY FRIDGE

Fridges run all day every day and they make up a large portion of your energy bill (around 18%). Depending on the age and size this could be costing you significant money each year. However there are simple things you can do to reduce this cost.

IS MY OLD FRIDGE COSTING ME MONEY?

A typical fridge manufactured today uses about a third of the energy of a fridge made 15 years ago. Old fridges are very inefficient and could be costing you a significant amount of money in your energy bill.

If you have an old fridge at home it is likely to be very inefficient by today's standards. It may be worth replacing due to the high running costs.

KEEPING A SECOND FRIDGE

Keeping a second fridge is likely to be costing you a significant amount on your energy bill.

Getting rid of your second fridge is an easy way to save considerable money and energy.

If you decide to keep an old fridge for use as a second fridge, even if it is inefficient, then consider only switching it on when you absolutely need to – for example for Christmas or a family function.

IS BIGGER BETTER?

Size matters when thinking about fridges – a smaller fridge may often have a lower KWh rating than a larger fridge.

Only buy the size of fridge that you need, and try to buy the one with the lowest KWh rating in that size range.

DOES OPENING THE DOOR USE ENERGY?

Opening the door of a fridge lets cold air out and warm air in, but this doesn't represent a lot of energy.

Don't worry too much about opening the door of the fridge as this is unlikely to use a lot of energy. Just try not to leave the door open for extended periods of time.

WHAT TEMPERATURE SHOULD MY FRIDGE BE?

Keeping your food and drinks at the best temperature can help you be energy efficient and also keep your food nice and fresh. Temperatures less than 3°C make fruit and vegetables less crisp and can be detrimental to fresh goods. Storing foods at colder temperatures in the fridge also uses more energy. Every degree lower requires roughly 5% more energy.

Storing foods at 3° to 5°C is recommended for fridges and -15° to -18°C for freezers.

You can use a thermometer to help with this. Consider the NSW Food Authority Guidelines for safely storing food in the fridge and freezer: **www.foodauthority.nsw.gov.au**

HOW DO I CHOOSE AN ENERGY EFFICIENT FRIDGE?

When thinking about buying a fridge looking at the amount of electricity it uses each year, it's Kilowatt Hours (KWh) rating, is important. A lower KWh rating means that the fridge will use less energy in the home.

Always look at the KWh rating of a fridge to assess how much energy it will use.

DO FRIDGES NEED MAINTENANCE?

Taking good care of your fridge is important. Make sure that it is located where the ambient temperature is not too high, and that it is well ventilated so that it operates at maximum efficiency. For example, ensure that there is at least 75mm of air space around every side of the fridge, and if you have a fridge with an exposed 'coil' on the back (usually a thin black pipe in a zigzag shape) make sure that it is not covered in dust or cobwebs.

Make sure the door seals are intact. Replace them if they become worn or damaged.

CAN I RECYCLE MY FRIDGE?

If you do decide to dispose of an old fridge it will not go to waste. The materials of a fridge are highly recyclable and there are services available to help manage their disposal. When you buy a new fridge the retailer may even offer to take the old one away for you.

There's also 'Fridge Buyback', an energy savings program that may actually pay you to give up your old second fridge or upright freezer. **www.fridgebuyback.com.au**

" I needed a new fridge so I went out and bought one. It cost me $800. Best $800 I ever spent. It's amazing how much less electricity the new appliances use "

Figure 4.54 Feature on fridges and freezers in the "Energy+Everyday Living" newsletter from the social marketing program.

The retrofit program complemented these social marketing materials by including the removal and recycling of the obsolete fridges as a mandatory requirement of the fridge/freezer retrofits. This solved the problem of appliance disposal for our older participants, but also removed the risk of householders holding on to their replaced, inefficient fridges and increasing energy consumption. Another barrier to replacing existing fridges is the strong sentimental value often associated with fridges, e.g. after being gifted from other family members. This and other themes on fridges are illustrated in Insight 4.5.

Insight 4.5 Keeping rather than replacing energy inefficient domestic appliances: fridges and freezers.

Keeping rather than replacing energy inefficient domestic appliances: fridges and freezers.

Some participants have fridges and freezers that are over twenty years old. Living with a freezer and second fridge was often an integral part of maintaining the rhythms of family life when children lived at home. Across participants there was limited awareness of the energy costs of running an older fridge and or freezer. For example, in an early interview, Marina and Rex (retired couple, 70s, house in the community, Shoalhaven) discussed their second fridge and chest freezer:

> *Marina: …back up fridge...Someone gave it to us…*
>
> *Rex: … somebody bought it for $5, it's a very old fridge and then he gave it to my son … [who] said: "What you need is another fridge". Ad you know that fridge has been there for years. And, of course, the light doesn't come on in it, but it keeps everything nicely, just ticks away.*
>
> *Then:*
>
> *Rex: We've also got an old freezer…*
>
> *Marina: We don't use it that much. I usually put some bread in it every week when we go, put the bread for the week in it and there's some ice in it and inside of the ice cream maker, it has to be cold when you use it. I don't very often use it actually but it makes nice ice cream. We bought that second hand when we moved into the house.*
>
> *Rex: That was 35 years ago, so it's old but it…never given us any bother.*
>
> *Marina: When we had the children all at home we used to buy our meat in bulk so we needed a freezer. So we don't really need it anymore. We could probably do without the freezer but it won't break down.*

Fridges and freezers are integral to sustaining households, including the rhythms of shopping and cooking. Hence, fridges and freezers often become invisible in households, except when they break-down.

In the earlier interviews, before Rex and Marina were offered a new fridge, they seemed fine with their old fridge. After the fridge was replaced as part of the retrofit, Marina was open about how she actually disliked the old fridge:

> *Marina: The [new] fridge is very nice because the old one was really disgusting, but*

> *Rex liked it because he'd painted it...*
>
> *Rex: Well, it all happened because our son in law gave it to us because his mate gave it to him and his mate paid five dollars for it. It was about twenty… a long time ago.*
>
> *Marina: It worked pretty well, but what was wrong? Was there something gone wrong with it? Anyway, the new one is very lovely.*

Fridges are often attached with family biographies. The fridge is more than a cooling technology, but often integral to articulating memories and demonstrating personal attributes like thrift. The interviewer asked Rex for more detail on his thoughts on replacing the fridge:

> *Interviewer: You sounded very attached to that …fridge. Was it hard to let go of that fridge?*
>
> *Rex: As I say it wasn't really, but I did clean it up once and painted it…No I didn't really have a real strong emotional attachment to it. But it was one of those things that it was faithful in so far as it went for years, but sadly it wasn't a modern fridge.*
>
> *Interviewer: So, it wasn't too hard to give away.*
>
> *Rex: No, it wasn't too hard because in my advanced years I'm glad that I didn't have to help get it out and take it to the tip or anything [Laughter].*

Here, Rex also points to another co-benefit mentioned across several interviews, of having an old appliance removed from the home. Second fridges and freezers were often accommodated in homes simply because their physical weight and size operate as friction. How the removal of fridges – and hot water systems – was facilitated through free labour was welcomed by a number of participants.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, *rather than representative of all older low income households.*

The age criterion for fridges/freezer retrofits was set at a minimum of 10 years in the retrofit assessments, noting that often the age had to be estimated on-site either from participant recollections or type of fridge/freezer. This minimum was intended to limit premature recycling and prioritise replacement of older appliances that were nearer to end-of-life and expected to be less efficient. The life expectancy of fridges is claimed to be around 15 years (KPMG 2014; Seiders *et al.* 2007).

Further criteria considered for this retrofit recommendation for each household included, where available, included: rated annual energy consumption (found on the energy rating label), rated energy consumption of an equivalent replacement and cost of an equivalent replacement. However, it was commonly found that this information was not available. This lack of available energy consumption information for existing fridges/freezers, *in-situ* rather from laboratory testing, emphasises the need for further study to establish benchmark data that will reduce cost-benefit uncertainties.

In this project, the consultation process for fridge/freezers presented unexpected complexities and householder requirements to manage: size, brand, colour, freezer location, features, door opening orientation, dimensions of the available space, access issues for delivery and transfer of food from the existing fridge/freezer to the new appliance to provide for immediate removal for recycling. Brand preferences were often strong. Some participants expressed a perception that older fridges keep food fresher. As an example, one participant received his fridge replacement, but then complained that his new fridge dried out his food to the extent that he decided to unplug the new fridge and revert to an additional old spare fridge that he still owned, claiming that his old fridge keeps the food fresher. These challenges should not be overlooked in any roll out program for fridge/freezers.

The outcomes of the work in the present program have already been of interest to other agencies, exemplified by the fact that the SBRC team attended NSW Government program co-design workshop discussions with the Office of the Environment and Heritage (OEH) and shared some insights to assist in preparation for the OEH rollout of an appliance replacement subsidy program targeting replacement of inefficient fridges and TVs in low-income households.

The case studies below also demonstrate that actual in-home fridge/freezer energy consumption is highly sensitive to the type/model of appliance, the surrounding indoor environment and user practices.

4.2.7.1 *Case studies on the electricity consumption of fridges/freezers*

Fourteen (14) fridges/freezers case studies were selected for energy consumption evaluation during operation in the homes of the Social Marketing with Retrofits cohort. The data for this analysis was acquired through an in-home monitoring system that measured the power consumption of the fridge/freezers at an appliance level (Appendix H). A test period of five (5) continuous days during May 2015 were with the assumption that this period was representative of the average daily electricity consumption of the fridge/freezer, and measurements were extrapolated to derive an annual electricity consumption value.

It is important to note that the estimation of annual electricity consumption of fridges/freezers is subject to high levels of uncertainty and as reported in previous studies (e.g. Geppert & Stamminger, 2013; Hasanuzzaman, *et al.*, 2008; Liu *et al.*, 2004; Saidur *et al.*, 2002). This variability and uncertainty arises from a wide range of factors including:

- Variations in the temperature of air adjacent to the appliance between different households and between seasons/climate (often correlated with the indoor/outdoor air temperature);
- Occupant usage and practices over the year, e.g. quantity, type and temperature of food stored, varying thermostat settings, frequency of door opening, etc.
- Thermo-physical condition of fridge/freezer (e.g. condition of door seals, dust/debris restricting air flow on condenser coil, etc).

Table 4.13 shows the resulting estimated annual energy consumption from the in-home monitoring data, the fridge/freezer capacity, the average indoor air temperature of the kitchen during the five measured days, and, where available, the energy consumption as displayed on the Energy Rating Label of each fridge/freezer. It was observed that there was a large variation between the fridges/freezers energy consumption and the energy consumption displayed on the corresponding Energy Rating Label irrespective of the fridge/freezer size (Table 4.13).

On comparison of the measured estimated energy consumption and the Energy Rating Label, it was found that the rated consumption shown on the Energy Rating Label was consistently higher than the measured energy consumption. This is attributed to the fact that energy rating consumptions are obtained by testing the fridge/freezer under laboratory conditions following the AS/NZS 4474.1 (2007) and AS/NZS 4474.2 (2009) Standard and therefore these conditions may not be representative of real operative conditions of the fridge/freezer.

Table 4.13 Fridge/freezer monitoring and analysis data for 14 case study households: fridge/freezer volume or capacity; measured in-home monitoring data (extrapolated to an annual consumption); Energy Rating Label consumption (where available); and average kitchen air temperature for the five-day test period.

Dwelling	Volume (L)	Measured estimate of annual Energy (kWh/y)	Energy Rating Label (kWh/y)	Ratio Measured/Rated	Average Indoor Temper-ature (°C)
1	393	267	530	0.50	14.5
2	580	366	680	0.54	18.1
3	416	265	469	0.57	20.2
4	303	515	676	0.76	18
5	300	264	268	0.99	19.9
6	380	516	*N/A*		17.7
7	517	347	*N/A*		17.6
8	434	789	*N/A*		17.8
9	459	379	*N/A*		19.5
10	390	590	*N/A*		20.5
11	290	1090	*N/A*		20.9
12	370	539	*N/A*		20.6
13	215	512	*N/A*		20.7
14	454	676	*N/A*		19.5

[1] *N/A: not available, i.e. no energy rating label found on the fridge/freezer during the Building Characterization Audit.*

From the above it is clear that potential energy savings obtained from fridge/freezer upgrades are highly dependent on the existing fridge/freezer model number, the thermal environment surrounding the appliance, and user practices. In the case studies above the actual energy consumption of the fridges with labels was found be up to up to 50% less than that predicted by the Energy Label rating.

This significant uncertainty means that a robust cost benefit analysis for replacement of fridges/freezers cannot be provided without further research to test a statistically significant number of old and replacement fridges in people's homes. It is clear that not only may Energy Rating labels provide an erroneous cost benefit result, but a great number of existing fridges do not have Energy Rating labels (or a publicly available consumption rating for a given model on-line), and it is therefore currently not possible to calculate the retrofit cost benefit with accuracy.

To determine a statistically valid cost benefit analysis would require the monitoring of pre-retrofit (the old fridge) and post-retrofit (the new fridge) conditions of a statistically representative sample of homes. Some of the main parameters required for this evaluation include:

- Energy consumption for different seasons of the year;
- Fridge/freezer surrounding air (cavity) temperature;
- Fridge/freezer compartment temperatures; and
- Door openings (frequency and duration).

Note: due to the delays in implementing the retrofits in the present project (fridges only installed by February 2016) *in-situ* testing of the new fridges has yet to be completed. These results will be made available in an addendum to the present report later in 2016.

The above measured energy consumption values in Table 4.13 have therefore been useful in establishing performance benchmarks for the particular households in question, and have highlighted the very significant differences between actual and Energy Rating Label energy consumption. However, as explained above, it is not appropriate to use these measurements to derive generalised cost benefit values.

4.2.7.2 *Concluding remarks on the fridge/freezer retrofit evaluation*

Information failure on multiple levels was a barrier to the older low-income householders in this cohort improving their energy efficiency for food refrigeration. Key findings on fridge/freezers were:

- The average number of fridges that were self-reported per household by participants in this project was higher than the NSW average in previous Australian Bureau of Statistics surveys;
- However, our Building Characterisation Audits found many households possessed an even larger number of fridges than they self-reported through the evaluation survey;
- An apparent low awareness by participants of the substantial energy savings available by replacing and rationalising the number of fridge/freezers; and
- There are a wide range of participant preference factors (e.g. aesthetics, emotional attachment to old appliances, etc) that will be import to address in future fridges/freezers replacement programs.

This project addressed this information barrier with an interdisciplinary, multi-component intervention of social marketing materials to raise awareness of refrigerator energy consumption alongside the fridge/freezer replacement trial. The uncertainty in and lack of energy consumption data for existing appliances also precluded the development a robust cost-effectiveness assessment of these retrofits. Further study of these issues is suggested to provide clearer evidence-based decision support information for fridge/freezer replacements.

4.2.8 Hot Water Systems

Analysis of billing data for households with off-peak meters showed that on average approximately 34.8% of household electrical energy was used for heating hot water (using off peak electricity consumption data). This is significantly higher than the projected figure of 21% quoted by YourHome for the average Australian home (YourHome, 2016), which indicates that hot water system upgrades are potentially more significant to low-income households. 30% of homes had electric storage hot water systems that were more than 10 years old and were recommended for retrofitting. A further (49% - 30%) of homes had electric storage hot water systems less than 10 years old, totalling 49% of hot water systems still being electric storage. This represents a very significant opportunity that will have significant cost saving impact on low-income households.

Significant improvements in heat pump hot water system performance have been claimed in recent years, e.g. the model installed in the present project quoted a 78% saving in electricity consumption, i.e. COP of 4.5 at ambient 20°C, 60% RH, and water heating from 20°C to 60°C (Quantum 2015). Manufacturers are also claiming less energy consumption than solar hot water systems from standard performance testing at the time of writing. With significant performance variation from solar hot water systems dependent on orientation, shading, size and type of collector, size of tank, location of boost element and control algorithm for the boost element, more detailed analysis of actual system performance for intensively monitored hot water retrofits is required to understand how these systems perform in practice.

Anecdotal feedback from hot water retrofit recipients indicated that they were delighted that they were participants in the LIEEP project, saying they were amazed, very lucky and had been saved a lot of trouble in not having to source a unit themselves. One commented that they can now enjoy a longer shower without feeling guilty about it. This last comment highlights the cost/comfort balance that the more vulnerable residents will always be weighing up, and which may significantly impact the direct energy efficiency cost-benefit result.

An estimated one third to half of participants needed to be convinced to get their hot water system replaced with barriers to acceptance including concerns such as: water temperature, roof structure, longevity of the new system, maintenance concerns, and aesthetics. Approximately half said they preferred the new system. One household declined the offer to replace their hot water system as they wanted to prolong their enjoyment of extra hot water without a tempering valve, but their hot water system failed several weeks later and needed to be replaced outside of the present project.

Contrary to expectations, there was not a single complaint, to the knowledge of the project team, that the hot water from the retrofitted systems (with tempering down to 50°C) was too cold.

Figure 4.55 Examples of solar hot water and heat pump hot water retrofits.

4.2.8.1 *Solar Hot Water Systems*

(Retrofits recommended in 22% of homes and implemented in 15%)

There was an affluence aspect to this most visible and prestigious of the project's retrofit offerings. Participants typically felt pride at the chance of owning such a system where it was visible for all to see on the roof and perceived widely in the community as a very desirable technology.

It is known that for solar hot water systems, the time of day at which showers are taken may significantly affect the amount of boost energy required to heat the water after a shower. If the storage tank booster element and sensor is in the bottom of the tank and showers are taken after sunset, and the booster control has no built-in time delays, then the booster may provide all of the energy required to reheat the whole tank during the night. Similarly, if little hot water is used during the day then the solar collectors will only offset the relatively minor energy storage losses and draw-offs through the day.

In response to discussions with the project team one family changed the time at which they take showers with their solar hot water system. Another participant turned off the electric booster on her solar hot water heater when she had previously had it on all the time. These examples demonstrate that participants were very often willing to change their day-to-day hot water practices to get the most benefit and maximise energy/cost savings from their new hot water technology.

Older solar hot water systems installed some years previously typically had an electric booster isolation switch installed inside the home, which was designed to allow householders to leave the booster switched off unless they decided to turn it on. Some householders with this booster isolation switch reported never needing to switch the booster on. This means that their hot water heating electricity consumption would have been zero. Others were not aware of the switch and left it always on meaning that a significant amount of their hot water energy would have been provided by peak electricity consumption.

Two existing gas instantaneous systems were replaced with instantaneous gas-boosted solar systems as a trial. An important issue was highlighted during discussions with the householders, in that the existing systems had remote temperature control, which was used by householders to set the temperature for their shower as low as 35 to 40°C. Since gas instantaneous systems have no hot water storage, there is no requirement to comply with regulations to heat the stored water above a minimum temperature to eliminate the risk of legionella and storage heat losses are minimal. The upshot of the retrofit was that since water supplied from the hot tap would be significantly hotter than that previously supplied directly from the gas heater, the gas booster could not be used to reduce hot water temperatures for showers in this case the householders would need to change their day-to-day practices and use manual control of the hot and cold water, or mixer, taps.

Due to the fact that retrofit installations were completed towards the very end of the project (February 2016) quantitative evaluation of the performance of the new systems has not been carried out at the time of writing, however, on-going evaluation will continue beyond to the end of the current project and results reported in an addendum to the current report.

4.2.8.2 *Heat Pump Hot Water Systems*

In contrast to solar hot water systems participants with new heat pump hot water systems seemed more interested in the impact on their bills and less in aspects of perceived affluence/status and pride. This was understood to be driven by the fact that the heat pump system would be less publically visible than a solar system on the roof.

There were several noise complaints in relation to these heat pumps, though it should be noted that this was a comparison made by participants comparing the heat pump to their previous and silent direct-electric storage hot water tank.

Quantum heat pumps were used in the current project and feedback from the installation head contractor was that these were selected for superior reputation and proven track record, though the veracity of this view has not been tested to date.

4.2.8.3 *Pipe-lagging*

This was the most frequently recommended retrofit (at 62% of the retrofit cohort) since very few of the existing hot water systems had any pipe lagging installed and this was a relatively simple, low cost retrofit implemented during the consultation visit. The proportion of recommendations was slightly higher for ILUs (72%) due to the high prevalence of older electric storage systems. The proportion was slightly lower for Wingecarribee LGA (54%) possibly due to higher proportion of gas instantaneous systems or greater awareness of thermal losses in the colder climate.

Some participants were sceptical about the benefits of this simple retrofit measure and the greatest impact for them was to see the heat loss benefit/reduction through on-site use of a thermographic camera to display surface temperatures before and after fitting of the lagging and valve cosy.

Figure 4.56 a) Thermographic camera image of hot water system with pipe lagging shared with participant; b) outside pipe lagging and valve 'cosy' retrofit.

4.2.9 Fans

4.2.9.1 *Ceiling fans*

(Retrofits recommended in 20% of homes and implemented in 16%)

Ceiling fans were a relatively frequent retrofit to be recommended, allocated and accepted. The recommendation process carefully considered the suitability of ceiling fans for each household according to whether summer discomfort or summer air conditioning energy was significant and if existing pedestal fans presented a significant trip hazard, especially to mobility impaired participants. The consultation with participants paid attention to details about the specific room and location in that room that they spent most time in on a hot summer's day, aesthetics such as style and colour (from a limited shortlist) and whether an integrated light was required. With hindsight the team would have offered more remote control units for fans, especially for use in bedrooms for control during the night from the bedside for the elderly, the additional cost of which was of order of $100.

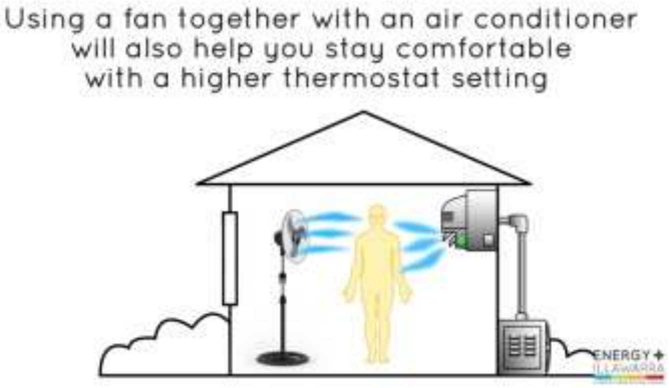


Figure 4.57: Social marketing materials developed in an inter-disciplinary collaboration to promote more efficient and complementary use of fans and air conditioners

The displacement of summer air conditioning energy by ceiling and pedestal fans used as an alternative or as a complementary thermal comfort measure, while increasing the air conditioning thermostat setting by around 3°C, was presented in the Social Marketing newsletter and narrative videos developed in close collaboration between the engineering and social marketing teams.

4.2.9.2 *Pedestal Fans*

(Retrofits recommended in 10% of homes and implemented in 1%)

Unlike ceiling fans, portable pedestal fans were generally not welcomed by participants and viewed as an less significant and valued retrofit ("If I want one I can get that myself"). This feedback may be considered in tailoring more energy efficient, quieter and aesthetically pleasing pedestal fan options in future, as these remain a low cost, effective alternative to air conditioning in the temperate climate zones.

Figure 4.58 Typical ceiling fan and reverse cycle air conditioning retrofits.

4.2.10 Draught Stripping and Building Air Permeability Assessment

(Retrofits recommended in 62% of homes and implemented in 38%)

Blower door tests were carried out in a number of retrofit homes, and in addition to quantitative evaluation of the building envelope, the process also had the benefit of highlighting to participants where heated or cooled air may be lost from their building. The test itself was relatively intrusive, as it required the temporary installation of a 0.5kW fan in the front door of the building to depressurise the house (see Figure 4.6).

The practice of conducting the test and making gaps clearly visible became an important mechanism for engendering behavioural change in some participants. For example, in the final ethnographic interview, one household explained the impact of one of the blower door test on their house. The blower door test made visible a cat-flap installed in a sliding screen door as an air leakage, and source of energy inefficiency. Their everyday practice had been to have the glass sliding door open day and night to accommodate access of the cats in and out of their house (see Insight 4.6).

Insight 4.6 Blower Door Test.

Blower Door Test

One participant, a 65 year-old male, explained that the blower door test:

> *woke our eyes up to where we losing heat and cool - and cold…I've done something about our major leak, a 40 per cent leak was going out that door. So I've…built myself a little contraption to minimise that. I mean, we have to let the cats in and out, but…well, one of [the engineering researchers conducting the test] said they actually build a cat or a dog door in their wall so they didn't have to open the door. I built a wall to put in the door. [laughter] So it's the same thing, you know, it's - rather than put another one in the wall, which is going to be quite expensive and that, I quite cheaply made a wooden one and put it in and…I've just got to finish it by putting handles on it and a bit of felt and some locks, so - just so it just holds everything together."*

The blower door test showed that:

> *When we had [the glass door] shut, we lost very little, it was a small percentage, just very*

> *small, just the normal you would expect in a house with under doors and out of - you know, the drain holes and the windows and things like that. So we lost very little.*

The new 'wall' (see Figure 2) was installed the day before the interview. Yet, the participants felt they could already notice a difference:

> *We tried it for the first time last night, we had the air conditioning on, and I found it better because it shut the air cond-, because watching our monitor, we could see it shut down, start up, and it shut down real early to just 'maintain' mode from 'let's cool the house' mode. So really, it's - you know, it was very good.*

A female household member said,

> *noticed last night that my room was cooler. … Now, in winter, my - even with the heater, with that [sliding] door open, I don't get a lot of the heat going through to my room…in summer, the air conditioner's very late to get into my room. Well, last night it was better…And that's only from what he's done."*

Figure 4.59 Glass sliding door with wooden panel placed in track, blocking airflow except through cat flap.

Like other participants, she felt more in control of energy bills through engagement with the trial. When asked whether the project had helped make them feel more or less in control of their energy bills this participant spoke about the blower door test. , iThe blower test enabled participants to locate then themselves address the air leakage from the sliding door:

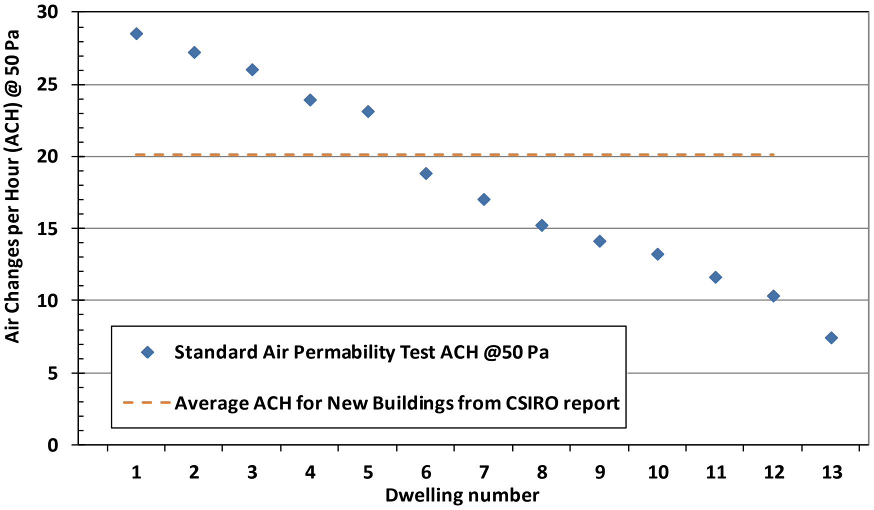
> *…the loss of energy out the back door where [he's] built the cat door thing, yeah, that will make a big difference, 'cause you're not going to be running things on such a high temperature, or you know, such a low temperature in summer, you know, to get that extra*

> *bit of heat or extra bit of coolness. Yeah. 'Cause it's a big home and everything's, sort of, in the central - in the middle of the home, so like, for the heater here in the lounge, it's got to heat the front, it's got to heat the back. And having that draught come through the back door has made one hell of a difference. Had we known how much we were losing we probably would have done something earlier. I mean, it doesn't look much when you look at the cat door, and you know, just that little corridor on the screen door, but you get a hell of a shock when you find out how much you're losing. I mean, 40's close to 50, and losing 50 per cent of your energy is one hell of a lot that you're going to have an increase.*
>
> *Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.*

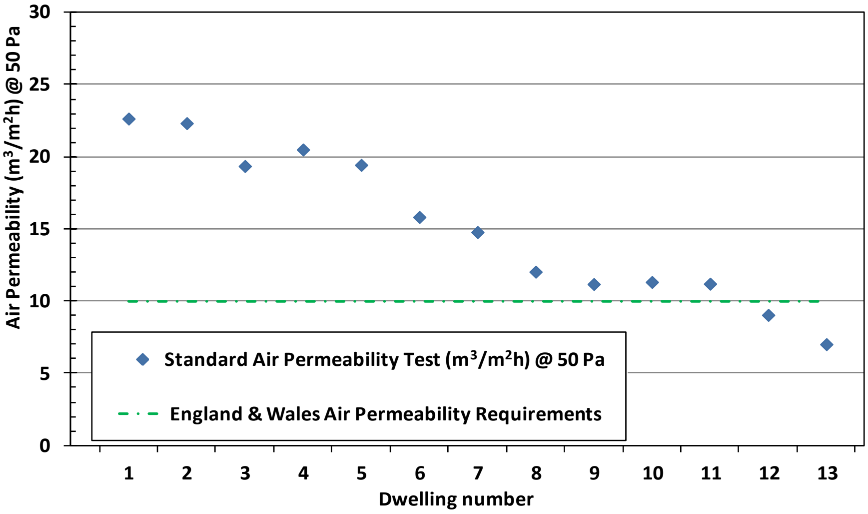
Many external hinged doors had existing spring-loaded hinged seal flaps to seal against gaps at floor level. Many of these were observed to be poorly adjusted, probably due to movements in timber doors and doorjambs, leaving significant gaps.

4.2.10.1 *Air permeability test results*

Results from the Standardised Air Permeability Tests are reported in this section. Out of the 14 dwellings that were planned to be tested, 13 tests were completed and one test was cancelled due to unsuitable weather conditions during the visit to that property.



(a)



(b)

Figure 4.60 Building air permeability test results conducted for 13 dwellings to assess the level of air tightness and need for draught proofing: a) air Changes per Hour at 50 Pa; and b) air permeability ($m^3/h/m^2$) at 50 Pa.

The test results are displayed in Figure 4.60, where that are compared to benchmarks including: the average air permeability value measured in new Australian residential buildings (Ambrose and Syme, 2015); and the mandatory maximum permissible air permeability value in England and Wales (E&WBR, 2013). It can be seen that most dwellings had air leakage rates that were well above the permissible rates specified by the English and Welsh regulations. A building with high air permeability values will allow more warm conditioned air to escape to the outside in winter while more hot outdoor air will enter the cooler indoor spaces in summer. This uncontrolled air flow causes thermal discomfort to occupants and an increase in the demand for heating and cooling.

Note that uncontrolled infiltration heat transfer from outside air will lead to increased peak cooling loads in summer and this will also have economic implications for the operation of energy supply and distribution companies.

4.2.10.2 *Draft sealing cost benefit evaluation*

A range of co-benefits can arise from the installation of draft sealing and include improved thermal comfort and health (e.g. cold drafts will be eliminated in winter and indoor air temperatures in both winter and summer are likely to be more comfortable, providing window opening practices are adjusted appropriately).

Direct financial benefits should accrue from reduced energy bills if draught-sealed rooms are heated and/or cooled in winter/summer. The following section presents an evaluation of the direct cost benefit of draught sealing in some homes of the present project. There are however a significant number of assumptions and constraints that have been applied to enable such an evaluation to be carried out.

Figure 4.61 a) Typical door draught seal; and b) casement window draught seal retrofits.

A direct cost benefit analysis of draught sealing is a complex, multi-variable, dynamic challenge with many factors with unknown influence coming into play. We have made a number of assumptions in the following. Firstly, the cost of a draft proofing retrofit in practice varies significantly, ranging from do-it-yourself (DIY) costs up to much higher contractor-installed prices. Secondly, although the cost of electricity will vary over future years, the development of detailed macroeconomic and techno-economic models was outside the scope of this project. Thus, the assumptions made in our calculations were as follows.

1. Future cost of using electricity remains constant at $0.20/kWh and no account is taken of interest rates required for raising and repaying capital funding to undertake the retrofit.
2. The buildings would be heated and cooled with a reverse cycle air-conditioning system that has a Coefficient Of Performance, COP = 3. When buildings are heated with less efficient systems, for example with direct electric heating systems, the importance of draught stripping increases in inverse proportion to the COP of the heating/cooling and the payback period reduces accordingly.
3. The calculations are only applicable to the two climate zones of the present project and it was assumed that people will be using reverse cycle air-conditioning systems for heating and cooling in their houses to maintain standard indoor comfort conditions throughout the year.
4. Other climate parameters such as wind speed and wind direction will have the same patterns over the years as those during the measurement periods of the study.
5. The cost of potential air permeability (blower door) tests that would precisely quantify the reductions of air leakage are not included in the calculation.
6. The Degree Days (DD) calculation method (CIBSE, 2006) was used to estimate the potential energy savings in a better sealed house.

The evaluation was applied to five (5) individual case study homes that had the door(s) temporarily sealed during the blower door test to replicate the effect in the infiltration rate of door sealing retrofits. For these particular homes a key part of the blower door test performed on-site consisted of temporarily sealing one or more of the external door(s) and assessing the change in infiltration rate (ΔACH) at 50 Pa. The change in infiltration rate can then be compared to the original air permeability test (i.e. without sealing of the external doors) and the payback period calculated using the assumptions listed above. Results on estimated payback periods presented in Table 4.14 are for two capital costs for the retrofits to each specific house, i.e. i) those applicable to do-it-yourself (DIY) purchase and installation of the door seals; and ii) quotes from the contractor work orders under the present project.

Table 4.14 Direct payback period estimate for the effect of retrofitted door seals on building infiltration rate for five specific homes in the Social Marketing with Retrofit cohort. (Co-benefits of draught sealing not included).

Installer Type	**Capital Costs ($)**	Climate Zone	House volume (m^3)	No. of Doors Sealed	ACH_i (h^{-1})	ΔACH (h^{-1})	Estimated Payback Period (years)
Contractor **DIY**	218 54	1	309	2	13.3	0.91	**31.8** **7.9**
Contractor **DIY**	109 27	1	212	1	23.2	1.911	**10.9** **2.7**
Contractor **DIY**	109 27	2	435	1	11.7	0.82	**5.6** **1.4**
Contractor **DIY**	218 54	2	266	2	18.9	1.41	**10.7** **2.7**
Contractor **DIY**	109 27	2	337	1	17.1	4.24	**1.4** **0.3**

A very significant variation can be seen in the payback periods and the differences in the infiltration rates (ΔACH) for similar sealing measures (Table 4.14). As an example, in one case, sealing two doors had a payback period of 7.9 years for the DIY capital costs whilst in another, sealing a single door had a payback period of 0.3 years.

In addition, extra draught-proofing in one home compared to another (e.g. one door seal versus two doors seals) did not result in the same proportionate improvement in the infiltration rate. This is to be expected since the pre-retrofit leakage through the door(s) will vary significantly from one home to the next.

It should be noted that the above direct cost benefit analysis has been undertaken to address the specific request of the Department of Industry, Science and Innovation to provide such estimates, where possible, for all LIEEP projects. However, the present authors wish to make clear that the results cannot be generalised beyond the specific case study houses tested/analysed here or beyond the assumptions listed above.

4.2.11 Reverse Cycle Air Conditioner heating upgrade

(Retrofits recommended in 6% of homes and implemented in 4%)

The rated energy efficiency of heat pumps in general, including reverse cycle air conditioners has improved significantly over recent years. For example, it is claimed that the Daikin US7 (Model number FTXZ25NV1B) was the first split system in Australia to be awarded a 7-star energy rating (Figure 4.62) with an AEER (annualised energy efficient ratio for cooling, including consideration of standby power) of 5.9, and an ACOP (annualised coefficient of performance for heating) of 5.77. This model had other features including both humidification and dehumidification and was trialled in several homes with particularly high usage of air conditioning associated due to the health needs of the participants concerned. Other high efficiency air conditioners were also installed as part of the trial.

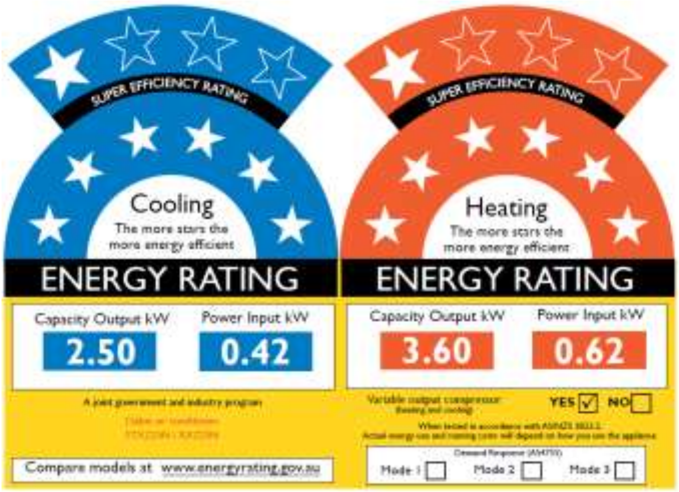


Figure 4.62 An energy rating label from one of the reverse cycle air conditioning retrofits of this project.

With these gains in energy efficiency, split system reverse cycle air conditioners were selected as a retrofit option for this trial, primarily targeted to replace inadequate, inefficient electric heating systems. Households with existing, older, relatively inefficient reverse cycle or ducted air conditioners were not eligible as even these older air conditioners are typically 2 to 3 times more efficient than an electric heater.

Note that any heating/cooling system cost-benefit calculation is very sensitive to occupant usage. Referring back to 4.2.1.1 for a range of nominal heating scenarios, and just for illustrative purposes, a typical household may use their heater for approximately 5 hours per day for say the 3 months of winter, which is 456 hours/year; some households reported not using any heating energy at all; whereas, other households reported using reverse cycle air conditioning for more than 16 hours per day for nominally 6 months of the year throughout both summer and winter, which is 2920 hours/year (33% of total hours per year).

Figure 4.63 Reverse cycle air conditioning retrofits.

A comparison with gas heating systems was not carried out and households with existing gas heating systems were not considered eligible for this retrofit unless there was a health concern (typically respiratory) with an existing un-flued gas heater. Some anecdotal evidence arose on differing perceptions of heat and thermal comfort from various types of heating appliances, including radiant effects, humidity and air velocity. Further work is recommended to understand the impact of these perceptions on heating appliance selection and energy efficiency.

Noting again the dominant need for heating over cooling in the climate zones of this study, and the rising demand for air conditioners for summer cooling, the project team was aware that providing reverse cycle air conditioners as an energy efficiency heating upgrade had the potential to improve heating energy efficiency and improve thermal comfort targets of the program, but conversely result in increased energy bills in summer for vulnerable households. It was hoped that the increase in summer energy consumption would be minimised through the promulgation of the education and awareness-raising materials developed in collaboration with the social marketing and geography teams on best-practice in use of air conditioning in both winter and summer.

With installation of these "heating upgrades" during the 2015-16 summer period, many participants voiced their eager anticipation of the new reverse cycle air conditioner to provide improved summer thermal comfort. This initial anecdotal feedback provided some confirmation that summer use for improved thermal comfort is likely to increase energy consumption for these households, while winter heating costs are expected to be significantly reduced and/or thermal comfort improved.

4.2.12 Lighting upgrades

(Retrofits recommended in 49% of homes and implemented in 30%)

The original specification for lighting upgrades was to focus on LED bulb replacements of incandescent and halogen bulbs. It was decided not to replace CFL bulbs as the cost-benefit analysis result was only favourable for CFLs that were very highly utilised. However, with the householder-centred approach, it was found during the consultation visits that participants were often dissatisfied with lighting quality of CFL bulbs and these were replaced upon request. Some householders also received lighting upgrades that required upgrading of light fittings in order to be safe and effective.

Figure 4.64 a) Light meter used to assist participants in understanding the improvement in light levels from retrofits; b) LED globe retrofit.

Figure 4.27 provides some evidence that regulatory changes to the minimum energy efficiency standards of light globes and the roll out of CFL globes in programs such as the NSW Government's Home Power Saver Scheme had already been effective in bringing high efficiency lighting technologies into the homes of our participants with the associated benefits. However, around 50% of the light bulbs replaced in this project were CFL bulbs that had been reportedly supplied as part of the Home Power Saver Scheme. Anecdotal feedback on this scheme was generally positive and appreciative, while a significant proportion did not entirely trust the mass rollout approach and were glad to have more interaction, information, choice and attention to detail. An example of some extraordinary co-benefits from care taken to consider lighting quality in addition to energy efficiency are related in Insight 3.1. Care taken to clean the existing light diffuser and fittings before refitting was a simple detail that was appreciated and sometimes made a significant difference to the impact of the lighting retrofit.

This low cost "do-it-yourself" retrofit of LED light globes was another collaborative opportunity to combine the positive impacts of social marketing and home improvements through both technology and "myth-busting". A comparison of light bulb types and cost-analysis results for the replacement of the listed bulb types with an LED bulb is included in Table 4.15. (An excerpt of an earlier version of this table was included in the "Energy+Everyday Living" newsletter of the social marketing program).

Direct cost-benefits of LED bulb replacements indicate excellent payback periods for replacement of incandescent or halogen bulbs for immediate replacement, except in very infrequently used light fittings. CFL bulbs are generally recommended to be replaced with LED bulbs upon failure, since LED globes are rated at approximately double the lifespan of CFL globes and 6 times the lifespan of halogen globes. The older low-income householders of this study were expected to find the reduced replacement requirement a particularly welcome, un-costed co-benefit. The risk of associated falls and other injury is another potential health and safety co-benefit.

Table 4.15 Comparison of light bulb types and direct cost benefit analysis of DIY replacement with an LED bulb (a version of this table was included in the "Energy+Everyday Living" newsletter of the social marketing program).

	Incandescent	**Halogen**	**CFL**	**LED**
	🟥	🟧	🟨	🟩
Colour range	Warm white	Warm white	Warm white to cool daylight	Warm white to cool daylight
Wattage comparison[1]	60 W	45 W	13 W	9 W
Lifespan[1]	1200 hours	2500 hours	8000 hours	15000 hours
	1.1 y	2.3 y	7.3 y	13.7 y
Purchase cost per bulb[1]	$0.50	$1.80	$6.00	$11.00
Purchase cost for period[2]	$6.25	$10.80	$11.25	$11.00
Purchase saving for period[2,3]	$5.75	$9.00	$5.25	-
Electricity cost[4]	$13.14 /y	$9.86 /y	$2.85 /y	$1.97 /y
Electricity cost for period[2,4]	$180.00	$135.00	$39.00	$27.00
Cost saving for period[5]	$158.75	$117.00	$17.25	-
Annualised cost savings	$11.59 /y	$8.54 /y	$1.26 /y	-
Benefit-Cost Ratio (BCR)[3]	14.4	10.6	1.6	-
Payback period[3]	0.9	1.3	8.7	-

Notes:
1. Light bulb data researched in May 2015, nominal/conservative values were assumed.
2. Labour/installation cost was not included. The assumed accounting period was the lifespan of the LED bulb
3. Savings came of original/obsolete bulbs over lifespan of LED bulb. First bulb was discounted, presuming replaced globe was new.
4. A utilisation rate of 3 hours/day and energy cost of $0.20 /kWh was assumed.
5. Purchase cost saving + electricity saving (for period).

Insight 4.7 *Fiat Lux* ('Let there be light').

Fiat Lux ('Let there be light')

This case study involved the on-the-spot replacement of light bulbs during a retrofit 'consultation visit' conducted by Stephen Choi, Retrofit Implementation Coordinator of Viridis. The insight illustrates the extraordinarily disproportionate and positive co-benefits that often arise from energy efficiency retrofits. Rich contextual insights of an expert project team member delivered immediate and tangible impacts to a householder when a simple LED light bulb replacement led to greatly enhanced wellbeing at home and in the community – through the participant joining a crocheting club.

During the consultation visit, the participant talked of spending considerable time crocheting in her cold and hot garage for the benefit of the bright fluorescent light. The auditor pro-actively then engaged the participant in a discussion of her situation and invited her to sit in her preferred crocheting chair in the main living area holding a light meter to see the measurements of luminous intensity of her existing, inadequate, light bulb and then seeing the result of several options of brighter LED bulbs and quantitatively and subjectively comparing these options with the garage lighting.

With the installation of energy efficient LED lighting in her living room, the participant was delighted to be able to move her crocheting activity back from the garage into a comfortable living area. Saving a little lighting energy was a small, but important, part of this story but triggered the whole transformation of thermal comfort, living habits and social co-benefits for this vulnerable person.

Note: This insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

4.2.13 In-home energy displays

(Retrofits recommended in 53% of homes and implemented in 53%)

As noted in Section 4.1.9.3, in-home energy displays were widely recommended trial retrofit technology in this project, and were installed at the same time as the other retrofits, with approximately half of the cohort receiving these devices. There was a wide range of participant responses to this perhaps most interactive of retrofits offerings, with the capacity to reveal both good and bad practices and appliances used by the household. Many participants were extremely positive, with one participant enjoyed observing the change in power consumption as he switched his TV from colour to black and white and switching various appliances on and off. One household that did not initially want an in-home display but was persuaded to have one installed, reported observing the energy consumption of their 4-slot toaster and purchased a 2-slot toaster in response to this new information.

On the other hand a small minority of participants were less positive and we estimate that around 5-10% of participants did not use the display at all. Several put the display away in a drawer saying words to the effect that, "I don't worry about using energy", while others took slight offense at the offer to have an in-home display installed saying that energy consumption is not a concern that they wished to monitor were implied that they thought their energy consumption was being judged by the project as being excessive and requiring monitoring.

Figure 4.65 a) In-home energy consumption display; b) switchboard with energy consumption display transmitter retrofitted.

Insight 4.8 Making energy consumption visible: In-home energy displays.

Making energy consumption visible: In-home energy displays

In-home displays, that make energy consumption visible, can be both empowering and disempowering. Here, we highlight two different experiences of project participants: Sally and Joe.

For some, the display was a source of empowerment. The awareness of how energy was consumed in their home provides possibilities for greater control, notably through turning appliances off.

Sally (70s, retired, living in the community, Shoalhaven) was provided an in-home display as part of her energy efficiency upgrade. When asked what part of the project influenced her to change her energy practices, which in her case was switching items off more, she talked about the monitor:

> *Sally: It shows me physically what's going on. I mean, I've got one, or two of the fridges going. Because I've got a freezer, plus two fridges. I'm doing alright, oh, and the fan's going in the lounge. But the pool's off. So we know what the pool's pulling… That [the display] is the best indicator out, because you're physically seeing, without having to go out to the box, to say, 'oh, it's not going round so fast now.' So yes, that's been very good.*
>
> Interviewer: *So that impacts on you turning things off?*
>
> Sally: *It can, yes.*

The feelings are not always positive, though; they can be relative. For example, Sally explains the periodic worry as the energy use from her pool is highlighted; and then the joy when the pool pump turns off:

> Sally: *…I've got that monitor that's connected to my electricity board, and when the pool is going, I'm over a 1000, and I think, 'oh god, if only I could turn it off.' So then, when it's*

> *finished and it stops and it comes down to 400 odd, I feel so good."*
>
> *I notice it when the pool's on because that is the thing that's drawing the power, because it's got a pump. It draws quite a lot. Which is why I tried turning the pool back for two hours, instead of four. But I got told off about that. I might try three, soon....But, it is nice when it switches off, it comes right back to about four or 500. Which makes a hell of a difference because that just means the fridges are working, or the TV's working, or something.*
>
> *When the air conditioner's on, it does go up around this area again. But, it's a tossup between bill paying or comfort. I go for comfort every time. I put a 100 a fortnight on my electricity bill, and I'm always in advance… So, I don't feel bad about that. Because something like the air conditioning is more important to me than the pool. It's just when the pool goes green that I had to worry.*

The energy monitor may or may not lead to participants changing their own energy practices. In Sally's example, she tried to reduce the energy used by the pool, with negative consequences for the water quality. Whereas, the awareness of the energy used for an activity that she values highly - her comfort in hot and humid weather - is not worrisome, as she is choosing thermal comfort, in the knowledge that she has the money to pay for staying cool.

Joe (70s, retired, Illawarra) had a different in-home display in his home as part of the intensive monitoring research component of the project. He had specifically asked to have one of the displays in his home. He had noticed higher energy use in winter compared to summer, but was not sure why this would be the case. He had also used the display to investigate spikes in energy use.

> *Joe: I check it every now and again to see what the daily consumption has been, and if there's a spike I try and find out why; I've only ever had one spike and it was one of the nights the fridge door came open and it spiked big time, big time. In fact, it trebled and it showed up on that.*

In Joe's case, having the display has made him 'marginally' more concerned about his energy use, because "it's there. I mean it's under your face so to speak, under your nose so to speak. So you look at it and say, "Well, gee, I'd better be careful." Although, Joe saw this as a good thing, because he is concerned about fossil fuel use and future generations.

Greater awareness of energy use can have varying impacts on the householder.

Sally reminds us that women often are responsible in households for doing the work of energy saving (Organo et al 2013). Sally said:

> *Sally: … that is what's in the forefront of our minds, you know, that, they're all, all the kids are the same. Whether they're 40, or 10, they're all of the same mind. It's something that's there, that you don't consciously think of. And we have to try and nag them into the fact that it is something that costs. Either the electricity or the water, is costing.*

Sally has always been one to turn lights off: "Being sensible with stuff, I find, is enough for me. That, alright, I go round and turn TVs off, I turn lights off, and what have you…" The project reinforced these practices:

> *Sally: I think [the project's] instilled in me that to do it is better than not. Because I'm consciously trying to save on power bills, and that. So it does make a difference.*

The in-home display encourages Sally to turn off appliance to save energy, even if others in the home act differently.

In Joe's example, the project overall making him more aware of his energy use, has made him frustrated "because I can look at things that can be done; I can't do anything about them and it's frustrating". Although not specifying the display unit as a source of his frustration, this example shows that greater awareness is not necessarily positive if the householder cannot effect change, either due to not being in control of the building, or for financial reasons.

How people put to use the energy display meter must be understood in the socio-technological context of the individual home. People react to the information in a range of ways, which can have positive or negative consequences for themselves, and they may or may not reduce the energy used in their home.

Support in using in-home displays

While some participants seem to have been easily using their displays, it became apparent during interviews that some needed more assistance to set up and use in-home energy displays. Without this support, the displays may be ignored, if not from the start, as soon as something goes 'wrong' with them, such as being reset after a blackout, or if they need to move appliances. Information, including written reference and ideally some form of follow-up needs to be provided if continued use is to be made more likely.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

In combination with existing air conditioning, new ceiling fans and lighting, the in-home displays provided an excellent opportunity for occupants to discover and compare quantitative electrical consumption of fans compared to air conditioning, whilst also comparing the efficacy of cooling of these appliances.

4.2.14 Co-benefits arising from interactions between project team and participants

Qualitative research is imperative to bridge the perceived gulf between science and social science research on energy efficiency policy. Measuring the physical attributes of the building and electrical appliance is important. However, this can render people as static, essentialised and passive. Qualitative research is essential to unsettle the dominant narratives and representation of energy efficiency in the policy realm, which tend to privilege prediction, cost-benefit analysis and quantification. As part of our project we turned to qualitative research methods to better understand domestic energy use within its human context. We drew on semi-structured interviews, and home-tours. Through these methods we could better understand the different ways that energy was enrolled to make, and re-make rooms into homes through reflecting upon concerns and ideas, and showing us a range of practices. These practices varied from opening windows to maintain flows of fresh air, to vacuuming dog hairs, to placing and rotating food within fridges. The domestic energy narratives people shared with us challenged dominant policy ideas of energy efficiency as productivity; that is doing the same with less. Instead, the qualitative methods revealed how knowledge of domestic energy is acquired through lived experiences from the past, shared ideas of generational difference and everyday interactions within their homes, through making cups of tea, preparing meals, watching televisions, taking showers and caring after their often ailing bodies. Qualitative methods enrich more than scientific modes of knowing energy policy.

Many insights were gained during the visits that were made by project team members at various stages of the project. The following are a few examples where project interactions with participants have had a significant effect on energy efficiency outcomes.

Insight 4.9 Interactions between 'researchers' and householders – conversations count.

Interactions between 'researchers' and householders – conversations count

The project success is part due to personal and ongoing interactions with project participants.

- A substantial number of participants do not use a computer, or use one to a limited extent. They would be unlikely to come across government or other advice around household energy efficiency online.
- Paper newsletters posted to participants were well-valued by *some* participants, and some even shared them with others.
- The combination of expert technical advice with personalised context, in discussion with the householder, in their home is critical to identifying energy efficiency upgrades likely to succeed in an individual's home.

Being involved in the overall project over a period of time, rather than it being a 'one-off', and having the intensive monitoring equipment as a physical reminder, helped one participant be more aware of her energy use. Although she identified strongly as being from a generation that needed less advice about energy use than those of her children and grandchildren, she now performed more of the actions that she knew she should, such as put on a jumper before turning on the heater.

Personal interactions are also likely to be more effective when introducing something new. For example, although many people used the thermometer that was posted with a newsletter, fewer participants made use of the remote control power socket. For some, the remote control power socket remained in its box. For others, the power socket provoked various questions Some questioned if it would interfere with the project monitoring equipment. Others were stumped by the question of instalment. And, yet others put the technology aside for later consideration. These results highlight how technology interventions alone do not work alone. Older low income households cannot be assumed to be adopters of energy efficient technologies.

The 'personal touch'

Several participants provided positive feedback on the time taken to explain what was happening in the home, to answer questions. Several noted the punctuality and politeness of project staff, and tradespeople cleaning up after themselves. For example, Sally (70s, retired, living in the community, Shoalhaven) mentioned the utility of having someone change her lightbulbs:

> Sally: *I was very pleased when they changed all my light bulbs. We did a lot of cleaning that day. Because as he got them down, I had to clean them all...All the shades, before they went back up, they were disgusting. Especially the one in the kitchen, because that one collects all the bugs. I'd kept looking at it, 'oh, I must do that one day, must do that one day.' Well when you've got a fellow going up ladder to change the lightbulb, we will just do the cleaning while you're here. So he had to help me by cleaning up as well. So that was very good as well.*

The negotiation/consultation phase of the project is incredibly important due to a number of resistances to changing domestic energy practices. Some of these resistances are specific to the older low-income cohort including: ageing bodies; generational practices of thrift; resistance to new ideas by some, embodied routines, stage of life cycle and heightened sense of vulnerability. Project examples show that people's own experiences can matter significantly despite the advice received. For example, Rex and Marina would not be swayed on the benefits of insulation. And Helga (70s, retired, living in the community in the Illawarra) would not accept a solar hot water system. Helga explained that:

> *Helga: I've had too many bad experiences. My sister had one that was hopeless. A friend of mine had one – he got it removed. And I said, no, don't want it. I said, if you give me the panels on top, the whole lot with it, I said yes. But only the hot water system, no. I'm on my own – how much hot water do I use? I said, nah, don't want it. Nothing but problems with it. My sister lived in Queensland, and you know how much sun there is in Queensland. And when I came back when I visited her, and I came back from Sea World, sweaty, and the first thing she said, 'I hope you don't want to take a shower'. I said, 'what do you mean, of course I need a shower?' She said, 'oh, I need a booster'. Well how good is it to me, living in Queensland, to take one shower you need a booster in the afternoon. I said, no thanks, don't want it. No good. Whole family, maybe, but not for myself. I said, I'm inviting trouble, and I don't want any trouble…*

When asked:

> Interviewer: *So it's more important to you to know that it's going to work, is that what you mean? So you've got something and you know it's working, so don't change it – is that what you're thinking?*
>
> Helga: *Yeah. Don't touch it. Look, the saying is, if it works, why change it? If it uses a bit more, all right, I have to pay for it. And I'm in an age where I want my comfort. I'm used to what is there, I know what it's doing."*

Here Helga referred to the importance of how energy is used in making home comfortable in older age. Helga highlights that how places called home are made and remade reply on experience, a sense of control, and familiarity with domestic appliances. Combined with the negative experiences of other people's solar systems, she did not accept the advice of the project team to install a solar hot water system.

Trust is central to the installation of energy efficiency retrofits. Mechanisms to build trust cannot be over-emphasised. This goes beyond the demands of Human Research Ethics Committee that requires informed consent and management of potential harm and risk. The personal touch is key for energy efficiency retrofits with older low-income households.

Our trail suggests that security, both physical and financial, is a significant concern for many older low income people. With this in mind, some participants found parts of the consultation process unsatisfactory.

For example, one participant reported finding the consultation and negotiation around energy efficiency upgrades very stressful and upsetting. Being wary of scams, she was very concerned on receiving in the mail the letter offering various energy efficiency upgrades. Even though she was 'quite confident about what I was doing' and had had a phone call about the upgrades before receiving the letter, its expression and language, such as about liability, made her 'stressed'; 'the paperwork upset me terribly'. She had visited her daughter to discuss it, and then rang the project contact number in the letter to find out more. The experience with the paperwork had flow-on effects as it contributed to her being 'nervous' about other aspects of the project, specifically the people that were coming to her home to install the upgrades. Having also heard on the radio warnings about people in bushfires being taken advantage of, she rang the project team to check on installers' qualifications.

At least one couple mentioned the concern of family members at first on hearing about the project, and were wary of parents being taken advantage of.
Working out who in the project to contact for a particular issue can be difficult for a participant, particularly if they have a concern. One participant a suggested a diagram to show the different project partners (and staff working at each organisation who contact the participants) and their responsibilities – particularly between Project management, UOW and installers. This can be important if a participant has concerns about one part of the project, but not other parts – greater transparency may well lead to less tension – or at least clearer understanding and greater confidence from the participant.

The anticipations of what was going to occur with an installation/replacement appliance required careful management. For example, one participant was adamant that she said she would only accept one brand of appliance; and had argued with someone from the project team who said she had signed to accept a different brand. Another participant said he was not aware that the freezer that was going to be replaced would be removed; let alone on the day of the new one being delivered. It was full of meat and he had been considering giving the old freezer to someone else.

In addition, it is worth reflecting that the project is only one part of participants' life and home. Participants have been dealing with many people, in person, on the phone and via written documentation, and are most likely not keeping track of who all the different people and organisations are within the project. In particular, for participants with intensively monitored homes, they have given a level of control of an aspect of their home to researchers. Participants can refer to the cables and equipment in ways such as 'all that stuff back there'.

On occasion there was some confusion about what was theirs to keep as part of the energy efficiency upgrades, and what was project equipment; or what was project equipment that was there for their use.

- For example, Dana had been supplied an energy monitor as an upgrade, however did not realise that this was for her to keep, even though presumably this would have been in the documents she signed. She reported that an electrician had replaced the previous monitor with this one, but that the electrician didn't explain anything to her about why this was happening. So she saw her monitor as part of the research equipment.
- In another home, Tod and Jenna (retired couple, 70s, living in the community, Shoalhaven) had not looked at the display that was part of the monitoring equipment over the many months it had been sitting next to their kettle, as they didn't realise it was there for them to make use of. Instead they saw that spot in the kitchen as a good location as they would be unlikely to disturb it there.

Recommendations:

- Projects need to have sufficient resources to staff a central point of contact for participants, and provide transparent information about all partners involved in the project, and their respective roles.
- Consultation needs to be slow and clear – recognising that elderly people (and others) can

be overwhelmed, or need to go over the details of the written paperwork that they sign.

- Confirmation of what is going to happen should occur at different stages, especially in cases when there are time delays in items being delivered or installed
- Project members liaising with participants should not assume the participant has the same understanding about what is occurring. Instead, the team member, including installers, should always reiterate the information about the stage of the project, where they fit in, and what is happening now, and confirm that the participant is understanding of and satisfied with this.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

Some other benefits and issues arising that arose from interactions with participants during home visits by the project team included the following.

1. **Self-funded retrofits triggered by participant interactions with the project team.** It is estimated that around 40 to 50 participants reported in their 'consultation visit' that they had either made substantial changes to their behaviour or made one or more technical improvements to their home as a result of their Building Characterization Audit visit. This very positive anecdotal evidence suggests that participants and the project team were engaging in a very productive manner. Once the value of a change was demonstrated, many participants took the initiative to grow the benefits by implementing multiple cases. Often if we installed a ceiling fan or remote-controlled standby isolation switches, residents purchased more of their own. One participant installed honeycomb (cellular) blinds after these were discussed during their audit visit as an option and then, after the later blower door test, they independently sealed up some simple, significant window air leakage paths that were highlighted. As reported by one of the project team, "The audit is as much an intervention as anything else we did in the program. We're showing them their own home through a different lens."
2. **Expectation management**. As was foreseen prior to the trial, there was a wide range of responses to the energy efficiency retrofits on offer. Some participants were delighted with a single light bulb, while others remained disappointed after multiple, major retrofits. The overwhelming majority were very positive. With a wide range of retrofits and budgets being trialled it was important to set clear expectations with participants. However, it was very difficult for the broader team of Building Characterization auditors to convey the scope/limits of the program to participants. For example, several participants had set their minds that they were going to get a new oven, despite this never being considered as a retrofit option in the program. It was difficult to counter this disappointment. It should be noted that no matter how clearly expectations are expressed, some people will only remember what they wanted to hear. One ILU household tried to claim the increased capital value of the property from their aged care provider and withdrew from the project when they were unsuccessful in doing this.
3. **In-home interpretation of temperature sensor data**. During visits by the project team to download data from the iButton temperature sensors, team members took time to show participants the temperature variations in their living room over the past year. This helped maintain a sense of participants owning their data and being engaged in the project

outcomes, and had similar educational and awareness raising outcomes for participants' knowledge of influences on their thermal comfort as the role of in-home energy display did for their knowledge of energy efficiency.

4.2.15 Retrofit insights: participant and team member experiences and reflections

The wide range and number of insights gained from the cumulative interactions of project team members with participants, including particularly the initial and final ethnographical visits, were crucial to understanding the true success of the various retrofits and other processes in the overall project.

A key outcome and insight from our project, and that should play an important part in informing government policy and delivery of future programs, is that the success of each retrofit should be judged holistically, and in context of the everyday lives of householders, not just judged from the point of view of quantitative technical performance.

4.2.15.1 *Barriers and prerequisites to adopting retrofits*

Low-income older Australians are experts in a "waste not, want not" approach of making the most of what you have and this comes with a deeply held reluctance to throw anything away while it still works. Sentimental attachment adds to this barrier, especially for fridges, as one participant shared, *"my 2nd refrigerator in the garage was the 1st one we bought when we were married. It is a Kelvinator and it's still going after 49 years. … we keep other frozen things in it, soft drinks and alcohol. … And I think the older fridge is cooler and keeps the food fresher. Everything is so chilled and beautiful when you get it out".*

A retrofit is likely to be well received and have a positive impact if the following issues are addressed:

a) Familiarity and understanding: if the participant is made clearly aware of the benefits and they are well understood;
b) Desire: the retrofit is desired by the resident to fulfil a role or need in their life;
c) Provision: an appropriate means is provided to procure and implement the change.

This insight is a particularly important guide in a householder-centred retrofit approach and it is encouraging to note that the means for 'provision' is already significantly being taken up independently by participants installing their own retrofits, who clearly have developed understanding and desire.

4.2.15.2 *Trust*

Trust was perhaps the most significant factor in how the participants received the improvements. Where trust in both the relationship and in the technical advice were high, participants tended to readily accept the recommendations of the project team, but where trust was not as high, recommendations were treated with scepticism, more information was sought and further consultation effort was required. For example, the installation of ceiling fans appears simple as a rollout option, but required attention to details such as location, aesthetics, lighting and control.

Demonstrating good technical knowledge and consideration for suitability for each household built trust and efficiency. The good reputation of the University of Wollongong and Macquarie University in the community was a significant factor is establishing trust with participants. This level of trust increased further over the course of this project. Responses within the aged care provider ILUs was mixed and correlated strongly with levels of satisfaction of the residents with their ILU provider. Where high levels of satisfaction and trust already existed, the whole program was most readily supported. Where trust was not as high, negotiations around particular retrofits were mixed with expressions of discontent. Some participants expressed a scepticism and wariness that the LIEEP program was in effect "too good to be true", but this was more than offset by the good standing of universities in the community.

4.2.15.3 *Perceived increases in feeling of affluence and pride*

As discussed in previous sections, participants' feelings of increased affluence and pride were recorded in several consultation visits around particular retrofit offerings, with solar hot water being very positively received, and in contrast general indifference to pedestal fans. Such feelings served to help overcome other barriers to adopting retrofits.

4.2.15.4 *Installation contractor handover to participants*

A well-managed handover from the contractor to the household should give householders the chance to become familiar with the controls and operation, with a hands-on demonstration, of the retrofit at their own pace, where they get to operate it themselves. Many participants with existing air conditioner systems said words to the effect that their thermostat setting was set by "the air conditioner man when he installed it", and they had not changed the thermostat setting since.

An example of good practice in this issue was the process developed for handover of in-home energy displays. The electrician asked the participant for pricing information from their bill, and then entered the information in front of the participant. The kettle would then be turned on and off and perhaps the fridge observed cycling on or off. These simple steps gave the participant a sense of "this is my personalised information for me to use." Good engagement during a handover provides more surety of a good outcome by instilling a sense of ownership in the participant.

Insight 4.10 Retrofits that may compromise perceived home comfort: the examples of draught sealing and fridges.

Retrofits that may compromise a sense of home: the examples of draught sealing and fridges

Energy is enrolled in different ways to help sustain places as home. However, energy efficiency retrofits and making sense of home are not always aligned in the context of home life. For example, participants spoke of how draughts worked against a sense of home As Dana (70s, retired, Southern Highlands) explained, insulation and draught seals around doors can be of great benefit to older people who are often sitting, for long periods at home.

> *…for older people, draughts can be very debilitating. We don't move around as much, so we don't, you know sitting around, it's very depressing if you're just sitting in a draught all the time.*

But home security is also central to making and sustaining home. For one participant in the project, the poor installation of draft sealing worked against a sense of security that is integral to making a house a home. As such, he was not entirely satisfied with the door seals that had been installed. The door seal worked against possible draughts but also worked against latching the door properly. He appreciated the reduction in draughts and rattling; however the door was made more difficult to close properly. At times the door remained unlocked when he and his wife had thought it was locked – it could easily be pushed open. Although the participant did not subsequently remove the door seals – he became alert to the problem– it is possible that other people in a similar situation might do so.

A second example of how retrofits may comprise embodied notions of home is illustrated by Jake's (70s, retired, lives alone in home in the community, Illawarra) rejection of his new fridge. This example brings to the fore the importance of routine storage practices and taste in how people enrol energy to help sustain places as home. Jake had turned off the new fridge and was using his second fridge in another room to store all his food. Before the new fridge arrived, he'd made space in the kitchen for it (moving the second fridge to another room):*"the new one I thought oh yeah that'll be a beauty, you know, so I set it up."*

However, after a few days he switched off the new fridge as he wasn't happy with it. He plans to move the second fridge back into the kitchen. When asked why he was dissatisfied with the new fridge, he talked about how in the new fridge the items have to be closed-up, otherwise they dry out; contrary to his experience with his older fridge where he finds he can leave things uncovered. In earlier interviews Jake had been quite specific about various second-hand fridges he had bought and his view of their superiority over newer, frost-free ones. Jake said:

> *It's [The fridge] ancient. I bought it four or five years ago second hand. The old type of fridge because I like the old type ones. The big modern ones, they dry all the food out.*

Refrigerated food is embedded in embodied understandings of freshness. Working against energy efficiency in this case are the different tastes and practices demanded of living with a new refrigerator. Perhaps in this case acknowledgement of the practices of food storage, taste alongside the new fridge specifications prior to the retrofit would be more likely to lead to satisfaction and therefore use of the new, more efficient fridge.

Inside Jake's old fridge, Dec 2014.

The examples of the door seals and Jake's fridge also indicate that provision of a resource or retrofit does not guarantee uptake and therefore achievement of a policy objective, in this case reduction of energy use. Often competing resistances only come to the fore once something has been installed or put into practice. The more these resistances can be anticipated beforehand, and accounted for in consultation or negotiation phases of a program; and checked, for example awareness of the importance of security on the part of draught seal installers, the more likely the ultimate policy goal of energy reduction will be realized.

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

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5 COMMUNITY TRAINING TRIAL

5.1 Methodology

The aim of the community training activities were to achieve an upgrading of skills of householders to increase community connectedness and empowerment through using digital media tools, techniques and information provision in ways that older people access information. The original intention was to reach over 500 householders through these activities to help influence and positively affect household energy efficiency behaviour without sacrificing thermal comfort. Consortium member WEA Illawarra fulfilled the design and delivery of the training program led by key personnel including Kerry Smith and Graham Neville.

5.1.1 Program design and structure

The design and structure of the training program was informed by the results of formative research sessions and insights gained from the initial ethnography visits that were carried out by UOW researchers. These insights allowed trainers to respond to fresh findings that were relevant to how older residents in the Illawarra region may prefer to receive information about household energy efficiency. The initial Energy+Illawarra newsletter, website and other resources developed for the social marketing trial were utilised in the training activities which enhanced the material developed specifically for the training program.

Taking this responsive approach required a great deal of flexibility by WEA Illawarra to ensure that the programs worked with, and were complimentary to, the retrofit and social marketing trials. It was recognised that there was a high risk associated with the training delivery given that a large part of the content and delivery method were planned to be influenced by insights gained as the social marketing and retrofit trials progressed. It was assumed that this risk would be overcome and managed through continuous ongoing communication between trials.

Overall it was deemed important by consortium members that the reach of the project be extended, that is, project outcomes were to live beyond the project timeline to encourage ongoing dialogue and change within the Illawarra region. Bearing this requirement in mind, a three-tier approach was developed as follows:

Tier 1: Community information sessions

Information sessions were planned to cater for up to 20 participants per session across the project area. It was initially planned for these sessions to be conducted within a 2-3 hour window, which included morning or afternoon tea. The duration of these sessions was revised on an as needed basis depending on the level of interaction that the trainer was able to achieve during the sessions.

Tier 2: Champions program

The Champions program was to cater for 15-20 participants at a time, and was a full 2 day course for participants from Tier 1 who self-identify as being interested in attending more detailed energy efficiency training and be able to utilise digital resources to help them further influence other community members or advocate on behalf of community members for positive energy efficiency outcomes. This program was to include a digital technology introductory session.

Tier 3: Up skilling advocacy organisations and aged care providers

Provide training and work-skill instruction to volunteer or employed staff within the aged care sector whose sphere of influence includes colleagues and clients. Recruitment focussed on individuals who have the ability to help bring about behavioural change in domestic energy use because of their existing influence and regular opportunities to impart knowledge to others during their day to day duties. This was an accredited program using three nationally recognised units of competency: Make a presentation (BSBCMM401); Provide work skill instruction (TAEDEL301A); Mentor in the workplace (TAEDEL404A). These were to be delivered to a background of energy efficiency ideas; for example, the subject matter for all assessment tasks was to be household energy efficiency and thermal comfort. It was planned that participants would be split into 2 groups and that training would be completed in 5 days over a number of weeks. Time was also required for trainers to assess each participant in order to gain accreditation.

5.1.2 Recruitment

Recruitment of this cohort came from the general community and other specific target groups. It was recognised that there would be increased risks associated with having a separate recruitment for Tiers 1 and 2 of the training program. These included:

- The data being collected for these participants would be predominantly qualitative
- It may be difficult to collect contact details and/or gain project consent forms for the Tier 1 participants
- The number of people engaged in the community through the Tier 1 program may not reach 500 or manage to engage across the whole project area due to the additional cost and effort associated with conducting a separate recruitment process
- If there is a low rate of participants in Tier 1 then this would directly affect participation rate in Tier 2

The above risks were weighed against the risks associated with redesign of the social marketing and retrofit trials. A decision was made that modifying the approach for the training could still achieve substantial and beneficial outcomes for the project even if the above risks were realised.

The approach to recruitment for each Tier is described as follows:

Tier 1: Community information sessions

The aim was to recruit a total of 500 participants sourced from established local networks, e.g. U3A group contacts, Legacy membership, residents at aged living villages as well as dates being advertised in the WEA Illawarra Term Course Guide, the Energy+Illawarra website and via consortium member networks. Dates were to be set and venues organised for 25 sessions. It was requested that people who wished to attend would register via phone prior to the session so that seating and refreshments could be prepared.

Proactive recruiting took place in various locations where it was judged that people aged over 60 years old may meet and would be receptive to being approached. This included a stand at Wollongong Disability Expo and individual representations to the following local clubs, community centres and retirement villages:

Collies Club Wollongong
Collies Club Balgownie
Corrimal Leagues Club
Wests Leagues Club
Warrigal Village Warilla
Figtree Bowling Club
Windang Bowling Club
Wiseman’s Park Bowling Club
Master Builders Club
Bellambi Neighbourhood Centre
Legacy
Catholic Care
Scarborough/Wombarra Bowling Club
Basin View – local retirees
Berry – Berry Arts Centre
Corrimal Neighbourhood Forum
WEA – Senior’s classes
Wollongong Golf Club – Local Government
Retirees Superannuation meeting
Mittagong RSL

Tier 2: Champion programs

The aim was to identify a total of 30 champions to attend this program. These 30 would be “graduates” who self-select from the Tier 1 program and were interested in learning more and promoting energy efficiency.

Tier 3: Accredited program for workers with a relevant sphere of influence

The aim was to identify 30 members of staff, either paid or volunteer, from the aged care sector to complete and gain accreditation in skills with a particular focus on energy efficiency.

5.1.3 Delivery

Tier 1

Twenty-one courses were scheduled and advertised utilising the Energy+Illawarra brand. The drawcard was the offer of free workshops which would help people save money on energy bills, bust myths about energy use and give people an opportunity to discuss how small changes can make big differences to energy bills and thermal comfort.

These sessions were poorly attended. Feedback was gathered from some of the few participants that did attend, as well as those that didn’t attend and were happy to explain why they weren’t interested in attending. Reasons for not attending included the fear that these sessions had been arranged by an energy retailer. Others stated quite clearly that they already have sufficient information about energy efficiency. This information was considered and a revised approach was planned for the Tier 1 program. A further 10 sessions were scheduled titled “Energy + iPADs” which were advertised as free iPAD training for over 60’s. The course utilised the Energy+Illawarra website with exercises that required participants to find answers to specific energy efficiency questions. WEA Illawarra provided iPADs for use during the 3-hour sessions.

It was decided that the insights, narratives and comments being collected during the proactive field recruiting was valuable qualitative information for the program, therefore this was continued over a 6-month period in parallel to the roll-out of the training program.

Venues for these sessions were mainly at WEA Illawarra premises, however some were conducted at other consortium member’s facilities.

Tier 2

Tier 2 courses were to be scheduled and delivered as names were gathered from the Tier 1 courses. Unfortunately, due to the poor registration and attendance rate for the initial Tier 1 program format, no attendees were recruited for the Tier 2 program. By the time the Tier 1 program was redesigned, the project did not have time to roll out a Champions program. This fact was also considered when redesigning the Tier 1 program to the Energy + iPADs format and recruitment process in order to utilise the training budget appropriately.

In summary, no Tier 2 courses could be delivered due to lack of interest.

Tier 3

The accredited training program was offered to organisations that had staff who provided aged care services within the project area. This included our consortium members who were either aged acre providers themselves, or who had direct contact with organisations that had volunteer staff who worked in the industry.

The course was delivered to three groups, with two of these groups attended by staff from Warrigal.

5.1.4 Evaluation Methods

Success of the training programs was intended to be measured by comparing a participant's skills and knowledge prior to training to the skills and knowledge after they had attended the programs. The original design for the project was for much of this data to be captured via surveys. However, after redesigning the training program it was agreed that evaluation would be accomplished in the following ways:

- Collation and review of comments captured at Tier 1 courses
- Collation and review of comments captured during the proactive field recruitment
- Review and summary of student evaluation sheets collected at Tier 1 and Tier 2 courses
- Analysis of registration and attendance numbers at all training courses

5.2 Results

Tier 1 – Energy+Illawarra Workshops

Twenty-two courses were scheduled at a variety of locations including village facilities at Warrigal and IRT Group as well as WEA Illawarra. Residents at the facilities were invited via a letter-box drop. Potential attendees were requested to register with WEA prior to the day of the workshop, however in many cases there were no registrations and therefore the workshop was cancelled. A total of 9 people attended these workshops and only a few chose to leave their contact details.

Tier 1 - Conversations

Attempts to interest or recruit seniors into the Tier 1 workshops as originally designed were largely unsuccessful. However, it was decided that the energy efficiency conversations that were initiated during this proactive recruitment process provided some useful insights and so were pursued with over 200 seniors at the clubs and other venues where the target cohort regularly attended for meals, recreation and social activities.

Energy + Illawarra newsletters were distributed at these locations and conversations on energy efficiency introduced.

Contact details were not obtained from these participants as it was judged that it would be invasive and likely to reduce any level of trust that would be established and limit the conversation - especially when the team member had joined an existing group conversation uninvited. The result of this was that there was no follow-up available. However, project team members who engaged in this manner prepared reports on their observations and experiences. A total of 233 individuals were engaged across 19 venues.

In general, it was observed that many of those aged 60 and over had a relatively high level of knowledge about how to manage their energy use in their home. The topic was not new to the majority of the contacts and they freely discussed ideas and strategies they had employed over the years and enthusiastically compared them with the ideas that were introduced by project team members. Their level of interest outweighed the odd case of cynicism and while they accepted the need to continue with their practices, their overwhelming interest in the topic related to the education of their children in sensible and economic practices.

The Community Training team provided the following anecdotal feedback:

- In some conversations it was found that energy efficiency to not be a priority. The subjects of most concern were matters over which the individual has no control, but which seriously impacts on their lives. Rents and rates were seen as a bigger impost than the energy use and remain an on-going concern. The most unexpected issues raised in these conversations related to trees. There was a depth of hostility toward trees. Individuals, who had moved to an independent living facility, or who are still in the home they built/purchased decades ago, were now contending with mature trees. This was thought to be beneficial in summer, but created unwanted shade in winter, leading to a cold home and additional heating costs. It was conveyed that even in summer the shade from large trees affected clothes drying and the leaves/branches clogged gutters and drains for which they had to pay to clear.
- There were serious concerns raised by those in apartment living. They considered themselves the most vulnerable as they believe other tenants impose energy costs upon them.
- In general, there was little interest in talking about fridges, washing machines and dryers as the bulk of people stated they were knowledgeable about the star rating and energy use and saw no reason to discuss the matter. The majority had no intention of replacing such equipment in the near future, being happy with what they had, or unable to afford replacements, even though they appreciated the cost benefit.
- There were recurring conversations about pensions, government charges and “prices”. Superannuants feared government attempts to rob them of their savings. The pensioners feared pension cuts and being unable to keep up with the cost of living. They were not so much worried about energy costs, as they were the price of food. The fluctuation in petrol costs was often quoted as an even more serious cost imposition, because it impacts on everything they do, or need.
- The majority appeared to be satisfied with their life and are living in what they consider to be reasonable comfort. They accept they have no control over price rises and believe the efficiencies they may make via our advice and encouragement will be offset by the unknown.

- Most people did not want to listen to advice on energy efficiency, they wanted the project team member to listen to them about their energy efficiency practices.

Tier 1 – Energy + iPADS for seniors

Five sessions were scheduled and advertised with the following attendance:

Date	Number Registered	Number Attended
18 Aug 15	7	7
8 Sep 15	3	3
30 Oct 15	10	6
26 Nov 15	10	7
27 Nov 15	10	5

Participants in the various activities associated with Tier 1 activities were informally asked if they were also involved in the surveys that were being conducted by the other trials within the project. WEA reported that there was no cross over in the trial participation even though there was direct marketing contact made through letter box drops at the facilities where known core participants resided.

Tier 2 – Champions program

The unexpected lack of interest in Tier 1 workshops by the Illawarra Region's seniors resulted in an absence of possible Tier 2 recruits. As a result, some of the training resources planned for this activity were diverted into the Tier 1 Conversations delivery.

Tier 3 – Up skilling advocacy organisations and aged care providers

As previously mentioned the Tier 3 component covered the presentation of three Units of Competency from the Certificate IV in Training and Assessment.

The particular combination of Units of Competency was chosen for its potential to improve participants' basic facilitation skills and provide them with an increased confidence in their dealings with staff and residents. Such dealings may be general conversations, or responding to specific questions of concern and with this training, the required information and/or direction will be provided in a more complete manner, with real outcomes possible. To date there have been three groups:

- Group one comprised 2 participants from The Illawarra Forum's membership, with classes and assessments completed by 28 October 2015.
- Group two was comprised of 12 participants from Warrigal and was completed in February 2016.
- Group three commenced in December 2015, with 3 participants from Warrigal. This was completed in March 2016.

5.3 Discussion

Tier 1

Unfortunately, it is not possible to obtain a quantitative measure for outcomes from the conversations conducted in the community as part of Tier 1. However, some of the comments collected provide useful insights. For example:

- People do not freely talk about or share their energy efficiency practices unless they trust the other parties involved
- The concept of energy efficiency or even cost of energy efficiency in the home is not a priority compared with the pension, superannuation or other costs of living. That is, it is rare that energy efficiency would be front of mind for this cohort

Based on the observations, conversations and direct feedback, the lack of success of recruitment into the original Energy Efficiency Workshops as part of Tier 1 compared with the relatively well-attended "Energy + iPADs for Seniors" could be put down to:

- Energy Efficiency Workshops were solely linked to the effectiveness of a minimally resourced recruitment process for the community training program with no clear "hook"
- The enticement of acquiring current technical skills, which can be applied for many other purposes, was more successful in attaining voluntary attendance and interest.

Tier 2

The Champions program was originally planned to include the Energy + iPADs component with more content and further technical skills. However, we were unable to assess the success of this program.

The clear recommendation from this activity is that a recruitment strategy should not be solely dependent on the recruitment success of another training program, especially where there are time restrictions for delivery.

Tier 3

This has been the most successful operation in terms of attendance and reported outcomes. The Tier 3 training has the potential to provide beneficial outcomes to Warrigal residents. Reports from Warrigal's Employee Relations Unit indicate there are already noticeable improvements in workplace relationships. The participants are each in an influential role within the organisation, either as Registered Nurses, or Cert III and Cert IV supervisors. As such, they have responsibility for the development of their teams and continuous improvement programs.

The training they have received will improve their interaction with staff and residents and as the units have been presented with an energy efficiency theme, it is expected that this topic will be a logical conversation piece in staff development sessions and in day-to-day interactions with residents.

The noticeable change of season in coming months will be an ideal opportunity for the Warrigal participants to interact with residents on energy efficiency actions that a comfortable but affordable lifestyle will require.

Additionally, two of the participants are the first point of contact with prospective residents and their families and the energy efficient practices endorsed by their organisation will be aspects of competitive advantage they will highlight.

It is expected that this energy efficiency commitment will continue with group three (within Tier 3), as it will comprise non-supervisory staff who have a daily hands-on responsibility for the well- being of residents in both ILUs and high care.

The results of the training will not be observable until the Autumn and Winter months of 2016 have an effect on resident's comfort, economics and lifestyle. The WEA have committed to pursue this over coming months while its trainers work with the organisation's staff on other training programs.

6 PROJECT MANAGEMENT

6.1 Project administration, operation and processes

The role of overall project management and administration was provided by RDAI and delivered by key personnel including Deborah Petkovic and Natalie Burroughs. However individual activities were planned and managed by the team or organization that was responsible for delivering that activity within the larger project plan. The processes and procedures relevant to each trial are provided below.

6.1.1 Overall Project

Project Management and Governance

A Governance Plan was created to document how the consortium would operate and make decisions. Consortium representatives formed a project steering committee who met for 2 hours at least once every 2 months for the duration of the project. This steering committee operated under terms of reference and set agenda items ensuring that budget, action items and progress were reviewed at each of these meetings. RDAI recorded and distributed minutes for each of these meetings.

The project management challenge was the coordination of activities being carried out by the separate teams/organisations and ensuring that all teams understood the impact on the overall schedule and scope if any variations were made or deliverables were delayed.

The initial overall project delays caused by Milestone 2 requirements and the resourcing pressures arising from this and other variations required an ever increasing effort required to review, assess and decide on the actions required to still be successful in view of LIEEP’s overall objectives. These variations are listed below, along with both the immediate and long term impacts to project deliverables.

Administration

The majority of meetings between consortium members were also attended by RDAI. A key project team meeting was held on a weekly basis and was primarily attended by research representatives from UOW and the RDAI project manager. These meetings became a crucial communication forum for the project. Towards the latter part of the project, fortnightly Executive meetings were held with representatives from RDAI and UOW in attendance to discuss progress and make any outstanding decisions to ensure timeliness and to complete on schedule.

Risk Management

Risks for this project were considered associated with:

- Project outcomes
- Financial
- Compliance and governance
- Staffing
- Technological

- Workplace health and safety
- Professional indemnity

Considerable attention was made in the assessment and management of risks associated with the installation of retrofits across the 185 work sites. Many of the project team members were unaware of the actions that would be required to adequately manage risks associated with home visits and installation of various retrofits. Additional training, procedures, and legal agreements were required to mitigate these risks, which had added unexpected costs to the retrofit trial.

Procurement and Contract Management

Each consortium member followed their own procurement policies and procedures where that consortium member was wholly responsible for delivering the activity. Where an activity crossed a number of roles, RDAI took on the procurement and contract management for engaging the relevant consultants and/or contractors.

The following consultants and contractors were engaged by RDAI:

Role	Method of procurement	Successful Applicant
Participant recruitment	Request for Quotation	I-view
Building characterisation audits	Request for Quotation	Viridis Australasia
Retrofit coordination	Request for Quotation	Viridis Australasia
Retrofit installations	Expression of Interest then Request for Quotation	Programmed Facility Management
Supply of fridge/freezers for retrofit installations and materials to support minor retrofits	Request for Quotation	Bunnings Group

Project Variations

Table 6.1 shows a summary of the major variations that had to be managed during the course of the project.

Table 6.1 Major project variations.

Timeframe	**Summary Description**	**Immediate Effect**	**Project Impact**
August 2013 to March 2014	Delayed commencement of core project activities due to Grant Funding Agreement requirements	Legal Agreement between all Consortium members. Unforeseen resourcing required to address risk management, governance and legal requirements. Delayed recruitment of key project staff by consortium members	Project design linked to activities occurring in particular seasons. Whole project timeline squeezed as initial tasks unable to be funded until Milestone 2 achieved
Nov 2013	Change in recruitment methodology	Time to arrange and instruct market research recruitment agency to generate	Delays in starting recruitment. Prolonged time to recruit adequate numbers resulted in

		study/intervention sample, and control group study sample. Effects compounded by the addition of control group	1st survey not being completed until August 2014. All dependent activities delayed
Nov 2013	Control group added for Social Marketing Trial	Increase of in-kind costs from UOW	Improved data analysis and evaluation for final report
May 2015	Draft Final Report deliverable required by CSIRO	Resource stress – no additional experienced resources available to deliver earlier	Distraction of resources from other project deliverables
July 2013 to July 2015	Repeated modifications of LIEEP database specification	Unable to change survey questions after 1st survey already completed	Many fields unable to be filled
Feb 2016	Removal of 3rd survey from project scope	Divert resources to analysis and evaluation tasks	Removal of persistence measurement – decrease in assurance of results

Each of the major variations tended to conclude in the deferral of deliverables, i.e. stretching of timelines. On reflection, further consideration could have been given to a reduction of scope in the variations that occurred earlier in the project timeline given the strict timeline and budget restrictions of LIEEP.

In hindsight, the resource planning for many activities was under estimated at the application stage. It was felt that this was largely attributed to the competitive nature of the grant funding process and the perceived pressure to provide more value for less funding.

Many research organisations have two approaches to estimating costs for projects depending on whether they are researcher-led or subcontracted research, and this was the case for UOW. During the grant application process, LIEEP was positioned as a researcher-led program where innovation and a trial approach were encouraged. However, the overarching governance and legal requirements of the program as well as the influence of CSIRO as the Department's research partner transformed this project into a subcontracted research project requiring significantly more administrative effort than originally planned. To address this funding shortfall, UOW provided significant additional cash and in-kind funding to fulfil their role in the project

6.2 Project Budget

6.2.1 Overall Project

While the project was able to deliver against the agreed scope within the LIEEP grant-funding budget, significant additional cash and in-kind contributions were required to achieve the outcomes. University of Wollongong, Viridis Australasia and Macquarie University primarily provided the additional in-kind contributions.

Table 6.2 Summary of overall budget and expenditure.

	Actual	Budget
GRANT FUND EXPENDITURE		
RDAI PROJECT MANAGEMENT AND ADMINISTRATION	350,000.00	335,000.00
EE3A CONSORTIUM COSTS	25,044.23	45,000.00
EE3A PROJECT COSTS		
1300 Number	0.00	2,000.00
Branding	0.00	5,000.00
Community Group Events	0.00	6,000.00
Event Sponsorship	0.00	5,000.00
Household Energy Assessment	98,842.00	60,000.00
Installation Hot Water Systems	361,046.00	327,000.00
Logo Development	0.00	10,250.00
Marketing Collateral	36,230.81	45,000.00
Participant Recruitment	19,373.00	20,060.00
Participant Incentives	47,385.96	60,000.00
Retrofitting Residences	250,000.00	250,000.00
UNIVERSITY OF WOLLONGONG		
Data Collection & Analysis	564,705.00	564,705.00
Recruitment & Formative Reseach	20,219.00	20,219.00
Sensor Equipment	177,200.00	177,200.00
Social Market/ Behaviour Change	242,503.00	242,503.00
UOW-Travel & Accommodation	5,000.00	5,000.00
WEA		
Training & Educational Services	79,898.00	97,510.00
TOTAL GRANT FUND EXPENDITURE	**2,277,447.00**	**2,277,447.00**
INKIND CONTRIBUTIONS (Consortium)		
All Consortium Members	185,730.00	53,100.00
Illawarra Forum	8,960.00	25,000.00
IRT Group	14,269.00	20,000.00
RDAI	27,900.00	22,000.00
RFBI	10,972.50	20,000.00
UOW	1,164,130.00	657,794.00
UOW/Macquarie University	57,912.00	0.00
Warrigal	15,655.00	20,000.00
WEA Illawarra	5,700.00	0.00
TOTAL INKIND CONTRIBUTIONS (Consortium)	**1,491,228.50**	**817,894.00**
CASH CONTRIBUTIONS (Consortium)		
Warrigal Retrofits	56,554.00	82,500.00
IRT Group Retrofits	14,428.00	82,500.00
RFBI Retrofits	34,906.00	82,500.00
TOTAL CASH CONTRIBUTIONS (Consortium)	**105,888.00**	**247,500.00**
CONTRIBUTIONS (NON-CONSORTIUM INKIND)		
Viridis	135,379.00	0.00
"Other"	0.00	130,250.00
TOTAL INKIND CONTRIBUTIONS (NON-CONSORTIUM)	**135,379.00**	**130,250.00**
TOTAL CONTRIBUTIONS (CASH AND INKIND)	**1,732,495.50**	**1,195,644.00**

In-Kind and Cash Contributions

All cash and in-kind contributions were reported and reviewed at each project steering committee meeting. Each consortium member and project partner was required to submit authorised in-kind reports which detailed hours spent on specific project activities. These reports were audited as part of the annual financial report from RDAI for the project.

Over $530,000 of unbudgeted in-kind contributions from project partners were necessary to adequately complete agreed the deliverables. The majority of this additional funding was necessary to support the additional home visits that were required during the retrofits trial.

6.2.2 Cost estimates for future program rollout

The following tables show the estimated breakdown of costs associated with each of the trials.

Table 6.3 Trial cost level estimates - grant funds

	Cost level estimates (LIEEP funding)				
Trial Name	a. Total cost of delivering trial (in future no measurement, research or recruitment)	b. Cost associated with recruiting and maintaining participants	c. Cost of running an organisation to do a. & b.	d. Additional cost of participating in a government funded trial	TOTAL
Social Marketing Only	$ 28,967.78	$ 61,256.10	$ 72,664.87	$ 207,128.66	**$ 370,017.42**
Social Marketing + Retrofits	$ 796,791.35	$ 64,944.18	$ 195,744.62	$ 732,547.01	**$ 1,790,027.16**
Community Training	$ 39,949.00	$ 15,180.62	$ 39,028.58	$ 23,244.22	**$ 117,402.42**
					$ 2,277,447.00

Table 6.4 Trial cost level estimates – partner cash and in-kind funds

	Cost level estimates (cash & inkind contributions)				
Trial Name	a. Total cost of delivering trial (in future no measurement, research or recruitment)	b. Cost associated with recruiting and maintaining participants	c. Cost of running an organisation to do a. & b.	d. Additional cost of participating in a government funded trial	TOTAL
Social Marketing Only	$ -	$ 19,578.00	$ -	$ 160,960.15	**$ 180,538.15**
Social Marketing + Retrofits	$ 227,729.10	$ 13,052.00	$ -	$ 960,225.75	**$ 1,201,006.85**
Community Training	$ 3,100.00	$ -	$ 2,600.00	$ 23,824.50	**$ 29,524.50**
					$ 1,411,069.50

Table 6.5 Trial cost level estimates – total funds

	Cost level estimates (all funding sources)				
Trial Name	a. Total cost of delivering trial (in future no measurement, research or recruitment)	b. Cost associated with recruiting and maintaining participants	c. Cost of running an organisation to do a. & b.	d. Additional cost of participating in a government funded trial	TOTAL
Social Marketing Only	$ 28,967.78	$ 80,834.10	$ 72,664.87	$ 368,088.81	**$ 550,555.57**
Social Marketing + Retrofits	$ 1,024,520.45	$ 77,996.18	$ 195,744.62	$ 1,692,772.76	**$ 2,991,034.01**
Community Training	$ 43,049.00	$ 15,180.62	$ 41,628.58	$ 47,068.72	**$ 146,926.92**
					$ 3,688,516.50

Table 6.6 Trial cost level estimates per participant – total funds

		Cost level estimates per participant (all funding sources)				
Trial Name	Number of participants in each trial	a. Total cost of delivering trial (in future no measurement, research or recruitment)	b. Cost associated with recruiting and maintaining participants	c. Cost of running an organisation to do a. & b.	d. Additional cost of participating in a government funded trial	TOTAL
Social Marketing Only	459	$ 63.11	$ 176.11	$ 158.31	$ 801.94	**$ 1,199.47**
Social Marketing + Retrofits	185	$ 5,537.95	$ 421.60	$ 1,058.08	$ 9,150.12	**$ 16,167.75**
Community Training	45	$ 956.64	$ 337.35	$ 925.08	$ 1,045.97	**$ 3,265.04**

A cost per participant for each of the trials is summarised in the above table, however caution should be used in employing these figures to directly compare costs to other similar research. This is because these trials were always intended to have an integrated approach. All three trials had shared activities and many project team members fulfilled roles in all three trials. Distributing the costs for these shared activities can only be roughly estimated.

The following discussion further explores a breakdown of specific activity costs that may be more clearly applied for estimating the cost of future programs and expands on the assumptions that were made when compiling the generalised trial costs.

6.2.3 Focus on Recruitment Costs

As described in Sections 2.1.2 and 3.1.2, recruitment for the Social Marketing Trial and the Retrofit trial occurred at the commencement of the project during one activity. All those participants that were engaged in the Retrofit trial had already been recruited for the Social Marketing trial. The above tables have attempted to split recruitment costs between these two trials, however the figures presented include the economy of scale that was achieved which may not be possible if the Retrofit trial was carried out independently from the Social Marketing trial.

The direct costs of recruitment of an online control group (using a market recruitment consultant) for the social marketing trial were included at *d. Additional cost of participating in a government* *funded trial* and are distributed between the Social Marketing Only and Social Marketing + Retrofits trial figures.

The Energy+Illawarra project achieved a good recruitment result by using a market recruitment consultant. 830 participants were originally recruited as the intervention cohort over a period of approximately 2 months for a total cost of $24,746. It is estimated that the time taken for project staff to support this activity is valued at approximately $20,500. Therefore, we could estimate that recruitment costs using this method were approximately $54.50 /participant.

As was originally intended in the project design and methodology, all interactions with project participants contribute to the ongoing engagement of participants. This includes the visits to individual's homes to complete surveys, to carry out building characterisation and consultations, as well as the newsletters and social marketing material sent, and even follow-up phone calls to carry out quality assurance checks. Therefore, these interactions could be included at either a. Total cost of delivering trial or b. Cost associated with recruiting and maintaining participants. A rough estimation was made to split the costs between these two columns in the above tables.

6.2.4 Focus on Data Collection and Measurement Costs

Costs associated with data collection and measurement, including costs of ethnographies are included at *d. Additional cost of participating in a government funded trial* and distributed between the Social Marketing Only and Social Marketing + Retrofits trials;

6.2.5 Focus on Social Marketing Costs

Social Marketing is a research and practice approach to behaviour and social change, and measurement, recruitment and research are all integral components as per international best practice (Lee and Kotler, 2013; French and Gordon, 2015). In social marketing, recruitment, research, intervention, and measurement/evaluation – as well as programme implementation are all interlinked and interdependent. As such, no social marketing trial would ever be implemented without any measurement, research or recruitment, as these are always constituent parts of social marketing programmes. Therefore all costs from the Social Marketing project team are contained in *d. Additional cost of participating in a government funded trial* and distributed between the Social Marketing Only and Social Marketing + Retrofits trials.

6.2.6 Focus on retrofit budget

The retrofit budget was originally estimated based on the following assumptions:

- A total of 200 homes would receive retrofits
- 50 electric boosted solar hot water systems would be supplied and installed by a consortium partner at a discounted price
- 50 gas hot water systems would be supplied and installed by a consortium partner at a discounted price

- Approximately 33 participants would be recruited from each of our aged care consortium partners, providing 100 participants in the retrofit trial that reside in independent living units
- 50 ILU participants would receive a hot water system as a retrofit
- $2,500 cash contribution would be made by the aged care partners for each independent living unit that received a retrofit.

Ultimately only 55 ILU participants out of a total of 185 homes received retrofits with 23 ILUs receiving hot water systems.

The inability to accurately estimate the mix of participant type, i.e. ILUs vs homes in the general community created a challenge in that the total retrofit budget available was unknown until:

- all building characterisations were completed and all high priority retrofits recommended
- a schedule of rates was supplied by the head contractor for all possible retrofits that would be recommended
- All consultations with participants were completed as participants often didn't want the recommended retrofit.

Given the above considerations, the retrofit allocation methodology was developed with the overarching goal that every one of the original 200 homes would receive a suitable retrofit and that the total retrofit budget would not be exceeded. A detailed description of the Retrofit Allocation Methodology can be found at Appendix F.

Table 6.7 Retrofit expenditure

Retrofits: Grant Funds and Cash Contributions	**Actual**	**Budget**
Installation Hot Water Systems	361,046.00	327,000.00
Retrofitting Residences	250,000.00	250,000.00
Warrigal Retrofits	56,554.00	82,500.00
IRT Group Retrofits	14,428.00	82,500.00
RFBI Retrofits	34,906.00	82,500.00
Total	$716,934.00	$824,500.00

The costs associated with delivery of retrofits to 185 homes are summarised in the following table.

Table 6.8 Delivery costs of tailored retrofits

Delivery Costs of Retrofits	**Total Expenditure (including contributions)**	**Budget**
Retrofit management, coordination and additional visits	339,549.00	
Supply and Installation of customised retrofits to 185 Homes	486,778.90	
Total	$826,327.90	$824,500.00

The retrofit budget assumed that $327,000 would be spent specifically on hot water system upgrades, however upon completion of the building characterisation audits it became clear that other higher priority energy efficiency measures would be more suitable based on occupant use patterns and the age/efficiency of the existing hot water systems.

The necessary costs associated with overall retrofit management and coordination for a project of this scale was underestimated in original budgets. This included tasks such as preparation of a scope of work for each home detailing the technical specifications required for retrofit type within that home. This work required construction industry expertise in planning for these installations as well as ensuring all aspects of the contractual obligations of installers were being fulfilled at each home.

The supply and install costs included a 20% management charge by the head contractor to schedule subcontractors visits at various homes, provide all administration associated with installation warranties, ITPs and completion certificates and to ensure the required level of quality assurance. All invoicing was centralised for all trades through the head contractor.

Based on the above, a cost per participant can be calculated for all activities during the retrofit trial that were required to arrange for a tailored, high value retrofit solution after a participant had been recruited. This cost per participant would be added on to the actual supply and installation costs for any specific retrofit item.

Cost per participant to supply tailored retrofit solution:

(Costs of retrofit management, coordination and additional visits + head contractor overheads) / number of homes retrofitted

= ($339,549 + 20% x $486,778.90)/185

= $2,362 per household

It is considered that this figure is reflective of what the cost would be if this approach was taken on a larger scale considering that all in-kind costs were monitored and that a commercial approach was taken to the delivery of the retrofits.

[Note: Estimated breakdown of the following costs was:
(Retrofit management, coordination and additional visits)
= Retrofit coordination costs (Viridis) + Building characterization visit costs (Viridis and SBRC) + Consultation visit costs (Viridis & RDAI)
= $159,379 + $98,842 + $81,328 = $339,549 excl. GST]

6.3 Cost Benefit and Effectiveness Analysis

A cost-benefit/effectiveness analysis has been carried out in accordance with LIEEP requirements and results summarised below.

6.3.1 Electricity Billing Data Results July to September 2015

A preliminary cost benefit analysis of the project on the basis of energy savings has been undertaken using the electricity data that was available at the time of writing. Electricity data was collected for 186 dwellings from the Social Marketing with Retrofits trial group between November of 2012 and March of 2016. The majority of this data was collected in January of 2016 with the remainder being collected in March of 2016. Unlike the situation in many other areas of the country (e.g. where Smart meters are installed with 30-minute data sampling), billing data from the electricity distributor for the Illawarra region was only available at quarterly (3-monthly) intervals and meter reading dates could fall on any day within these intervals (as mentioned in Section 4.2.2.3). So, the most recent billing dates available at the time of writing ranged from October 2015 to January 2016.

The data was sorted into seasons using the methodology applied in the ACEL Allen Consulting report (ACEL Allen, 2015). As mentioned in Section 4.2.2.3 this method calculates the mid-date of the billing period and assigns the season of this date to this billing period. The median date for our most recent electricity consumption data will range from September 2015 to December 2015. With summer 2016 data only being available for a small proportion of the dwellings it was decided to perform an analysis using the spring electricity consumption values for the years of 2013, 2014 and 2015. Not all households had spring 2016 data available.

Dwellings with solar photovoltaic systems installed have not been included in the following analysis, since the electricity data provided by the local energy distributor does not identify whether a home with PV solar installed is 'gross' or 'net' metered and this means that it is not possible to determine actual household electricity consumption from the electricity bills. In addition, only those houses with electricity data for spring 2015, 2014 and 2013 have been included. This brings the total number of dwellings with relevant data available to 121.

However, for an electricity consumption reading to be considered properly as 'post-intervention data', the start of the billing period needs to be after the intervention date, yielding at the time of writing an *available energy billing date range only from July 2015 to September 2015*. It can be seen in Table 1.1 that only a small proportion of post-intervention energy consumption data is available at this time and therefore should not be expected to indicate a significant change in energy consumption. It is also noted that the intervention dates listed in Table 6.9 represent substantial delays from the original project timeline. These delays were primarily attributed to protracted negotiation of the consortium agreement and the unexpected challenges of establishing the householder-centred retrofit assessment and implementation process.

Table 6.9 Timeframe for interventions and available billing data.

Activity	Timeframe
Social Marketing Newsletter 1	June 2015
Social Marketing Newsletter 2	August 2015 to October 2015
Social Marketing Newsletter 3	December 2015
Retrofits	August 2015 to April 2016
Electricity consumption data request date	January 2016
Electricity consumption data - start of most recent billing period.	July 2015 to September 2015

As discussed in Section 4.2.2.3 it is important to assess the impact of any significant changes in climatic conditions when investigating the potential impact of energy efficiency interventions on utility bills. The climatic conditions for the area of study were evaluated for spring of the three years in question (2013, 2014 and 2015). While the small values of spring cooling-degree-days increased significantly over the 2013-2015 period, it was found that there was generally relatively little year-on-year variation between the spring heating-degree-days totals as compared to other uncertainties in the project; heating-degree-days being the primary driver of space heating/cooling costs in the

Illawarra climate. The results are displayed below in Table 6.10 and Table 6.11. For the following preliminary benefit analysis the impact of climatic conditions has therefore not been included due to the relatively small year-on-year variation, but a more in-depth analysis will be performed for the Addendum report to be provided in the 4th Quarter of 2016.

Table 6.10 Climatic conditions for Albion Park, Nowra and Moss Vale for springs of 2013, 2014 and 2015 (CDD = Cooling Degree-Days, HDD = Heating Degree-Days).

YEAR	NOWRA		MOSS VALE		ALBION PARK	
	CDD	HDD	CDD	HDD	CDD	HDD
2013	32.45	237.7	10.38	468.8	27.86	222.83
2014	29.7	255.01	16.14	474.06	21.61	227.02
2015	41.59	237.36	17.85	468.76	30.78	198.26

Table 6.11 Variance of spring period heating and cooling degree days from spring 2015 values.

Variance from 2015	NOWRA		MOSS VALE		ALBION PARK	
	CDD	HDD	CDD	HDD	CDD	HDD
2013	-22%	0%	-42%	0%	-9%	12%
2014	-29%	7%	-10%	1%	-30%	15%

The average daily electricity consumption is plotted for the spring periods of 2013, 2014 and 2015 and the descriptives of this data were explored, as shown in Figure 6.1 and Table 6.12.

It was found that there was no significant change in household electricity consumption between the three spring periods. The mean of the 2015 average daily electricity consumption was 0.14kWh/day higher than that of the spring of 2013 and 0.13 kWh/day higher than spring 2014, whereas the median was less by 0.03 and 0.05 kWh/day, respectively.

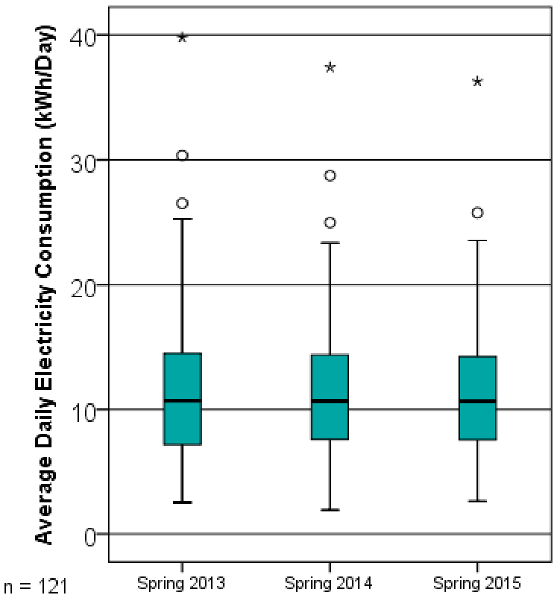

Figure 6.1 Average daily electricity consumption (kWh/day) for the majority of households in the Social Marketing with Retrofits cohort during spring periods of 2013, 2014 and 2015 (n=121).

Table 6.12 Average daily electricity consumption (kWh/day) for households during spring of 2013, 2014 and 2015 (n=121).

Billing Period	Mean	Median	Standard Deviation	Minimum	25th Percentile	75th Percentile	Maximum
Spring 2013	11.48	10.68	5.87	2.55	7.14	14.62	39.79
Spring 2014	11.47	10.66	5.55	1.94	7.44	14.39	37.42
Spring 2015	11.61	10.63	5.60	2.64	7.53	14.37	36.28

This result was to be expected given that the July 2015 to September 2015 billing period did not cover a sufficiently long duration after interventions for significant changes in household consumption to be detected. Ongoing evaluation of the project will reveal more definitive effects of the interventions in future billing periods.

In conclusion, since only very limited post-intervention energy consumption data was available from the electricity distributor, due to the project delays and the quarterly energy billing cycle, no substantial change in energy consumption was expected. The very preliminary results available at the time of evaluation confirm that no significant change was measured when comparing the spring season of 2015 to that of 2014 and 2013. As discussed above these results are preliminary and interventions were still ongoing at the time in which this billing data was captured.

Notwithstanding the formal closure of the EE3A project in May 2016, the UOW and Macquarie University evaluation teams are actively continuing the energy consumption and temperature data collection and analysis work alongside a third and final evaluation survey to be carried in the 3rd Quarter of 2016. An addendum to the present report will be made available in the fourth quarter of 2016 with results of this ongoing evaluation, in which we will provide definitive data on changes in electricity bills of households.

6.3.2 Cost benefit of estimated future energy savings from energy efficiency retrofits

Since definitive post intervention energy consumption data is not yet available for households that have received retrofits we have carried out some basic modelling to estimate the likely maximum benefits in future energy savings from energy efficiency retrofits for these households, as an interim evaluation. These estimates will be replaced by results using actual household billing data in the Addendum to this report that will be published in the 4th Quarter of 2016.

A summary of the estimated energy savings over the next ten years at energy prices the time of writing is provided in Table 6.13.

The overall direct energy saving benefit overall to all participants from the retrofits is therefore likely to be of order $520,688 over ten years (noting that there is very significant uncertainty in this figure due to the large number of assumptions that have had to be made).

This implies that the direct cost benefit ratio estimated from the possible future energy savings from the Retrofit program against the cost of delivery (see Table 6.8) was therefore of order cost/benefit = $826,327/$520,688 = **1.6**.

Table 6.13 Summary of preliminary estimated maximum energy cost savings to households (at 2016 energy prices) of retrofits installed in the Social Marketing with Retrofits cohort over a period of 10 years.

Class of retrofit	Overall energy cost savings to the Retrofitted households ($)
Thermal Envelope (ceiling and sub-floor insulation, draught sealing)[1]	$385,488
Hot water systems[2]	$49,198
High efficiency heating systems (reverse cycle A/C) and A/C standby power switches[3]	$41,863
Lighting upgrades[4]	$22,289
Refrigerator/freezer replacements[5]	$21,850
Total cost savings over 10 years	**$520,688**

Note: these are theoretical estimates, and are a number of significant assumptions. This data will be replaced by changes in billing data results using actual energy billing data in the Addendum to this report to be published in the 4th Quarter of 2016. Some example assumptions are as follows.

1) *Installation of insulation was over 70% of floor area of home. Home assumed to be heated for 50% of time/temperature difference compared to degree-day weather data.*
2) *Hot water energy savings based on the Ausgrid calculator (Ausgrid, 2016). Majority of households were on off-peak tariff so savings likely less than in general community.*
3) *Calculated from NatHERS Star Band Criteria (Energy Loads [thermal] in MJ/m^2.annum) for Climate Zones of our cohort and assuming home heating thermal energy only 50% of NatHERS criteria (NatHERS, 2016a).*
4) *Conservative assumption of 50W savings per light bulb, 3 light bulbs per house, 3 hours per night.*
5) *Assumed average savings of 250 kWh/year after fridge replacement.*

For the purposes of satisfying the Department of Industry, Innovation and Science's requirement for a cost-benefit analysis against the four levels of cost listed in tables Table 6.3 to Table 6.5, we have prepared a preliminary cost benefit table for the overall trial.

NOTE: these results will be replaced in the Addendum to this report to be published in the 4th Quarter of 2016, with actual billing data from households across the whole trial. Here only the theoretically estimated direct energy saving benefits from the retrofits are included as benefits.

Table 6.14 PRELIMINARY cost-benefit results for the total cost of delivery of Social Marketing only and Social Marketing with Retrofit trials – using only the theoretical estimates of the energy/cost savings of the retrofits as detailed in Table 6.13. ***This table is presented purely to illustrate the process that will be followed once post-intervention energy billing data is available to the project team*.**

Component of trial	Cost (from Table 6.5)	Cost/benefit
a. Delivery of Trial	$1,053,218	2.02
b. Recruiting and maintaining participants	$158,830	0.31
c. Running organization to do a. & b.	$268,408	0.52
d. Additional cost of participating in a government trial	$2,060,861	3.96

6.3.3 Cost effectiveness of Social Marketing Program

Despite the fact that the Social Marketing intervention was far from complete after Survey 2 in the 3rd Quarter of 2015, Surveys 1 and 2 did show, amongst other benefits, the following:

a) A statistically significant increase in positive attitudes towards energy efficiency among project participants.
b) A statistically significant increase in positive perceptions of the social and ecological value of energy efficiency among project participants.
c) A statistically significant increase in perceptions of thermal comfort, and satisfaction with thermal comfort among project participants.

These changes are detailed in full in Table 3.7 and positive changes in attitudes and perceptions were key outcomes desired from the project. The changes in perceptions of thermal comfort for example are summarised visually in Figure 6.2 using the data from Table 3.7.

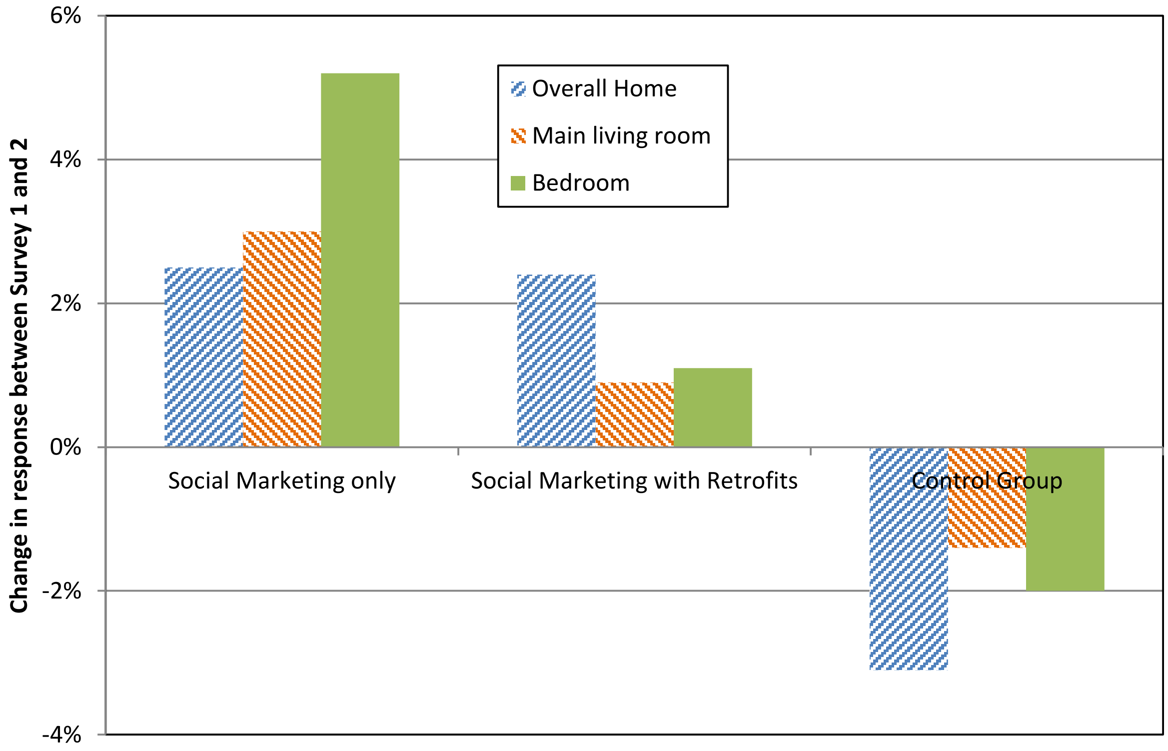

Figure 6.2 Changes in participant attitudes and perceptions between the baseline survey and first follow-up survey for: a) positive attitudes towards energy efficiency; b) positive perceptions of the social and ecological value of energy efficiency; and c) perceptions of thermal comfort, and satisfaction with thermal comfort.

A measure of the cost-effectiveness of the Social Marketing program is therefore the cost of delivering the Social Marketing program against the change in perception/attitude recorded. A preliminary example of the cost effectiveness of the change in perception of thermal comfort has have been detailed in Table 6.15. Here the average change in perception of thermal comfort across all three rooms for the Social Marketing relative to the Control Group was 5.7% between Survey 1 and Survey 2.

Table 6.15 Cost-effectiveness results for changes in attitudes and perceptions of Social Marketing and Social Marketing with Retrofits participants between Surveys 1 and 2, against total trial costs per participant (Table 6.6).

Component of trial	Cost of Social Marketing Only per participant (from Table 6.5) $	Change in perception of thermal comfort ($/%-change/ participant)
Increase relative to control group = 5.7%		
a. Delivery of Trial	$ 63.11	11.1
b. Recruiting and maintaining participants	$ 176.11	30.9
c. Running organization to do a. & b.	$ 158.21	27.8
d. Additional cost of participating in a government trial	$ 801.94	140.7

6.3.4 Summary of overall cost benefit analysis of the Energy+Illawarra program

Retrofits - the electricity billing data made available to the project team to date does not show a significant change in electricity consumption in the 121 households analysed to date – this was to be expected since this billing data applies prior to completion of the Social Marketing and Retrofit programs. However, the methodology is in place to definitively determine the cost benefit in the Addendum report to be supplied in the 4th Quarter of 2016.

Nevertheless, given the estimated direct benefits identified for the retrofit program the overall direct cost benefit analysis of the program and given the significant caveats that have been outlined above, the overall cost-benefit ratio over a ten year period for the Social Marketing with Retrofits cohort for LIEEP funding is likely to be of order cost/benefit ≈ 1.6.

In addition to this overall and preliminary estimate (prior to receipt of post-retrofit billing data), more detailed cost-benefit/effectiveness analyses of specific retrofits have been provided in Section 4.2.

Insulation – cost-effectiveness ratios for the increase in indoor temperatures following the installation of ceiling and subfloor insulation were found to be of order $20/^{o}C per m^{2} and $28/^{o}C per m^{2}, respectively, for two specific case study homes.

Lighting – the payback periods for the LED replacement of existing incandescent, halogen and CFL light bulbs were estimated at 0.9, 1.3 and 8.7 years, respectively.

Social Marketing – while there has been no significant change in participants electricity bills observed as yet (due to delays in implementation of trial activities and only quarterly bills being available) there were significant positive changes in participants' attitudes and perceptions. In the case of changes relative to the Control Group a total cost-effectiveness ratio of for the delivery of the trial only (item a.) was found to be 11.1 $/%-change/participant. *Note: these figures will be updated following in the Addendum to this report to be published in the 4th Quarter 2016.*

Community Training – due to the nature of the delivery of this component of the project (i.e. to members of the general community, rather than to recruited 'participants') it was not possible to identify the likely energy savings or other benefits to this cohort.

Co-benefits - the project provided a range significant co-benefits to participants as identified throughout this report. Two examples, from many possible, include the following.

- **Thermal comfort** - both the Social Marketing and Retrofit programs have provided information and home improvements that it is anticipated (and have already been measured in the case of insulation) will lead to significantly greater thermal comfort, safety and health of participants. While it is not yet possible to put a financial value to the participants in this trial, or to society as whole, of improving the thermal comfort of thoure participants, there is no doubt that this benefit will be very significant. Recent research in Australia and 12 other countries around the world (Gasparrini *et al*, 2015) has shown that mortality rates increase significantly in periods of cool or cold weather. This particularly has an impact on older people and can be attributed, in part, to an increase in blood pressure. The results are very significant for Australia, for example, 'In Sweden, cold caused an estimated 3.9% of deaths, whereas in Australia it caused 6.5% (that's one in 15 deaths)' (Barnett, 2015). One reason for this much higher figure for Australia, despite our much milder climate, is thought to be the poor thermal envelop and ineffective/inefficient heating system in this country. The Energy+Illawarra project has definitely made a positive impact in this regard.
- Health benefits – examples of very high cost-effectiveness have been found in our study (e.g. simple lighting retrofits/education leading to significant reduction in falls by elderly participants).

It has been noted within the Energy+Ilawarra team, and at recent LIEEP Forums run by DIIS, that a methodology does not yet exist for the proper evaluation of the financial benefits of co-benefits of energy efficiency interventions, which may be very significant. This is the subject of research by a number of teams in Australia and an important report will shortly be forthcoming from the International Energy Agency Annex 56 Cost-effective Carbon Emission Optimization in Building Renovation http://www.iea-annex56.org. Much could potentially be learned from the Social Return on Investment (SORI) and Quality Adjusted Life Year (QALY) approaches used in the community health sector in Europe and elsewhere.

7 KEY PROJECT OUTCOMES, BENEFITS AND INSIGHTS

This section provides additional description and analysis of a range of project outcomes, benefits and insights at different levels of detail and using various sources of data, including quantitative, qualitative/ethnographic and team evaluations.

7.1 Recruitment of participants

A crucial prerequisite for success for any trial such as the Energy+Illawarra project is that sufficient participants/households are recruited.

- A key outcome was sufficient participants were recruited (>830) to ensure that the target size of the main cohort >500 was maintained throughout the project (see Section 3.1.3). The benefit was that a sufficiently large participant sample size was involved throughout the trial, despite the vulnerability of our demographic of older low-income householders.
- However, a most import insight emerged in the very early project stages. The originally proposed recruitment methodology (of using community networks and other low-income support agencies) would clearly not be successful in the required short time-frame. The project team made a very significant and successful change by commissioning a commercial market recruitment agency to do this work. As a result, recruitment was completed in approximately six months. Without this initiative the successful delivery of the trial would have been significantly compromised.

7.2 Social Marketing Program

The social marketing program was successfully developed in accordance with recognised best practice in social marketing by being:

- Focused on social change/behaviour change outcomes to facilitate energy efficiency, comfort and wellbeing among older low-income people in the Illawarra.
- Using systems thinking, and strategic planning, monitoring and evaluation.
- Redefining energy efficiency to also focus on comfort, health and wellbeing.
- Being community and participant oriented
- Being developed based on research insight with older low-income people in the Illawarra
- Utilising relevant theory
- Using principles of segmentation, targeting, positioning, and tailoring of activities based on people’s needs, wants and everyday realities.
- Using a broad and multi-components range of intervention strategies (i.e. a broad social marketing mix)
- Following an integrative, critically reflexive and adaptive approach to the social marketing program design and implementation.
- Being focussed on creating and increasing perceptions of value among project participants regarding energy efficiency.
- Addressing competitive forces, barriers and inhibitors to being energy efficient and/or maintaining comfort, health and wellbeing.

The social marketing program trial was successfully implemented to the 830 participants in the baseline cohort intervention sample and to the wider community. This involved the following outcomes.

- The design of a community oriented project brand, Energy+Illawarra.
- A new definition/redefinition of energy efficiency: "Energy efficiency is using energy wisely and economically to sustain everyday life, live comfortably and support wellbeing". This definition featured heavily throughout all project activities".
- Development and mail out of three seasonal/phased Energy+Illawarra newsletters about energy efficiency to:
    - 830 project participants; and,
    - distribution of a further 3,000 newsletters in the wider community to 27 different community and health centres and community organisations, and also project consortium members for dissemination to community members.
- Distribution of 830 Energy+Illawarra branded fridge thermometers, and 830 remote control power switches to project participants.
- Development and promotion of an Energy+Illawarra project website: www.energyplusillawarra.com.au hosting a variety of resources and materials about energy efficiency for participants and community members. Between 1st June 2015 when the website was launched and 21st April 2016 the website attracted 1,692 distinct sessions, across 1,109 different users, with an average website visit session duration of 3 minutes and 6 seconds. Visits to the website were split by 65.5% new visitors, and 34.5% returning visitors.
- Development and promotion/distribution of 10 narrative/fact videos about energy efficiency through the project website, and LCD Brochures.
- Manufacture and distribution of 100 LCD Brochures containing the narrative/fact videos about energy efficiency that were distributed among the aforementioned 27 different community/health centres and community organisations, and also to project consortium members, policymakers, and media contacts.
- Extensive promotion of energy efficiency narratives, facts, and the project website and resources on Facebook and Twitter. The Energy+Illawarra Facebook page attracted a total of 305 unique user likes, 339 reactions, comments and shares forms of engagement, and 410 post clicks form of engagement from launch on 1st June 2015 to 21st April 2016.
- Twenty-one separate media stories about the project research and intervention activities across national (e.g. ABC Radio, *Sunday Telegraph*) and local (e.g. WIN News, *Illawarra Mercury)* television and print media.
- Placement of nine paid advertisements for the project containing energy narratives and calls to action to visit the project website; six adverts were placed in the *Illawarra Mercury*, two in the *South Coast Register*, and one in the *Milton-Ulladulla Times*.
- Distribution of 100 poster advertisements for the project containing energy narratives and calls to action to visit the project website to 27 different community/health centres and community organisations, and also to project consortium members.
- Advocacy and stakeholder engagement with energy retailers, policy makers and relevant stakeholders, leading to distribution of project materials by Energy Australia. This resulted in

a flow on future pilot project with Energy Australia, and contribution to key policy and practice discourses and forums in Australia.

The evaluation survey analysis indicated that the social marketing program was associated with:

- A statistically significant increase in positive attitudes towards energy efficiency among project participants.
- A statistically significant increase in positive perceptions of the social and ecological value of energy efficiency among project participants.
- A statistically significant increase in perceptions of thermal comfort, and satisfaction with thermal comfort among project participants.
- Qualitative insights from the ethnographies indicated that the social marketing materials influenced some participants' engagement with energy efficiency, their practices, and their influence on others with respect to energy efficiency. For example, participants in the ethnographies discussed how they had read newsletters and then passed these onto friends and families. Furthermore, some participants talked about how they had used the fridge thermometers, or receiving the thermometers had inspired them to go out and purchase an infrared thermometer to assist with their energy efficient practices in the home.

Two key insights regarding the impacts of the social marketing program trial were:

- A social marketing program on energy efficiency that uses recognised best practice can be effective at influencing attitudes, value perceptions, and thermal comfort among citizens (*cf* the many Insights provided in this document, for example). This is particularly important and relevant as attitudes and value perceptions are predictors of future behaviour, meaning it is possible that the social marketing program will lead to behaviour change.

- Thermal comfort is strongly associated with issues of health, wellbeing and personal comfort. The social marketing program was found to positively impact on the thermal comfort of participants, meaning that well designed and implemented social marketing programs can provide a useful approach to changing attitudes about energy efficiency, increasing the perceived value of using energy efficiently, and improving thermal comfort among citizens in Australia, and indeed elsewhere.

As identified earlier in this report, analysis of the 2nd follow-up survey (Wave 3) data will enable a comprehensive evaluation of the impact of the social marketing program on behaviours, behaviour change, energy usage (in kWh), and energy bills ($ value), to be made. (This data will be included in a later addendum to this current report and made available on the Energy+Illawarra website http://www.energyplusillawarra.com.au/).

There were also three other important and non-directly outcome focused insights relating to the social marketing program trial: research insights, interdisciplinary approaches and energy policy.

- The research insights generated with representative samples of priority groups are essential to inform the design, development and successful implementation of energy efficiency programs. In the Energy+Illawarra project, research insights were often key to inform intervention strategy, activities, tactics, adaptations, decisions, and delivery. Furthermore, research insights facilitate broader understanding and learning for citizens, communities, policymakers, stakeholders and researchers. This does not suggest that research with each and every household in a region, or country is required to inform effective interventions. Instead, what is argued is that research that can generate good insights with a sample selection from different priority/target groups is essential.

- Interdisciplinary, multi-stakeholder, multi-component and collaborative approaches to tackling energy efficiency is essential. Energy efficiency is a complex and often messy economic and social policy issue. This means that multiple perspectives, broad skills sets, and inclusive coalitions across different disciplines and stakeholder groups are important to address issues around energy efficiency. The social marketing program could not have been successfully designed, implemented and evaluated without the input and close and effective partnership and collaboration between the range of consortium members and other stakeholders involved in the Energy+Illawarra project.

- Energy efficiency cannot rely on one single policy level, or program, or intervention strategy or tactic. Extensive research in the behaviour change field shows that for lasting behaviour and social change to happen, multi-component, multi-faceted and long term intervention approaches that operate at all levels from the individual, to the household, to the community and workplace, to media and culture, and to policy, regulation and law are required to effect change (Department of Health, 2004; Hastings and Domegan, 2013; French and Gordon, 2015).

The social marketing program attempted to operate at some of these different levels through activities such as media relations, and stakeholder advocacy. We believe that future energy efficiency work in Australia would benefit from adopting the lessons from other behaviour change domains, to effect such multi-level and multi-component policies, programs and strategies.

7.3 Insights into the Characteristics of Participants and Their Homes

7.3.1 Energy Guilt and Billing Anxiety

- This issue of feelings of ‘Energy Guilt and Billing Anxiety’ affecting participants’ practices and perceptions arose very often over the course of the project.
- A key project benefit was the gathering and compiling of detailed qualitative/ethnographic information on the types and levels of fears and anxieties of participants. This report documents some examples, including the following Insight 7.1).
- Other benefits included the allaying of this anxiety through increased participant knowledge and skills – e.g. through the installation of in-home energy displays and the training of the participants in how to use these devices to understand and decrease their energy consumption (see Section 4.2.13).

Insight 7.1 Well-being – less anxiety and using lighting when needed.

Well-being – less anxiety and using lighting when needed

Renee (80s, retired, living in the community, Southern Highlands) was extremely grateful for the lighting upgrade she received as part of the project. Her home had many downlights and she was very anxious about the amount of energy they used.

> *Well, I'm absolutely delighted with the lights, because I would not have ever been able to afford… although I use a lot of lamps, but I do use these here. I'm absolutely delighted with that, the lamp. And I'm so grateful, and I thanked Steven so much for doing that, because I would never have been able to afford that, you know. Because they cost me $300 for free. That cost me there, $300 I think roughly. Under my circumstances I could never, so I am absolutely delighted.*

When asked if having the new lights changed the way she does anything at home, Renee answered:

> *Yeah, it is. With the curtains pulled in the bedroom, I never used to put them on because of…the cost of four of them going at once. But, I didn't hesitate [Laughter] yesterday because everything was dark. And oh [dog's] got fleas, and I had to, I needed a light to get these fleas you know. [Laughter] And I didn't hesitate in putting that, and [young grandson], I was a nervous wreck when he came and put the lights on in the bedroom. Because you know, I'm thinking oh my God… four lights going with you know, how much is that going to be…[Laugher] but now that I know they're only 5% each, I didn't mind if he put the lights on [Laughter].*
>
> *Interviewer: Great, so you feel a bit more relaxed about it.*
>
> *Renee: I do, definitely I do. [Laughter] In fact, if you hadn't have put them in for me, I would've had to put them in in that bedroom. Because [grandson], for some reason, will have a light on.*
>
> *Interviewer: That's good to hear Renee.*
>
> *Renee: Yes I don't hesitate. I don't use these [lights] out here very much, because as I told you, I use lamps, you know. But those [lights] there, I use nearly every night because [dog] wants to go out and so I put the hall lights on so that I can kind of see where, you know, until he comes back.*

Here Renee indicates that previously she would move around and stand in the dark while her dog went outside. Less anxious about the energy use she can put on the light and see what is happening. She recognised that this also makes walking around safer: "they're always worried about me falling and everything, maybe you know if I've got more light I won't fall or trip over anything." Renee also pointed to the intergenerational difference – her young grandson would have normally put the light on in the bedroom, which was stressful for her.

Excitement

In response to a different question about the changes to her everyday practices since being in the project, Renee responded that they made her home more comfortable, and more exciting:

> *because I've learnt something, you know, someone's put a seed in my mind with those yeah very exciting that I've learnt that.*

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households

7.3.2 Vulnerabilities of participants

- The project team appreciated during the trial planning phase that the cohort would include many very vulnerable members of society (low-income and old). Nevertheless, the full ramifications of the impacts of these vulnerabilities on the way the trial could be delivered only became fully apparent as the project unfolded.
- Infirmity, lack of mobility, ill-health and sometimes death of participants, were some of many issues that needed to be addressed by the project team in terms of: planning; risk management; appropriate training of researchers, project team and contractors; development of appropriate protocols for interacting with participants (including development of appropriate 'scripts' for phone calls and visits, provision of crisis/support agency contact details to staff, etc).
- In summary, the project team took a proactive approach to ensuring that they were ethical, adaptive, reflective and respectful in all interactions with participants and other stakeholders.
- A clear benefit of the retrofit component of the project was that improvements were made to the participants' homes and well-being that they either had no knowledge about or were simply too difficult and/or costly to implement. This included replacement (and removal) of old appliances, and replacement with more efficient and more functional appliances.

Insight 7-2. Replacement of an appliance that was quite old and probably in need of replacement before long – particularly hot water systems.

Co-benefits of Replacement, Installation and Removal

Replacement of older, energy inefficient appliance– particularly hot water systems.

Marina and Rex (retired couple, 70s, house in the community, Shoalhaven), point to the co-benefits of the project in overcoming the inertia often attached to some older energy efficient appliances**.**

> Rex: ***…****the hot water system, theoretically we should give that fifteen years out of the new one which was quite good, because that was coming up, like, that was going to be an expense before we grew much older."*
>
> Interviewer: *Okay, so that's kind of a bit of a relief?*
>
> Marina: *Yes, well as I said, once he mentioned that we could have one, we thought we had to take advantage of that given the age of the old one."*

A more functional appliance, eg. upright freezer:

Co-benefits arose from ease of accessing frozen food. Helga (70s, retired, living in the community in the Illawarra) explained a co-benefit arising from a upright freezer for an older, less agile person.

> Helga: *"And I got the upright freezer, so I don't have to bend down.*
>
> Interviewer: *Yes. Oh, now, instead of the chest one?*

Helga: *Now with the shelves in, yeah. Yeah. I've got an upright one, so I don't have to do all this bending down.*

Interviewer: *Yeah. Great. That's good.*

Helga: *I didn't even know what was down the bottom anymore in the other one, because you always think to put it on top…*

Installation of something that seems quite simple but which would otherwise be quite costly or difficult for a resident.

For example, installing draught stripping around and on the bottom of a door, in an ILU and/or in a regional town. Sometimes householders don't do DIY improvements because of the inconvenience of getting the job done. Living in regional Australia, participants often spoke of the additional costs of hiring someone to install or deliver an item.

Removal of an old appliance

Helga (70s, retired, living in the community in the Illawarra) pointed to co-benefits of the collection and movement of large heavy domestic appliances into correct conduits of disposal from houses of older low income households.

Helga: *"I had an old beer fridge out here – must have been fifty years old that thing. But it wasn't on anymore; it was already disconnected. I just wanted to get rid of it. I didn't know what to do with it. So they took that one as well. It's all gone now. Wonderful."*

Note: This ethnographic insight is illustrative of an emergent theme within older low income households, rather than representative of all older low income households.

7.3.3 Participant energy use, house and household characteristics

- A major project benefit was the in-depth characterization of approximately 200 homes with the Building Characterization Audit tool. This data will prove extremely useful in informing the development of housing 'archetypes' to provide advice to Government and individual home owners on the best strategies to improve domestic energy efficiency.
- The analysis of participants electricity bills and comparison of these against benchmarks of energy consumption by households, generally at postcode level, led to a number of key insights, including the fact that our cohort of householders use less energy than the general population, and was particularly true of households in aged care independent living units, which is explained in detail in Section 4.2.2.3.
- One of the key project insights was in relation to collection of participants' energy bills. The project had to overcome a range of challenges including, but not limited to, the following:
    - Without the direct intervention and imprimatur of the Department of Industry, Innovation, and Science the project team found it extremely difficult to gain traction with the gas and electricity distributors and retailers to obtain participants' past energy bills;
    - Provision of full details of electricity billing tariff codes on participants' bills turned out to be critical. In particular, this data was vital so as to differentiate between

households with Solar PV Gross and Solar PV Net metering, and between the various off-peak Control Load types.

  - The energy consumption *per se* for homes with Net-metered solar PV cannot be determined from billing data due to the fact that there is no quantification in the bill as to how much of the PV energy generated is dissipated in the home as opposed to exported to the grid. Therefore, energy consumption analysis of such homes is not possible without extra metering being installed. (Gross metered Solar PV households may be included in the analysis).

7.3.4 Insights into Co-Benefits of Participant/Project Team Interactions

1. Participant **communications:** It was recognised early in the project that the participant-project liaison and interaction model was very substantially under-resourced. Common feedback from participants was that they would have liked request more frequent updates, on the status of the project for example.
2. Passing on **advice** about energy efficiency: There was a general consensus in this older demographic that advice is deeply personal. Participants were happy to pass on newsletters, but there was a definite reluctance to being “preachy”. In-home displays sparked natural conversations for many participants.

7.4 Retrofit Outcomes, Benefits and Insights

A participant-centred approach to delivering a broad range of 19 retrofit options to a significant trial quantity of 185 homes was successfully developed and implemented. The first key measure of success was that retrofits were applied to virtually all of the targeted 200 homes. Reasons that participants did not eventually have retrofits installed were largely due to vulnerabilities of this cohort discussed elsewhere in this report.

Some of the key outcomes, benefits and insights associate with retrofits are summarised below.

1) There are important and sometimes complex relationships between thermal comfort conditions in people’s homes and their energy consumption. An example of the more complex effects that may come into play came to light during the evaluation of existing fridge energy consumption, for example, where increasing the mean indoor temperature of the homes of participants with very cold indoor temperatures in winter will also increase the energy consumption of a fridge in the home.

2) Factors in determining which retrofits were appropriate for a given building were complex, and ranged from technical suitability through to strong participant preferences.

3) Insulation.
   a) The retrofitting of both ceiling and under-floor insulation was found to be effective and well-received by participants.
   b) It was not possible to determine whether insulation was present in the ceilings of a surprisingly high proportion of dwellings (29%), due to lack of householder knowledge and/or inaccessibility of the ceiling space to the audit team.
   c) Our initial analysis of an initial two cases indicates that increases in average indoor temperature as a function of outdoor temperature (temperature ‘signatures’ of given houses) of between 1 and 2 ^{0}C resulted from the installation of insulation.

    d) The research team developed a cost benefit measure to estimate the cost to increase the mean indoor temperature as a function of outdoor temperature by 1.0^{o}C, i.e. with units of \$/^{o}C per m^{2} of insulation. To the knowledge of the engineering team, this type of analysis has not been previously reported in the literature and may provide additional insights into the benefits of installing home insulation.

4) Fridges and freezers.
    a) An important outcome from this project and an insight into how older low-income householders view fridges came from our Building Characterisation Audits which found that many households possessed an even larger number of fridges than they self-reported through the evaluation survey.
    b) Our testing of existing fridges/freezers in participants' homes indicated that the energy consumption of these fridges can be significantly different to that predicted by the Energy Rating Labels on those fridges. In the relatively small number of cases of existing fridges in Energy Rating Labels in our retrofit homes *in situ* energy consumption was found to as little as half that given on the Energy Rating Label. Previous research also indicates that fridge energy consumption is strongly dependent on usage and environmental factors including: air temperature surrounding the fridge, quantity and type of items loaded in or out; frequency and duration of door openings.
    c) There appeared to be a low awareness by participants of the substantial energy savings available by replacing and rationalising the number of fridge/freezers in their home; and
    d) There are a wide range of participant preference factors (e.g. aesthetics, emotional attachment to old appliances, etc) that will be import to address in future fridges/freezers replacement programs.
    e) Older low-income households were found, in many cases, to have strong emotional attachments or functional preferences in relation to particular appliances/technologies (e.g. fridges/freezers), which was found to be more important than information on appliance performance in determining whether they proceed with a retrofit or not. The project team worked to with great success overcome this barrier by carefully assessing such emotional attachments and the likely energy/comfort impact of an appliance retrofit during the Building Characterisation Audit, before offering retrofits to participants.

5) Lighting retrofits.
    a) Direct cost benefits calculations indicate that do-it-yourself (DIY) retrofits of LED bulbs to replace incandescent, halogen and CFL bulbs can be very worthwhile resulting in payback periods of order 0.9, 1.3 and 8.7 years, respectively. (*Note: that a number of assumptions apply to these calculations of nominal payback periods*. *See Section 4.2.12 for details*).
    b) Through the interactions with participants it was clear that there were significant co-benefits that come from lighting retrofits including:
        i. Longer life of LED replacements means longer intervals between replacements. This is very important for older and infirm people, with health benefits accruing from the reduced risks and worries of falls and other difficulties in replacing bulbs.
        ii. Better quality of life through increased illumination (lux) levels, which is particularly important for older people.

6) Draft sealing.

   a) Participants were generally happy with these retrofits, though some complained that the new seals made opening/closing doors too difficult for them.

7) In-home energy consumption display retrofits were installed in approximately half of homes in the Social Marketing with Retrofits cohort. The majority of participants welcomed the display and actively used it to better understand their consumption patterns and performance of particular appliances. On the other hand a small minority did not welcome the offer of this retrofit.

7.5 Benefits of a multi-component interdisciplinary intervention

Tackling complex issues such as energy efficiency requires pragmatic approaches to research and intervention. Therefore, projects and programs that use a pragmatic mixed/multiple methods approach are important. This means that qualitative and quantitative methods are important, and often of equal or symbiotic value. The Energy+Illawarra project team was fortunate to have researchers and practitioners with expertise across a range of methods including survey design, cognitive survey pretesting, survey implementation, and survey analysis and evaluation, experimental design and analysis, cognitive neuroscience, systematic literature reviews, focus group pretesting, qualitative open-ended interviews and focus groups, and ethnographic methods including open-ended interviews, participant observation, and visual ethnography methods (video home tours and photography).

This broad range of methodological skills was crucial to the Energy+Illawarra project. Quantitative research can help measure, quantify, predict and theorise regarding human behaviour and outcomes relating to energy efficiency. However, qualitative methods are also very important and complementary. Qualitative methods can often provide rich and deep insights about issues and behaviours that quantitative research cannot capture. In this project, qualitative or more-than-science voices offer a diversity of portrayals of energy efficiency. Qualitative research produced insights to domestic energy relations by approaching energy efficiency through a sense of place, the personal and emotional responses. Energy is meaningful and significant beyond scientific measures of thermal comfort and policy rhetoric of doing the same with less.

Multiple interactions: One of the team reflected that multiple intervention visits had a cumulative impact to reinforce behaviour change, while another added that multiple visits introduced fresh perspectives. The inter-disciplinary action research team, particularly for the 30 more intensively engaged households, brought participants into contact with a rich and diverse group of researchers and practitioners. So each home visit interaction may be an intervention in itself. These multiple mini-interventions delivered through a series of ad-hoc conversations generated an atmosphere of trust often built reinforced a message enough to facilitate positive change.

7.6 Ethnographic insights to inform future government policy

Accepting knowledge is situated in particular contexts: The uptake and effectiveness of residential energy efficiency upgrade programs will be enhanced by greater understanding of the plurality of energy knowledge. The goal of energy policy should not be to force people to retrofit their homes based on faith in engineer’s computer generated models. Nor, should energy policy be based solely on the belief that appliances like refrigerators may be full of emotional meaning and sustain reciprocal human-home relationships. Instead, future energy policy must meld science and how people understand and use energy in their daily lives. Policy that accepts that knowledge is situated in particular contexts should design interventions that encourage people to reflect on their energy choices, rather than nudge or force people to change their practices along a pre-determined pathway.

This melding together of science and personal narratives to provide a resource for people about energy efficiency and comfort is relevant for:

- Identifying the best retrofit recommendations for householders;
- Public communication resources promoting energy efficiency, such as the Energy+Illawarra video books; and,
- Increasing the take-up by people of energy efficiency opportunities provided by government.

Detailed analysis of the ethnographic data collected in this project will contribute to the literature in the energy policy field, and be available for future energy efficiency programs.

Let's talk energy efficiency: perhaps not. Overall, we have found that many people did not talk with friends or family about the ways they use domestic energy. How energy is used is taken-for-granted, therefore not worthy of conversation. Furthermore, talking about energy is often regarded as a morally loaded topic, embedded in judgements of 'good' and 'bad' practices. Hence, who delivers energy policy is equally as important and how it is delivered. For older low-income households, we would recommend face-to-face conversations over print or online media. However, conversations would only be effective with trusted members within their social network, for example home-help or home-nurse.

Ageing bodies: sickness and palliative care. The ways that energy is enrolled to sustain home changes across a person's life or lifecycle. Older low-income households draw attention to the ways in which decisions around domestic energy use and energy retrofits is deeply embedded in sickness, dying and death. Future research must pay closer attention to the intersections between energy, health and home.

Ideas about how government/others could provide advice. Some participants made suggestions on how advice on energy efficiency could be given to older low-income people. For example, Susie suggested in-home support workers as useful people to provide suggestions about moving a comfortable chair to a warmer room in winter, or closing off doors to keep their sitting room warmer. Some suggested the newsletters could be sent out to people; note though that while some participants valued the newsletters, others appeared to have not read them or only read them briefly.

Access to advice is important. Many participants relayed they do not have or use a computer, or if they do, they don't use it to the point of searching for government advice, on energy efficiency. This applied to both websites and Facebook. It appeared that people highly valued the **personal, targeted advice** provided in this project.

7.7 Community Training Trial Outcomes, Benefits and Insights

Key Findings from the Community Training trial can be summarised as follows:

- Little interest was reported by potential participants in workshops where the goal is solely to learn more about energy efficiency.
- Increased interest in workshops that provide a skill while conveying energy efficiency information, e.g. how to use tablet technology
- People do not freely talk about or share their energy efficiency practices unless they trust the other parties involved
- The concept of energy efficiency or even cost of energy efficiency in the home is not often perceived as a priority compared with the pension, superannuation or other costs of living.

7.8 Project Management and Administration Outcomes, Benefits and Insights

Key findings and observations regarding the project administration of this trial include:

- The revised recruitment approach using a market research consultant was a success to achieve the sample size, although this approach cause delays and changed the role of some of the consortium partners.
- Significant challenges resulted from the project being under-resourced for its scope. The consortium's expectation of the resources required for activities expanded after exploring the detail required to satisfactorily deliver each step, e.g. recruitment, number of home visits, development of scopes-of-work for each home that received a retrofit.
- Resources required to provide stakeholder support and management to consortium members, consultants and contractors were also underestimated.
- Our experience indicates that projects with a diverse group of consortium partners, to deliver simultaneous research, commercial and community outcomes require adequate time, budget and resourcing to ensure a strong team-approach and strong governance. Key recommendations include:
    - Conduct a series of consensus building forums at the outset to attain agreement on the priority of project objectives and outcomes, the strategies and processes that will be used to achieve these and to capture/share any assumptions made in the planning of the project;
    - Manage and negotiate an agreed governance structure and supporting processes including how to work through unforeseen variations and challenges.
    - Enable effective ongoing stakeholder management and regular communication between consortium members.
- There was an inadequate level of detail in the definition of each consortium member's roles which led to an imbalance of perceived influence within the consortium, throughout the life of the project.
- There was a particular challenge in obtaining adequate and timely energy data from electricity and gas distributors and retailers.

8 CONCLUSION AND RECOMMENDATIONS

The Energy+Illawarra householder-centred, insight-driven, multi-component, interdisciplinary team intervention approach has been demonstrated to provide good outcomes for participants and a wealth of data associated with energy efficiency in older person households of low income.

However, more time is required to analyse the large data sets that have been, and continue to be, collected; both quantitative and qualitative.

Initial survey results indicate that the social marketing trial has had a positive effect on the behaviour, knowledge and understanding of participants.

Our initial evaluation of some retrofits indicate that there has been positive effects on thermal comfort, e.g. through the installation of ceiling and underfloor heating, and in facilitating a decrease in energy consumption through retrofit of lighting, appliances and other measures. This has been supported by qualitative feedback received from participants as exemplified in Enthnographic Insights included in this report.

Unfortunately various project delays and hurdles associated with obtaining energy bills has limited our ability to have clear quantitative results for this trial at the time of writing. In addition, further effort is required to complete the analyses of the extensive ethnographic data collected. However, the University of Wollongong and Macquarie University research teams are committed to continuing this work and providing an appropriate addendum to this report in due course.

While there was no measured effect on energy efficiency improvement as a result of the Community Training trial, anecdotal evidence suggests there was some benefit to those participating during the actual event. This was due to: i) difficulty in recruiting interest in the training programs, and ii) being unable to measure a quantifiable long term effect that stakeholders who received training were able to influence energy efficiency in other members of the community.

Our experience in the present trial has provided further evidence that quantitative determination of reductions in household electricity consumption as a direct result of residential energy efficiency interventions is very challenging for many reasons, e.g. since results are very sensitive to year-on-year local climate variation, variations in household occupancy levels and day-to-day practices, the confounding impact of particular solar PV generation metering configurations on utility energy consumption data, etc.

8.1 Recommendations

In any future roll-out of household energy efficiency programs we would strongly recommend the following:

- It is important to position householders at the heart of the solution instead of considering buildings and behaviours as the problems to be solved.
- It is important to use an interdisciplinary approach that melds science and social science.
- Further research that investigates how energy research is strongly associated with ageing bodies, end-of-life, sickness, dying and death.
- Further research that prioritises those most at risk of fuel poverty.

- Conduct a cost-benefit analysis of a winter fuel bill assistance program for older low-income households living in temperate climatic zones to investigate whether the costs of an energy subsidy help offset costs of hospitalisation. This recommendation is based on results that show that participants stay at home during winter, and are often exposed to indoor temperatures well below recommended World Health Organisation levels and the anxiety surrounding turning on heaters in winter.
- Projects that include a diverse group of consortium partners, to deliver simultaneous research, commercial and community outcomes require adequate budget and resourcing to:
    - Conduct a series of consensus building forums at the outset to attain agreement on the priority of project objectives and outcomes, the strategies and processes that will be used to achieve these and to capture any assumptions made in the planning of the project
    - Manage and negotiate an agreed governance structure and supporting processes including how to work through unforeseen variations and challenges
    - Enable effective ongoing stakeholder management and regular communication between consortium members
- Future similar projects need to complete a more detailed mapping of resources with stated assumptions as part of the bid process.
- For projects or programs that span multiple years, additional budget be reserved by the Commonwealth to allow for any required variations in scope or deliverables.
- An open-source Home Energy Efficiency Decision Support (HEEDS) tool. Following the success of the Retrofit Assessment and Implementation Process designed and implemented in this trial, which combined the scientific assessment of the house with insights from how everyday practices sustain a house as a home, we recommend that this process now be refined and made available as an open-source Home Energy Efficiency Decision Support (HEEDS) tool. This tool will: facilitate home energy characterisation; be customisable to account for material, personal and social characteristics of households; provide options regarding retrofit recommendations; include a module to support face-to-face consultations with householders to finalise retrofit allocation and implementation processes.

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Recruitment Eligibility Questionnaire

Introduction

Good (MORNING/AFTERNOON/EVENING), my name is **Interviewer Name** and I'm calling on behalf of the University of Wollongong from I-view, a market research recruitment company. The University of Wollongong are currently involved in running a survey project that aims to explore approaches to encourage energy efficiency behaviours in the home among residents in the Illawarra. We are particularly interested in the views and experiences of residents in the community such as you. To assess whether the study is relevant to you would you mind if I ask you a few questions? It should only take roughly 5 minutes of your time.

DO NOT READ OUT

About UoW: The University of Wollongong is a public university located in the coastal city of Wollongong, New South Wales, Australia. The University has over 37,000 students enrolled and over 2,000 academic related staff. The University has been ranked 9th in the Excellence in Research for Australia (ERA) Australian University Rankings in 2012, among the top 1% for research quality in the world, and among the top 2% of universities in the world.

DO NOT READ OUT

About Centre for Health Initiatives: The Centre for Health Initiatives (CHI) is a dynamic, multidisciplinary research centre at the University of Wollongong with more than 20 staff, 26 full members, and over 80 HDR students. CHI's Vision is to make a difference in the lives of people through developing innovative solutions that address contemporary health and social issues. This vision is achieved by understanding and measuring health and social issues, and using this information to develop and implement effective strategies.

1. **Age: Are you 60+?**

Yes ☐

No ☐

Need to be 60+ to be eligible

1. **Disposable Income bracket (after tax & Medicare levy)**

0-$26,104 per year (or $0-$502 per week) ☐

$26,105-$33,176 per year (or $502.05-$638 per week) ☐

$33,177-$41,340 per year (or $638.05-$795 per week) ☐

$41,341-$49,816 per year (or $796.05-$958 per week) ☐

$49,817-above (or $958.05 or more per week) ☐

Need to be $26,104 per year or $502 per week or less to be eligible

2. **Are you living in a Housing NSW tenant properties?**

Yes ☐
No ☐
Don't know ☐

Answer must be 'no' to be eligible

If "Don't know", then check if someone in the household is aware else book an appointment to be called back at a later date. Kindly note, if an appointment is made you will need to confirm that you are speaking with the same respondent and hence will need to confirm their answers by restarting the survey.

3. **Are you an Australian Resident, or an Australian Citizen?**

Yes ☐
No ☐

Answer must be 'yes' to be eligible

4. **Are you living in a separately metered house (i.e. not co-habiting, as in the case of a granny flat)?**

Yes ☐
No ☐

Answer must be 'yes' to be eligible

5. **Do you plan to stay in your current home until May 2016?**

Yes ☐
No ☐

Answer must be 'yes' to be eligible

You are invited to participate in a project which aims to explore approaches to encourage energy efficiency behaviours in the home among residents in the Illawarra. We are particularly interested in the views and experiences of residents in the community such as you. Your contribution to the study would be extremely valuable.

The Centre for Health Initiatives (CHI) at the University of Wollongong will be conducting interviewer administered questionnaire surveys in the community at three times points, approximately one year apart. The questionnaire surveys will only take up 30 minutes of your time, and will measure the knowledge, attitudes and behaviours of residents in relation to energy use in the home. Survey questionnaires will be administered at three time points, each one-year apart in: April/May 2014, April/May 2015, and April/May 2016. Participants will receive a $30 Coles/Myer voucher each time they complete a survey as recompense for their time. Researchers will arrange surveys at your convenience and will be friendly, polite and courteous. Your participation will be very important to inform strategies to help people use energy efficiently.

Would you be willing to take part in this important study?

If yes

"Now that you have indicated willingness to participate in the study, a staff member from the University of Wollongong's Centre for Health Initiative will be in contact with you in the next few days to arrange a face to face interview. The interview will last about 30 minutes, and will be scheduled at a time and location of your convenience (normally your home or a local amenity)."

Tell us about yourself:

Name (Head of household/household representative):

____

Gender:

Male ☐
Female ☐

Date of birth: _____ / ____ / _______

Address including Suburb and Postcode:

____

Telephone Number: ____

Email address: (or N/A):____

Household:

Own ☐
Renting ☐
Aged Care Facility ☐
Other (please state) ☐

____

SURVEY CONSENT FORM

Energy Efficiency in the Third Age

Researcher's Names: Dr Ross Gordon and Katherine Butler

I have read the participation information sheet and have had the opportunity to ask the researcher any further questions I may have had. I understand that my participation in this research is voluntary and I may withdraw at any time from the study without affecting my relationship with the University of Wollongong in any way.

I understand that the risks to me are minimal in this study. I understand that I will be involved in participating in three annual interview administered survey questionnaires regarding energy use: one in April/May 2014, April/May 2015, and April/May 2016; and answering questions that will be recorded and analysed. My name or any personal information will not be used to identify my comments or work in the study. However, de-identified survey data may be shared for the purposes of the LIEEP program with the Department of Industry, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Personal information may be made available to other organisations if it will prevent or lessen a serious or imminent threat to someone's life or health, if disclosure is required or authorised by law, if the disclosure is reasonably necessary for law enforcement purposes, or to protect public (the Commonwealth's) money.

We may contact you in the future to ask if you would be willing to participate in additional research as part of the project, but this will be entirely your decision and we would ask your consent to do so.

If I have any concerns or complaints regarding the way the research is or has been conducted I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 4221 4457.

By signing below I am consenting to:

- Participating in the interview administered surveys questionnaires;
- Sharing of de-identified survey data with the Department of Industry, and CSIRO;

- Sharing of personal information with other organisations if it will prevent or lesson a serious or imminent threat to someone's life or health, if disclosure is required or authorised by law, if the disclosure is reasonably necessary for law enforcement purposes, or to protect public (the Commonwealth's) money;
- The University potentially contacting you in the future about your willingness to take part in additional research as part of the project. If this happens you will be asked for your consent to take part in additional research, and will be able to choose not to without affecting your relationship with the University of Wollongong.

I understand that information from me will potentially be used for a research paper and possibly other published studies, and I consent for it to be used in this manner. I understand that once my personal information has been collected, I can request access to my personal information and request corrections, deletions or additions.

Signature: ____

Date: ____

Name (please print): ____

PARTICIPANT INFORMATION SHEET

Questionnaire Surveys

Project title: Energy Efficiency in the Third Age

Researchers: Dr Ross Gordon and Katherine Butler

What is the questionnaire survey?

You are invited to participate in a project that aims to explore approaches to encourage energy efficiency behaviours in the home among residents in the Illawarra. The project is funded as part of a Commonwealth program to: evaluate different approaches in various locations that assist older residents to be more energy efficient; and to capture and analyse data and information to inform future energy efficiency policy and program approaches. Further details about the Program can be obtained by contacting the Department of Industry, or by visiting the Department website: www.industry.gov.au.

We are particularly interested in the views and experiences of older residents. Your contribution to the study would be extremely valuable. The Centre for Health Initiatives (CHI) will be conducting interview administered questionnaire surveys with older residents in the Illawarra, Shoalhaven and Wingecarribee Shire, to explore the knowledge, attitudes and behaviours of older residents in relation to energy use in the home. Questionnaire surveys will be conducted at three time points, in April/May 2014, April/May 2015, and April/May 2016. Questionnaire surveys will be interview administered and will take place in participant's homes or at a convenient local venue such as community centres, public libraries, or service clubs according to your own stated preference.

We may contact you in the future to ask if you would be willing to participate in additional research as part of the project, but this will be entirely your decision and we would ask your consent to do so at that time.

What will happen during the interview?

You will participate in three questionnaire surveys administered by researchers from CHI at the University of Wollongong. Our facilitators for this project are Dr Ross Gordon, Katherine Roggeveen, and Katherine Butler – you can learn more about them at http://www.uow.edu.au/health/chi/staff/index.html.

The researchers will ask you a series of questions and record your responses using an iPad. Each questionnaire survey will last approximately 30 minutes.

You will be compensated for your time with a $30 gift voucher upon completion of each of the three surveys.

During the questionnaire survey you will be asked some questions about:

- Your knowledge of issues relating to energy use and energy efficiency;
- Your attitudes towards energy use and energy efficiency;
- Your behaviours in relation to energy use and energy efficiency;
- Your awareness and exposure to interventions to encourage energy efficiency; and
- Information on your household size, income, and demographic questions (e.g. age, gender, occupation, ethnicity).

Confidentiality and consent

Your participation is entirely voluntary and you are free to withdraw from the study at any stage. Refusal to participate in the study will not affect your relationship with the University of Wollongong.

You will be requested to sign a Consent Form prior to the first questionnaire survey to confirm your understanding of these things and to indicate that you are happy to participate in the study.

The questionnaire survey responses will be digitally recorded. This is necessary for analysis, so please be aware that if you would prefer your personal information and your responses not to be recorded, participation in the questionnaire surveys is not possible. However, any personal information will be de-identified, and the data files will be password protected, stored in a safe and secure location, and any identifying information will only be accessible by the project team.

Individual data will not be identifiable in any reports or publications that arise from this research. However, de-identified survey data may be shared for the purposes of the LIEEP program with the Department of Industry, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). This data may be used for the Program to: compile information and prepare reports to be disclosed to the Department of Industry to deliver the program according to the program objectives; to enable the Department of Industry to evaluate the outcomes of the program; to enable the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to conduct analysis on the data collected and report on the results; for the purposes of auditing compliance and safety and resolving complaints; as authorised or required by law; and for reporting publicly on the findings and performance of the Program. Published information such as reports will be based on aggregate data and personal information will not be identifiable.

Personal information may be made available to other organisations if it will prevent or lessen a serious or imminent threat to someone's life or health, if disclosure is required or authorised by law, if the disclosure is reasonably necessary for law enforcement purposes, or to protect public (the Commonwealth's) money.

This research has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the UOW Ethics Officer on (02) 4221 4457 or email rso-ethics@uow.edu.au .

If you have any further questions, please contact:

Dr Ross Gordon
Centre for Health Initiatives
University of Wollongong
Ph: (02) 4298 1946
Email: rgordon@uow.edu.au

Contact Details for the Department of Industry:
Low income Energy Efficiency Program (LIEEP)
Address: GPO Box 1564, Canberra, ACT 2601.
Phone number: 1800 509 607
Email address: lieep@climatechange.gov.au

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Participant Code

ID. **Interviewer - please enter the participant's ID below (please see -participant list)**

Introduction

. We would like to find out your views about energy use and energy efficiency overall. Please answer the questions honestly. If there is anything that you do not understand, please ask the interviewer to help you.

Knowledge

.
SECTION 1

This section explores your knowledge about energy use.

Please tick one box only for each question.

Q1. **Which of the following do you think uses the MOST ENERGY in the average Australian home in one year?**

- ○ Refrigerating food and beverages.
- ○ Heating and cooling rooms.
- ○ Heating and cooling water.
- ○ Lighting the home.
- ○ Cooking and preparing food.

***Q2.* Which of the following do you think uses the LEAST ENERGY in the average Australian home in one year?**

- ○ Refrigerating food and beverages.
- ○ Heating and cooling rooms.
- ○ Heating and cooling water.
- ○ Lighting the home.
- ○ Cooking and preparing food.

***Q3.* Which of the following items do you think uses the most electricity in the average Australian home in one year?**

- ○ Refrigerator
- ○ Lights
- ○ Telephone
- ○ Television
- ○ Computer

Q4.

Of the following, which do you think determines the amount of ELECTRICAL ENERGY (electricity) an appliance will consume?

- ○ The size of the appliance (litres or gallons), and the cost of electricity.
- ○ The temperature of the appliance when it is turned on, and the length of time it is turned on.
- ○ The power rating of the appliance (watts or kilowatts), and the cost of electricity.
- ○ The power rating of the appliance (watts or kilowatts), and the length of time it is turned on.
- ○ The power rating of the appliance (watts or kilowatts), and the size of the electric outlet.

Q5.
The best reason to buy an ENERGY STAR appliance is...

(NB. ENERGY STAR is an international standard for energy efficient products such as household appliances/heating and cooling systems, home electronics, and lighting.)

○ ENERGY STAR appliances are usually bigger.
○ ENERGY STAR appliances cost more to purchase.
○ ENERGY STAR appliances use less energy.
○ ENERGY STAR appliances are more modern looking.
○ ENERGY STAR appliances cost less to purchase.

Attitudes

. SECTION 2

This section explores your attitudes towards energy use.

Q6. (Please tick one box only for each question)

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I would do more to save energy if I knew how.	○	○	○	○	○
Saving energy is important.	○	○	○	○	○
We don't have to worry about conserving energy, because new technologies will be developed to solve the energy problems (such as resource depletion and energy-related environmental problems) for future generations.	○	○	○	○	○
All electrical appliances should have a label that shows the resources used in making them, their energy requirements, and operating costs.	○	○	○	○	○
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Australians should conserve more energy.	○	○	○	○	○
The way I personally use energy does not really make a difference to the energy problems that face our nation (such as resource depletion and energy-related environmental problems).	○	○	○	○	○
I believe that I can contribute to solving energy problems by making appropriate energy-related choices and actions.	○	○	○	○	○
I believe that I can contribute to solving					

Thermal Comfort of Home

. SECTION 3

This section explores your view on the thermal comfort of your home (i.e. keeping your home at a comfortable temperature).

Q7. **Please rate the level of comfort, in terms of temperature, of:**

	1 (hot)	2	3 (comfortable)	4	5 (cold)
Your home overall.	○	○	○	○	○
The main living room of your home.	○	○	○	○	○
Your bedroom.	○	○	○	○	○

Q8. (Please tick one box only for each question)

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
How satisfied are you with the temperature of your home overall during summer?	○	○	○	○	○
How satisfied are you with the temperature of your home overall during winter?	○	○	○	○	○
How satisfied are you with the temperature of your main living room during summer?	○	○	○	○	○
	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
How satisfied are you with the temperature of your main living room during winter?	○	○	○	○	○
How satisfied are you with the temperature of your bedroom during summer?	○	○	○	○	○
How satisfied are you with the temperature of your bedroom during winter?	○	○	○	○	○

Values

. SECTION 4

This section concerns your perceptions of the value of using energy efficiently overall. Please answer the questions as best you can based on what you think and know.

Q9. (Please tick one box only for each question)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Using energy efficiently can be done consistently.	○	○	○	○	○
Using energy efficiently can be done easily.	○	○	○	○	○
Using energy efficiently can be done according to my needs.	○	○	○	○	○
Using energy efficiently is beneficial.	○	○	○	○	○
Using energy efficiently can be done conveniently.	○	○	○	○	○
Using energy efficiently is something I can control.	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Using energy efficiently is reasonably priced.	○	○	○	○	○
Using energy efficiently offers value for money.	○	○	○	○	○
Using energy efficiently is economical.	○	○	○	○	○
Using energy efficiently makes me feel protected.	○	○	○	○	○
Using energy efficiently makes me feel comfortable.	○	○	○	○	○
Using energy					

Social Norms

. SECTION 5

This section explores your perceptions of social norms on energy use. Please answer the questions to the best of your ability based on what you know and think.

Q10. (Please tick one box only for each question)

	Never	Rarely	Sometimes	Often	Always
How often do you think your neighbours use energy efficiently?	○	○	○	○	○
How often do you think your friends use energy efficiently?	○	○	○	○	○
How often do you think people in Australia use energy efficiently?	○	○	○	○	○

Q11. (Please tick one box only for each question)

	Strongly disapprove	Disapprove	Would not care	Approve	Strongly approve
How much do you think your neighbours approve of people who use energy efficiently?	○	○	○	○	○
How much do you think your friends approve of people who use energy efficiently?	○	○	○	○	○
How much do you think Australian residents approve of people who use energy efficiently?	○	○	○	○	○

***Q12.* Have you tried to use energy efficiently during the last year?**

○ Yes

○ No

***Q13.* When people try to use energy efficiently, the people around them can sometimes help and sometimes make things harder, even if they don't realise it. Please indicate how helpful these people were when you tried to use energy efficiently in the past year.**

(Please tick one box only for each question)

	Not at all helpful	A little helpful	Usually helpful	Completely helpful	Not relevant to me
Spouse/partner	○	○	○	○	○
Children	○	○	○	○	○
Other relatives	○	○	○	○	○
Friends	○	○	○	○	○
Neighbours	○	○	○	○	○
Work Colleagues	○	○	○	○	○
Energy Suppliers	○	○	○	○	○
Local / State Government	○	○	○	○	○
National Government	○	○	○	○	○

Energy Use at Home

. Section 6

This section is about your own energy use at home.

***Q14.* In your household, how many operating fridges do you have?**

***Q15a.* Approximately how old is your fridge (in years)?**

***Q15b.* Approximately how old are your two fridges (in years)?**

Fridge 1
Fridge 2

***Q15c.* Approximately how old are your three fridges (in years)?**

Fridge 1
Fridge 2
Fridge 3

***Q15d.* Approximately how old are your four fridges (in years)?**

Fridge 1
Fridge 2
Fridge 3
Fridge 4

***Q16.* How frequently are each of the following household appliances used in your household?**

(Please tick the most appropriate box for each statement.)

	Multiple times per day	Once per day	Most days	Some days	Rarely	Never	I don't own one
Washing Machine	○	○	○	○	○	○	○
Clothes Dryer	○	○	○	○	○	○	○
Dishwasher	○	○	○	○	○	○	○

***Q17.* How frequently are each of the following household appliances used in your household?**

	Continuously	A few hours each day	Most days	Some days	Rarely	Never	I don't own one
Computer	○	○	○	○	○	○	○
Television	○	○	○	○	○	○	○
Separate Freezer	○	○	○	○	○	○	○
Air Conditioner (in summer)	○	○	○	○	○	○	○
Fan (in summer)	○	○	○	○	○	○	○
Heater (in winter)	○	○	○	○	○	○	○
Laptop / iPad / Tablet	○	○	○	○	○	○	○

***Q18.* Do you run an air conditioner in SUMMER, and if yes, what temperature (in degrees Celsius: °C) is your <u>main living area</u> maintained at?**

***Q19.* Do you run a heater in WINTER, and if yes, what temperature (in °C) is your <u>main living area</u> heated to?**

***Q20.* Do you run an air conditioner in SUMMER, and if yes, what temperature (in °C) is your <u>bedroom</u> maintained at?**

***Q21.* Do you run a heater in WINTER, and if yes, what temperature (in °C) is your <u>bedroom</u> heated to?**

***Q22.* Compared to this time last year, has your household energy use increased, decreased or remained the same?**

○ Increase in energy use.

○ Decrease in energy use.

○ No change in energy use.

Q23. (Please tick one box only for each question)

	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Don't own one
I always fill up my washing machine when washing.	○	○	○	○	○	○
For drying, I usually tumble dry my clothes.	○	○	○	○	○	○
I always turn off the lights in those rooms I'm not in.	○	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Don't own one
I never leave electrical appliances at home in standby mode.	○	○	○	○	○	○
I always unplug the mobile charger when it's not in use.	○	○	○	○	○	○
I try to buy energy efficient household appliances.	○	○	○	○	○	○

Q24. (Please tick one box only for each question)

	Never	Sometimes	Often	Always	Not applicable
I reduce the temperature in my hot water system.	○	○	○	○	○
I keep heating / air conditioning low to save energy.	○	○	○	○	○
I turn the heating / air conditioning off in unused rooms.	○	○	○	○	○

***Q25.* Do you use solar power?**

○ Yes

○ No

Recent Bills

***Q26.* What was the amount of your most recent electricity bill?**

○ Please write in dollars ($) below:

○ I don't remember.

***Q27.* How much electricity did you use in your most recent bill?**

○ Please write in kilowatts (kW) below:

○ I don't remember.

***Q28.* What was the Billing Period?**

○ Please write in below:

○ I don't remember.

***Q29.* How often do you pay your electricity bills?**

○ Fortnightly

○ Monthly

○ Quarterly

***Q30.* Do you use gas in your home?**

○ Yes

○ No

***Q31.* What was the amount of your most recent gas bill?**

○ Please write in dollars ($) below:

○ I don't remember.

***Q32.* How much gas did you use in your most recent bill in Megajoules (MJ)?**

○ Please write in megajoules (MJ) below:

○ I don't remember.

***Q33.* What was the Billing Period for this gas bill?**

○ Please write in below:

○ I don't remember.

***Q34.* How often do you pay your gas bill?**

○ Fortnightly

○ Monthly

○ Quarterly

Advertising or Campaigns

.

The survey questionnaire does not have much left to go. Your answers are really important to us so please take your time to answer the questions as best as you can.

Section 7:

***Q35.* Are you aware of any advertising, campaigns or interventions to encourage energy efficiency that are currently taking place?**

○ Yes

○ No

○ I don't know

***Q36.* What is the theme/slogan of this advertising, campaign or intervention?**

***Q37.* Who (or what group of people) is this advertising, campaign or intervention supposed to help?**

***Q38.* Are you aware of any other advertising, campaign or intervention to encourage energy efficiency that are currently taking place?**

○ Yes

○ No

○ Don't know

***Q39.* What is the theme/slogan of this advertising, campaign or intervention?**

***Q40.* Who (or what group of people) is this advertising, campaign or intervention supposed to help?**

Demographics

***.* This section asks some demographic questions.**

***Q41.* What is your age?**

***Q42.* What is your gender?**

○ Male
○ Female

Q43.* What is your date of birth? (*Enter as dd/mm/yyyy)

***Q44.* Do you have any children, and if yes, how many?**

***Q45.* Do you regard yourself as belonging to any particular religion?**

○ Catholic
○ Anglican (Church of England)
○ Uniting Church
○ Presbyterian
○ Orthodox
○ Chinese Popular Religion
○ Taoism
○ Buddhist
○ Hindu
○ Jewish
○ Muslim
○ Sikh
○ Atheist
○ Agnostic
○ None
○ Other - please specify

Q46.* What is your ancestry? *Please tick up to <u>two</u> boxes only.

☐ Aboriginal / Torres Strait Islander
☐ Australian
☐ Italian
☐ Lebanese
☐ Filipino
☐ English
☐ Greek
☐ Dutch
☐ Indian
☐ Irish
☐ Scottish
☐ Maltese
☐ Croatian
☐ Chinese
☐ German
☐ Polish
☐ Vietnamese
☐ Other - please specify

***Q47.* In which country were you born?**

***Q48.* Which of these best describes you?**

○ Married
○ Living with partner
○ Single (never married and not living with partner)
○ Widowed
○ Separated
○ Divorced

Q49. **What is the occupation of the head of the household in which you live?**

○ Retired
○ Manager
○ Professional
○ Technician and Trades Worker
○ Community and Personal Service Worker
○ Clerical and Administrative Worker
○ Sales Worker
○ Machinery Operator and / or Driver
○ Labourer
○ Other

Q50. **What is your annual disposable income (after tax and Medicare levy)?**

Q51. **What is the highest level of education you have completed?**

○ Less than High School
○ High School
○ College / TAFE
○ University Degree (3 years)
○ Honours Degree (4 years)
○ Master's Degree
○ Doctoral Degree
○ Professional Degree (MD / JD)

Q52. **Which of the following best describes your housing situation? Do you live in:**

○ A house

○ A flat / unit / apartment / villa / townhouse

○ Mobile home / caravan / cabin / houseboat

○ Retirement village / self-care unit

○ Nursing home

○ Hostel

○ Other, please specify

Q53. **How many people (including yourself) currently live in your household?**

Q54. **How many bedrooms are there? Please count all bedrooms, even if they are not currently used as bedrooms (e.g. a study).**

Q55. Is this dwelling:

(*Life Tenure refers to households or individuals who have a life tenure contract to live in the dwelling but usually do not have any equity in the dwelling)

○ Owned by you outright?
○ Owned with a mortgage?
○ Being purchased under a rent/buy scheme?
○ Being rented?
○ Being occupied rent free?
○ Being occupied under a life tenure scheme*?
○ Other:

Survey Complete

Q56. We may contact you in the future to ask your permission to take part in additional research. Would you be willing to allow us to contact you for this purpose?

○ Yes
○ No

Q57. What is the best way to contact you? Please write the contact details below.

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Participant Code

RA. **Interviewer - enter your name:**

☐

ID. **Interviewer - enter the participant's ID below (please see -participant list)**

☐

Introduction

. We would like to find out your views about energy use and energy efficiency overall. Please answer the questions honestly. If there is anything that you do not understand, please ask the interviewer to help you.

Knowledge

.
SECTION 1

This section explores your knowledge about energy use.

Please tick one box only for each question.

Q1. **Which of the following do you think uses the MOST ENERGY in the average Australian home in one year?**

○ Refrigerating food and beverages.

○ Heating and cooling rooms.

○ Heating and cooling water.

○ Lighting the home.

○ Cooking and preparing food.

***Q2.* Which of the following do you think uses the LEAST ENERGY in the average Australian home in one year?**

○ Refrigerating food and beverages.

○ Heating and cooling rooms.

○ Heating and cooling water.

○ Lighting the home.

○ Cooking and preparing food.

***Q3.* Which of the following items do you think uses the most electricity in the average Australian home in one year?**

○ Refrigerator

○ Lights

○ Telephone

○ Television

○ Computer

Q4.
Of the following, which do you think determines the amount of ELECTRICAL ENERGY (electricity) an appliance will consume?

○ The size of the appliance (litres or gallons), and the cost of electricity.

○ The temperature of the appliance when it is turned on, and the length of time it is turned on.

○ The power rating of the appliance (watts or kilowatts), and the cost of electricity.

○ The power rating of the appliance (watts or kilowatts), and the length of time it is turned on.

○ The power rating of the appliance (watts or kilowatts), and the size of the electric outlet.

Q5.
The best reason to buy an ENERGY STAR appliance is...

(NB. ENERGY STAR is an international standard for energy efficient products such as household appliances/heating and cooling systems, home electronics, and lighting.)

○ ENERGY STAR appliances are usually bigger.

○ ENERGY STAR appliances cost more to purchase.

○ ENERGY STAR appliances use less energy.

○ ENERGY STAR appliances are more modern looking.

○ ENERGY STAR appliances cost less to purchase.

Attitudes

***.* SECTION 2**

This section explores your attitudes towards energy use.

Q6. (Please tick one box only for each question)

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I would do more to save energy if I knew how.	○	○	○	○	○
Saving energy is important.	○	○	○	○	○
We don't have to worry about conserving energy, because new technologies will be developed to solve the energy problems (such as	○	○	○	○	○

resource depletion and energy-related environmental problems) for future generations.					
All electrical appliances should have a label that shows the resources used in making them, their energy requirements, and operating costs.	○	○	○	○	○
	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Australians should conserve more energy.	○	○	○	○	○
The way I personally use energy does not really make a difference to the energy problems that face our nation (such as resource depletion and energy-related environmental problems).	○	○	○	○	○
I believe that I can contribute to solving energy problems by making appropriate energy-related choices and actions.	○	○	○	○	○
I believe that I can contribute to solving energy problems by working with others.	○	○	○	○	○

Thermal Comfort of Home

. SECTION 3

This section explores your view on the thermal comfort of your home (i.e. keeping your home at a comfortable temperature).

***Q7.* Please rate the level of comfort, in terms of temperature, of:**

	1 (hot)	2	3 (comfortable)	4	5 (cold)
Your home overall.	○	○	○	○	○
The main living room of your home.	○	○	○	○	○
Your bedroom.	○	○	○	○	○

Q8. (Please tick one box only for each question)

	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
How satisfied are you with the temperature of your home overall during summer?	○	○	○	○	○
How satisfied are you with the temperature of your home overall during winter?	○	○	○	○	○
How satisfied are you with the temperature of your main living room during summer?	○	○	○	○	○
	Very dissatisfied	Dissatisfied	Neither dissatisfied nor satisfied	Satisfied	Very satisfied
How satisfied are you with the temperature of your main living room during winter?	○	○	○	○	○
How satisfied are you with the temperature of your bedroom	○	○	○	○	○

during summer?					
How satisfied are you with the temperature of your bedroom during winter?	○	○	○	○	○

Values

. SECTION 4

This section concerns your perceptions of the value of using energy efficiently overall. Please answer the questions as best you can based on what you think and know.

Q9. (Please tick one box only for each question)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Using energy efficiently can be done consistently.	○	○	○	○	○
Using energy efficiently can be done easily.	○	○	○	○	○
Using energy efficiently can be done according to my needs.	○	○	○	○	○
Using energy efficiently is beneficial.	○	○	○	○	○
Using energy efficiently can be done conveniently.	○	○	○	○	○
Using energy efficiently is something I can control.	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Using energy efficiently is reasonably priced.	○	○	○	○	○
Using energy efficiently offers value for money.	○	○	○	○	○
Using energy efficiently is economical.	○	○	○	○	○
Using energy efficiently makes me feel protected.	○	○	○	○	○
Using energy efficiently makes me feel comfortable.	○	○	○	○	○
Using energy efficiently makes me feel safe.	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Using energy efficiently makes me feel happy.	○	○	○	○	○
Using energy efficiently makes me feel calm.	○	○	○	○	○
Using energy efficiently makes me feel relieved.	○	○	○	○	○
Using energy efficiently makes me feel proud.	○	○	○	○	○
Using energy efficiently would help me to feel acceptable.	○	○	○	○	○
Using energy efficiently would improve the way I am perceived.	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Using energy efficiently would make a good impression on other people.	○	○	○	○	○
Using energy efficiently is environmentally friendly.	○	○	○	○	○
Using energy efficiently pollutes the environment only marginally.	○	○	○	○	○
Using energy efficiently is more environmentally friendly than not to do so.	○	○	○	○	○

Social Norms

. SECTION 5

This section explores your perceptions of social norms on energy use. Please answer the questions to the best of your ability based on what you know and think.

Q10. (Please tick one box only for each question)

	Never	Rarely	Sometimes	Often	Always
How often do you think your neighbours use energy efficiently?	○	○	○	○	○
How often do you think your friends use energy efficiently?	○	○	○	○	○
How often do you think people in Australia use energy efficiently?	○	○	○	○	○

Q11. (Please tick one box only for each question)

	Strongly disapprove	Disapprove	Would not care	Approve	Strongly approve
How much do you think your neighbours approve of people who use energy efficiently?	○	○	○	○	○
How much do you think your friends approve of people who use energy efficiently?	○	○	○	○	○
How much do you think Australian residents approve of people who use energy efficiently?	○	○	○	○	○

***Q12.* Have you tried to use energy efficiently during the last year?**

○ Yes

○ No

***Q13.* When people try to use energy efficiently, the people around them can sometimes help and sometimes make things harder, even if they don't realise it. Please indicate how helpful these people were when you tried to use energy efficiently in the past year.**

(Please tick one box only for each question)

	Not at all helpful	A little helpful	Usually helpful	Completely helpful	Not relevant to me
Spouse/partner	○	○	○	○	○
Children	○	○	○	○	○
Other relatives	○	○	○	○	○
Friends	○	○	○	○	○

Neighbours	○	○	○	○	○
Work Colleagues	○	○	○	○	○
Energy Suppliers	○	○	○	○	○
Local / State Government	○	○	○	○	○
National Government	○	○	○	○	○

Energy Use at Home

. Section 6

This section is about your own energy use at home.

Q14. **In your household, how many operating fridges do you have?**

▾

Q15a. **Approximately how old is your fridge (in years)?**

▾

Q15b. **Approximately how old are your two fridges (in years)?**

Fridge 1	▾
Fridge 2	▾

Q15c. **Approximately how old are your three fridges (in years)?**

Fridge 1	▾
Fridge 2	▾
Fridge 3	▾

***Q15d.* Approximately how old are your four fridges (in years)?**

Fridge 1	▼
Fridge 2	▼
Fridge 3	▼
Fridge 4	▼

***Q16.* How frequently are each of the following household appliances used in your household?**

(Please tick the most appropriate box for each statement.)

	Multiple times per day	Once per day	Most days	Some days	Rarely	Never	I don't own one
Washing Machine	○	○	○	○	○	○	○
Clothes Dryer	○	○	○	○	○	○	○
Dishwasher	○	○	○	○	○	○	○

***Q17.* How frequently are each of the following household appliances used in your household?**

	Continuously	A few hours each day	Most days	Some days	Rarely	Never	I don't own one
Computer	○	○	○	○	○	○	○
Television	○	○	○	○	○	○	○
Separate Freezer	○	○	○	○	○	○	○
Air Conditioner (in summer)	○	○	○	○	○	○	○
Fan (in summer)	○	○	○	○	○	○	○
Heater (in winter)	○	○	○	○	○	○	○
Laptop / iPad / Tablet	○	○	○	○	○	○	○

Q18. **Do you run an air conditioner in SUMMER, and if yes, what temperature (in degrees Celsius: °C) is your <u>main living area</u> maintained at?**

▾

Q19. **Do you run a heater in WINTER, and if yes, what temperature (in °C) is your <u>main living area</u> heated to?**

▾

Q20. **Do you run an air conditioner in SUMMER, and if yes, what temperature (in °C) is your <u>bedroom</u> maintained at?**

▾

Q21. **Do you run a heater in WINTER, and if yes, what temperature (in °C) is your <u>bedroom</u> heated to?**

▾

Q22. **Compared to this time last year, has your household energy use increased, decreased or remained the same?**

- ○ Increase in energy use.
- ○ Decrease in energy use.
- ○ No change in energy use.

Q23. (Please tick one box only for each question)

	Strongly	Neither Disagree nor	Strongly	Don't

	Disagree	Disagree	Agree	Agree	Agree	own one
I always fill up my washing machine when washing.	○	○	○	○	○	○
For drying, I usually tumble dry my clothes.	○	○	○	○	○	○
I always turn off the lights in those rooms I'm not in.	○	○	○	○	○	○
	Strongly Disagree	Disagree	Neither Disagree nor Agree	Agree	Strongly Agree	Don't own one
I never leave electrical appliances at home in standby mode.	○	○	○	○	○	○
I always unplug the mobile charger when it's not in use.	○	○	○	○	○	○
I try to buy energy efficient household appliances.	○	○	○	○	○	○

Q24. (Please tick one box only for each question)

	Never	Sometimes	Often	Always	Not applicable
I reduce the temperature in my hot water system.	○	○	○	○	○
I keep heating / air conditioning low to save energy.	○	○	○	○	○
I turn the heating / air conditioning off in unused rooms.	○	○	○	○	○

Q25. **Do you use solar power?**

○ Yes

○ No

Recent Bills

Q26. **What was the amount of your most recent electricity bill?**

○ Please write in dollars ($) below:

○ I don't remember.

Q27. **How much electricity did you use in your most recent bill?**

○ Please write in kilowatts (kW) below:

○ I don't remember.

Q28. **What was the Billing Period?**

○ Please write in below:

○ I don't remember.

Q29. **How often do you pay your electricity bills?**

○ Fortnightly

○ Monthly

○ Quarterly

○ Other, please specify:

***Q30.* Do you use gas in your home?**

○ Yes

○ No

***Q31.* What was the amount of your most recent gas bill?**

○ Please write in dollars ($) below:

○ I don't remember.

***Q32.* How much gas did you use in your most recent bill in Megajoules (MJ)?**

○ Please write in megajoules (MJ) below:

○ I don't remember.

***Q33.* What was the Billing Period for this gas bill?**

○ Please write in below:

○ I don't remember.

***Q34.* How often do you pay your gas bill?**

○ Fortnightly

○ Monthly

○ Quarterly

○ Other, please specify:

Advertising or Campaigns

.

The survey questionnaire does not have much left to go. Your answers are really important to us so please take your time to answer the questions as best as you can.

Section 7:

***Q35.* Are you aware of any intervention, campaign, project or advertising to encourage energy efficiency that are currently taking place?**

○ Yes

○ No

○ I don't know

***Q35b.* Have you seen, or been involved in, or received anything from any projects promoting energy efficiency from any organisation, company or university?**

○ Yes

○ No

○ I don't know

***Q35c.* Have you seen, or been involved in, or received anything from any of the following projects (tick all that apply):**

☐ My Power

☐ Energy+Illawarra

☐ Power To Be

☐ Energy Every Day

☐ None of the above

***Q36.* What do you recall was the theme or slogan of this project, advertising, campaign or intervention?**

Q36b. **Was the theme or slogan of this intervention, campaign, project or advertising one of the following?**

○ My Power

○ Energy+Illawarra

○ Power to Be

○ Energy Every Day

○ Other, please specify

○ I don't know

Q37. **Who (or what group of people) is this intervention, campaign, project or advertising supposed to help?**

Q37b. **Of the following, who (or what group of people) do you think this intervention, campaign, project or advertising is aiming to help?**

○ Young people

○ People aged 60 and over

○ Parents, mothers and fathers

○ Everyone

○ Other, please specify:

○ I don't know

Q37c. **Where did you see or hear the messages from this intervention, campaign, project or advertising on energy efficiency? Please tick all that apply.**

☐

TV

☐ Newsletter Brochure

☐ Radio

☐ Newspapers and/or magazines

☐ Billboards / bus posters

☐ Video Brochure

☐ Website

☐ Facebook

☐ Twitter

☐ Other, please specify:

Q37d. **As part of this intervention, campaign, project or advertising, have you received or taken part in any of the following (please tick all that apply):**

☐ Newsletter

☐ Small products, such as a fridge magnet thermometer or a remote controlled power socket

☐ Retrofit to your home, for example energy efficient improvements such as insulation, installation of a reverse cycle air conditioning unit, replacement of an old fridge

☐ Energy monitoring support system in your home, including ibuttons and video interviews

☐ Attended a Community Seminar or Workshop on energy efficiency held by WEA Illawarra

☐ Watched educational videos or visual fact sheets on energy efficiency

☐ Visited and looked around the Energy+Illawarra website

☐ None of the above, I have not received or taken part in any of the above.

☐ I have received or taken part in something else not listed here (please specify):

Q38. **Are you aware of any other intervention, campaign, project or advertising to encourage energy efficiency that are currently taking place?**

○ Yes

○ No

○ Don't know

Q39. **What is the theme/slogan of this intervention, campaign, project or advertising?**

Q40. **Who (or what group of people) is this intervention, campaign, project or advertising supposed to help?**

Demographics

. **This section asks some demographic questions.**

Q41. **What is your age?**

▼

Q42. **What is your gender?**

○ Male

○ Female

***Q43.* What is your date of birth? (*Enter as dd/mm/yyyy*)**

***Q44.* Do you have any children, and if yes, how many?**

▼

***Q44b.* If you do have a child or children, how many are currently living with you at home?**

▼

***Q45.* Do you regard yourself as belonging to any particular religion?**

○ Catholic
○ Anglican (Church of England)
○ Uniting Church
○ Presbyterian
○ Orthodox
○ Chinese Popular Religion
○ Taoism
○ Buddhist
○ Hindu
○ Jewish
○ Muslim
○ Sikh
○ Atheist
○ Agnostic
○ None
○ Other - please specify

Q46.* What is your ancestry? *Please tick up to two boxes only.

☐ Aboriginal / Torres Strait Islander
☐ Australian
☐ Italian
☐ Lebanese
☐ Filipino
☐ Irish
☐ Scottish
☐ Maltese
☐ Croatian
☐ Chinese

☐ English
☐ Greek
☐ Dutch
☐ Indian
☐ German
☐ Polish
☐ Vietnamese
☐ Other - please specify ________

***Q47.* In which country were you born?**

[▾]

***Q48.* Which of these best describes you?**

○ Married
○ Living with partner
○ Single (never married and not living with partner)
○ Widowed
○ Separated
○ Divorced

***Q49.* What is the occupation of the head of the household in which you live?**

○ Retired
○ Manager
○ Professional
○ Technician and Trades Worker
○ Community and Personal Service Worker
○ Clerical and Administrative Worker
○ Sales Worker
○ Machinery Operator and / or Driver
○ Labourer
○ Other

Q50. **What is your annual disposable income (after tax and Medicare levy)?**

▾

Q51. **What is the highest level of education you have completed?**

○ Less than High School

○ High School

○ College / TAFE

○ University Degree (3 years)

○ Honours Degree (4 years)

○ Master's Degree

○ Doctoral Degree

○ Professional Degree (MD / JD)

Q52. **Which of the following best describes your housing situation? Do you live in:**

○ A house

○ A flat / unit / apartment / villa / townhouse

○ Mobile home / caravan / cabin / houseboat

○ Retirement village / self-care unit

○ Nursing home

○ Hostel

○ Other, please specify

Q53. **How many people (including yourself) currently live in your household?**

▾

Q54. **How many bedrooms are there? Please count all bedrooms, even if they are not currently used as bedrooms (e.g. a study).**

▾

Q55. **Is this dwelling:**

(*Life Tenure refers to households or individuals who have a life tenure contract to live in the dwelling but usually do not have any equity in the dwelling)

○ Owned by you outright?

○ Owned with a mortgage?

○ Being purchased under a rent/buy scheme?

○ Being rented?

○ Being occupied rent free?

○ Being occupied under a life tenure scheme*?

○ Other:

Survey Complete

Q56. **We may contact you in the future to ask your permission to take part in additional research. Would you be willing to allow us to contact you for this purpose?**

○ Yes

○ No

Q57. **What is the best way to contact you? Please write the contact details below.**

Focus Group Discussion Guide

INTRODUCTION

My name is … and I am from the University of Wollongong's Centre for Health Initiatives. We have spoken about the research project being undertaken – 'Energy Efficiency in the 3rd Age'. Can I confirm that you all received a Participant Information Sheet? Does anyone have any questions before we proceed?

I need your consent to go ahead with the focus group. The discussion will take approximately sixty minutes. Can you please read the consent form I have provided you each with? At this point I will also remind you that I intend to record our conversation on a digital recorder so that I can produce a typed transcript. If this is OK with everyone, please sign the consent form to participate in this focus group.

Thank you, we are ready to commence the discussion.

DISCUSSION QUESTIONS

(don't read out text in red)

[Seeking to understand

- Knowledge
- Attitudes
- Value perceptions
- Behaviours
- Social norms
- Barriers
- Potential strategies at multiple levels of engagement:
    - Individual level
    - Social support level
    - Wider environment e.g. policy, energy suppliers.]

[Starter (about 5 minutes)]

While I'm collecting the consent forms and we're settling in, please take a minute to think about how you make yourself comfortable (warm) in winter at home.

OK could you share that with the group now – just call it out.

Follow up:

1. Is this your preferred way of keeping warm?
2. If not, what would be?
3. Does the way you keep warm have anything to do with using energy efficiently?
4. Have you always kept warm this way?

Thanks everyone – this is the sort of thing we want you to think about today when we talk about how you use energy at home – it's about everyday practices and keeping comfortable.

[Knowledge]

5. What do you understand is meant by the phrase 'energy efficiency'?

   Only if people directly ask moderator for a definition, provide a basic definition: *NSW Govt defines energy efficiency as "about achieving 'more with less' by utilising the energy we use, to meet our needs and avoid energy waste, to achieve the same or greater results for our homes and businesses" and "getting the most from the energy".*

6. To begin with, what do you think are the significant contributors to energy consumption/use in Australian homes?
7. From where would you say you've gained your knowledge about energy efficiency?

[Perceived knowledge]

8. Do you consider you know a little, or a fair bit about energy efficiency?

[Attitudes]

9. Would you do more to save energy if you knew how?
10. Is it important to save energy?
    a. Why?

11. What would you say if someone said to you that we don't have to worry about conserving energy because new technologies will be developed to solve any energy problems for future generations?
12. Do you think all electrical appliances should have a label that shows the resources used in making them, their energy requirements, so that you can work out how much it will cost you to run?
13. Do you think Australians should conserve more energy?
    a. In their homes? To what extent (a little or a lot?)
14. Does the way you use energy make a difference to energy problems at a national level?
15. Do you believe that you can contribute to solving energy problems by the way you use energy?

    PROMPT: when you buy new appliances or make changes to your home
    PROMPT: by the actions you take day to day

16. Do you believe that you can contribute to solving energy problems by working with others?

[Value perceptions]

[Functional value]

Thinking about energy use and energy efficiency in your home life:

17. Is using energy efficiently something that can be done consistently?
    a. Please expand on your answer.
18. Is it easy to use energy efficiently?
    a. Is it convenient?

   b. Is it easy to be consistent?
   c. Is it something you can control?
   d. Can you still meet your needs?
   e. Please expand on your answer

19. Can you use energy efficiently in a way that still meets your needs?
   a. If no, please expand.
20. Is it beneficial to use energy efficiently?
   a. Why/why not?
21. Do you think that you can control energy efficiency?

[Economic value]

22. Is it economical to use energy efficiently?
23. Does energy efficiency offer value for money?
   a. PROMPT: Is energy efficiency reasonably priced?

[Emotional value]

24. I'm going to mention some different emotions and I'd like you to tell me if you feel any of them when you are using energy efficiently (expand on any as appropriate):
   a. Protected
   b. Comfortable
   c. Safe
   d. Happy
   e. Calm
   f. Relieved
   g. Proud

[Social value]

25. Does using energy efficiently help you feel more acceptable to others?
26. Does using energy efficiently improve the way you are perceived?
    a. PROMPT: more acceptable?
    b. PROMPT: make a good impression?
27. Would using energy efficiently make a good impression on other people?

[Ecological value]

28. Is it environmentally friendly to be energy efficient?
29. By using energy efficiently, would you agree that we are still polluting the environment, but to a lesser degree?
30. Would you say that using energy efficiently is more environmentally friendly than not doing so?

[Behaviours]

31. How do you mostly use energy in your home?
    a. PROMPT: Heating/Cooling/Cooking/Washing/Lighting/Entertainment.
32. Do you regulate or prioritise your energy use in any way?
    a. PROMPT Do you compromise on some activities but not others?
    b. PROMPT Does this change at different times e.g. of the week or year, if you are home alone or with others, if you are not feeling well?
33. We talked about keeping warm and heating earlier, what about keeping cool in summer? How do you keep cool and how do your practices relate to energy use?
34. *[N.b. Skip this question if no one has indicated that they compromise on comfort.]*

In terms of thermal comfort – is it just the hottest and coldest days or more often that there is an issue? i.e. how often are you thinking about your energy use and compromising comfort?

35. Compared to this time last year, has your household energy use (not price) increased, decreased or remained about the same? Why?
36. Are electricity or gas bills a concern for you?
37. Expand on any of the other energy intensive activities if necessary – cooking, washing, lighting, entertainment.

[Social norms] should take <5mins

38. Do you think people in the Illawarra/this region generally care about energy efficiency?
39. Do you talk about energy use with others? Eg. Friends, family, neighbours, people who live far away (eg on the phone), or around here?
40. Do you talk about keeping warm or keeping cool with others? Eg. Friends, family, neighbours, people who live far away (eg on the phone), or around here?

[Barriers]

41. What do you think are some of the issues relating to energy use and energy efficiency?
    a. PROMPT: do any issues particularly relate to financial cost?
    b. PROMT: do any issues particularly relate to people near to or following retirement?

c. PROMPT: do any issues particularly relate to health?

d. PROMPT: do any issues particularly relate to renters?

42. What are some of the barriers to using energy efficiently in your home day to day?

    a. PROMPT: finances?

    b. PROMPT: information?

    c. PROMPT: Government?

    d. PROMPT: Energy suppliers?

    e. PROMPT: Health/physical strength and abilities?

    f. PROMPT: Access (eg to gas supply)?

    g. PROMPT: Others?

43. What are some of the barriers to making changes to your home so that you can use energy more efficiently?

    a. PROMPT: finances?

    b. PROMPT: information?

    c. PROMPT: Government?

    d. PROMPT: Energy suppliers?

    e. PROMPT: Health/physical strength and abilities?

    f. PROMPT: Access (eg to gas supply)?

    g. PROMPT: Others?

[Potential strategies]

44. When trying to help people be more energy efficient at home, what is most important to focus on:

    a. How people go about everyday activities in their houses;
    b. Changes to their actual house to make it more efficient; or
    c. Broader policy or social or community initiatives around household energy use?

45. Could you expand on your thoughts here?
46. Do you have any thoughts on potential strategies that could be used to encourage people to use energy efficiently?
47. Do you have any thoughts on strategies that could be used to help you achieve energy efficiency and thermal comfort (keeping warm enough in winter and cool enough in summer) in your *own house*?

    OR

    Do you have any thoughts on strategies that could be used to help you achieve energy efficiency and thermal comfort (keeping warm enough in winter and cool enough in summer) in your *rental property*?

[Individual level]

48. Have you ever made changes to increase energy efficiency in your own home?
    a. PROMPT: have you advocated for energy efficiency in your rental properties?

[Social/wider environment/policy levels (questions cover various)]

49. *(If renters in group)* Do you think landlords can play a role in assisting renters be more energy efficient?
50. Do you see anything that could be addressed to support you to achieve energy efficiency and thermal comfort?
    a. What could the management of this village do?
    b. What could government do?

  c. What could energy companies do?
  d. What could contractors/tradespeople [that install appliances/deal with energy related products/services] do?
  e. What could friends and family do?
  f. What could neighbours do?

51. Have you received advice about energy efficiency or keeping warm and cool at home from any of the following groups?
    a. Friends
    b. Neighbours
    c. Colleagues
    d. Spouse or partner
    e. Children
    f. Other family
    g. Government
    h. Energy suppliers
52. Was the advice helpful? Did you follow it?
53. Which group of people would you trust most when it comes to advice on energy efficiency?
54. Many people have told us that they don't really talk with others about how they keep warm and cool at home….do you – and which groups of people?

    ONLY PROMPT IF NEEDED, AND THEN READ WHOLE LIST:

    a. Friends
    b. Neighbours
    c. Colleagues
    d. Spouse or partner

   e. Children

   f. Other family

   g. Government

   h. Energy suppliers

55. Who is your support network on a really hot or cold day?

56. How would talking more with others about keeping warm and cool help keep you more comfortable?

57. *Have onion diagram and suggest social marketing strategies* – do you think x would be useful for you? What about y? etc

58. Is there anything else you would like to add?

CONCLUSION

That's all the questions I have for you all. Does anyone have any questions for me about this focus group or the project in general?

Thank you very much for your participation today. I'd like to remind you all that the information provided will be kept confidential, and the Participant Information Sheet contains my details, as well as the UOW Ethics Office, if you have any queries. If you wish to withdraw from the study, you can contact me by those details, or I can provide you with them now.

Please feel free to contact me if you think of anything else you would like to add to our discussion, or if you have any other questions.

FOCUS GROUP CONSENT FORM

Energy Efficiency in the Third Age

Researchers: Dr Ross Gordon, Kate Roggeveen, Katherine Butler

I have read the Participation Information Sheet and have had the opportunity to discuss the research project with one of the 'Energy Efficiency in the Third Age project' team members who are conducting this research through the University of Wollongong. At this time I have asked any questions about the research and my participation.

I understand that my participation in this research is voluntary; I have been invited to participate and I am free to withdraw from the research at any time. My non-participation or withdrawal of consent will not affect my relationship with the University of Wollongong.

I understand that the risks to me in this study are minimal. I understand that my involvement consists of participating in a focus group/paired interview, which will be digitally recorded and transcribed. My name or personal contact details (such as address, phone number or email) that I provide will not be used to identify my comments or work in the study. However, de-identified data may be shared for the purposes of the Low Income Energy Efficiency Program with the Commonwealth of Australia as represented by the Department of Industry and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Personal information may be made available to these or other organisations, which may include if it will prevent or lessen a serious threat to the life, health or safety of any individual, or to public health or safety, or if the disclosure is required or authorised by law.

If I have any enquiries about the research, I can contact Dr Ross Gordon (02 9850 8559; email ross.gordon@mq.edu.au) or Kate Roggeveen (02 4221 3156; email katerogg@uow.edu.au). If I have any concerns or complaints regarding the way the research is or has been conducted, I can contact the Ethics Officer, Human Research Ethics Committee, Office of Research, University of Wollongong on 02 4221 3386 or email rso-ethics@uow.edu.au. If I have any concerns I can also contact the Department of Industry on 13 28 46 or email lieep@industry.gov.au.

By signing below I am consenting to (please tick):

☐ Participating in the focus group/paired interview.

☐ The facilitator digitally (audio) taping the focus group for research purposes.

☐ Sharing of de-identified data with the Department of Industry and CSIRO.

☐ Sharing of personal information with other organisations, which may include if it will prevent or lessen a serious threat to the life, health or safety of any individual, or to the public health or safety, or if the disclosure is required or authorised by law.

☐ Information from me being used by the University of Wollongong for research papers and other scholarly or general publications, conference presentations and reports.

I understand that once my personal information has been collected, I can request access to my personal information and request corrections, deletions or additions.

Signature: ____

Date: ____

Name (please print): ____________________________________

Centre for Health Initiatives
UNIVERSITY OF WOLLONGONG

Dear Participant,

You are invited to participate in a project which aims to explore approaches to encourage energy efficiency behaviours in the home among residents in the Illawarra, Shoalhaven and Wingecarribee Shire. We are particularly interested in the views and experiences of residents in the community such as you. Your contribution to the study would be extremely valuable.

The Centre for Health Initiatives (CHI) will be conducting focus group/paired interviews discussions in the Illawarra, Shoalhaven and Wingecarribee Shire in August-October 2014 to explore the knowledge, attitudes and behaviours of residents in relation to energy use in the home. The groups will consist of between 2 and 6 people and will be conducted in a convenient local venue such as community centres, libraries or easily accessible places for your convenience. Focus groups will last approximately one hour.

Participation will be completely voluntary and you will not be identified in publications. As a thank you for your time, you will receive a $50 gift voucher.

If you are interested in participating in these focus groups or have any other questions about participation please contact Kate Roggeveen on –

Ph: 02 4221 3156

Email: katerogg@uow.edu.au

PARTICIPANT INFORMATION SHEET

Focus Groups

Project title: Energy Efficiency in the Third Age

Researchers: Dr Ross Gordon, Kate Roggeveen, Katherine Butler

Purpose of the research

You are invited to participate in a project that aims to explore approaches to encourage energy efficiency behaviours in the home among residents in the Wingecarribee Shire, the Illawarra, and the Shoalhaven. The project is funded as part of a Commonwealth program – the Low Income Energy Efficiency Program – to inform future energy efficiency policy and programs that assist the energy efficiency of older residents' homes. Further details about the Program can be obtained by contacting the Department of Industry, or by visiting the Department website: www.industry.gov.au.

We are particularly interested in the views and experiences of older residents. Your contribution to the study would be extremely valuable. The Centre for Health Initiatives at the University of Wollongong will be conducting focus group/paired interviews discussions in the Illawarra, Shoalhaven and Wingecarribee Shire to explore the knowledge, attitudes and behaviours of residents in relation to energy use in the home. The groups will be held in approximately August-October 2014. The groups will consist of two to six people and will be conducted in a convenient local venue such as community centres, libraries or easily accessible places for your convenience, or in the case of a friendship group, potentially in the home of a group member, according to your stated preference.

What will happen during the focus groups?

You will participate in a focus group discussion with one to five other participants, led by a facilitator from the Centre for Health Initiatives at the University of Wollongong. Our facilitators for this project are Dr Ross Gordon, Kate Roggeveen and Katherine Butler.

The focus group will last around one hour. You will be compensated for your time with a $50 gift voucher. During the focus group you will be asked some questions about:

- Your knowledge of issues relating to energy use and energy efficiency
- Your attitudes towards energy use and energy efficiency
- Your behaviours in relation to energy use and energy efficiency
- Some of the barriers to using energy efficiently
- Issues and barriers in relation to achieving thermal comfort (keeping cool enough in summer and warm enough in winter) in your home
- Your views on potential strategies to encourage people to use energy efficiently, and to achieve thermal comfort.

Confidentiality and consent

The focus groups/interviews will be digitally recorded. This is necessary for analysis, so please be aware that if you'd prefer your voice not to be recorded, participation in this group discussion is not possible. However, the digital files will be destroyed after transcription. You are not required to provide your name or other personal details on the audio recording.

Your participation in the study is voluntary and you are free to discontinue at any stage. However you will not be able to withdraw your information once the focus groups have been conducted, as it would not be possible to extract one person's responses from the audio recording. The decision not to participate, or to withdraw from the study will not affect any current or future relationship with the University of Wollongong.

Information you provide during the focus group discussion may be used by the University of Wollongong for research papers and other scholarly or general publications, conference presentations and reports.

De-identified data from the focus groups/interviews may be shared for the purposes of the Low Income Energy Efficiency Program with the Department of Industry, and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). This data may be used for the Program to: compile information and prepare reports to be disclosed to the Department of Industry to deliver the program according to the program objectives; to enable the Department of Industry to evaluate the outcomes of the program; to enable the CSIRO to conduct analysis on the data collected and report on the results; for the purposes of auditing compliance and safety and resolving complaints; as authorised or required by law; and for reporting publicly on the findings and performance of the Program. Personal information may be made available to other organisations, which may include if it will prevent or lessen a serious or imminent threat to someone's life or health, or if disclosure is required or authorised by law.

You will be requested to sign a Consent Form prior to the focus group to confirm your understanding of these things and to indicate that you are happy to participate in the study.

This research has been reviewed by the Human Research Ethics Committee of the University of Wollongong. If you have any concerns or complaints regarding the way this research has been conducted, you can contact the UOW Ethics Officer on (02) 4221 4457 or email rso-ethics@uow.edu.au. If you have any further questions, please contact Dr Ross Gordon on (02) 9850 8559 or email ross.gordon@mq.edu.au; or Kate Roggeveen on (02) 4221 3156 or email katerogg@uow.edu.au. You can also contact the Department of Industry Low Income Energy Efficiency Program Manager at 13 28 46, email lieep@industry.gov.au or GPO Box 9839, Canberra, ACT 2601.

Thank you for your interest in this study.

ENERGY +
EVERYDAY LIVING

WWW.ENERGYPLUSILLAWARRA.COM.AU

SAVE MONEY, **SAVE** EARTH, **LIVE** WELL
AND CREATE A BETTER WORLD FOR TOMORROW

ENERGY +
ILLAWARRA

ENERGY+ ILLAWARRA

WHAT IS ENERGY+ILLAWARRA?

ENERGY+ILLAWARRA is a program developed with the community, for the community. It aims to support energy efficiency in the home, without sacrificing comfort or well-being. The Energy+Illawarra program features a range of activities that will help bust myths and misconceptions about energy use, and provide you with facts and various forms of support to use energy efficiently in the home.

IS THERE A WEBSITE FOR ENERGY+ILLAWARRA?

Yes! There is a website for the program, which you can find at:

www.energyplusillawarra.com.au

The website expands on some of the points in this brochure and contains lots of extra information and resources about energy efficiency. Don't forget to keep visiting the website over the coming months, as additional resources and tools will be added throughout 2015-16 providing key facts on energy use. There will also be educational videos featuring real people, real homes and real lives from our local community.

WHO IS INVOLVED IN ENERGY+ILLAWARRA?

ENERGY+ILLAWARRA is based on extensive engagement and research with community members who are at the heart of the project. The program involves partnerships between University of Wollongong (UOW), Macquarie University, Regional Development Australia Illawarra (RDAI), Warrigal, IRT Group, Royal Freemasons' Benevolent Institution (RFBI), Illawarra Forum, WEA Illawarra, and Southern Councils Group. This activity received funding from the Australian Government.

WHAT DO YOU MEAN BY ENERGY EFFICIENCY?

ENERGY EFFICIENCY IS USING ENERGY WISELY AND ECONOMICALLY TO SUSTAIN EVERYDAY LIFE, LIVE COMFORTABLY AND SUPPORT WELL-BEING

Being energy efficient doesn't always mean doing more with less, sometimes it's doing more with what you have. For us it's about maintaining quality of life whilst reducing energy consumption where possible.

WHY SHOULD I BE ENERGY EFFICIENT? WHAT IS THE VALUE?

There are a number of reasons to become more energy efficient and there are benefits for everyone:

SAVE MONEY – Being energy efficient can save money on your energy bills. It's that simple. The money you save on electricity bills could be better spent elsewhere to help support your well-being.

SAVE THE ENVIRONMENT - Using less energy means we save on precious natural resources, cut down pollution, and ensure a sustainable world for future generations.

LIVE WELL - Knowing how to use energy efficiently and having the key facts can help you run your home and live the lifestyle you want without hassle. Finding better ways to use energy and your home appliances can help you maximise comfort whilst minimising energy consumption.

FEEL GOOD - Knowing that you are using energy efficiently can make you feel happy and confident about how you run your home. You may also feel good about doing your little bit to help create a better world.

SET A GOOD EXAMPLE – By using energy efficiently in the home you can set an example to family, friends and for future generations that you know the benefits of being energy efficient. People could see you as a good source of advice and knowledge meaning you can help others as well as yourself.

ARE THERE EVENTS I CAN ATTEND?

Yes! WEA Illawarra are conducting 3-hour training events across the Greater Illawarra. You can learn about energy efficiency practices, the latest technologies, and what small improvements in your home can make a big difference. For more information on these community events you can visit the ENERGY+ILLAWARRA website at:

www.energyplusillawarra.com.au

ENERGY +
STAR RATINGS

WHAT IS A STAR RATING?

The Energy Rating Label is a mandatory comparative energy label. It shows you the energy performance information on a range of appliances and allows you to compare similar appliance models through a star rating of between one and ten stars. It also shows the annual energy consumption in Kilowatt Hours.

THE STARS

When comparing similar sized products the stars are a great way to quickly compare which model will be more energy efficient. The higher the star rating, the more efficient the appliance is.

However the stars do not tell you how much energy the appliance actually uses. This is the purpose of the Kilowatt Hours.

THE KILOWATT HOURS (kWh)

When considering the energy consumption of a household appliance, looking at the Kilowatt Hours (kWh) is key. The kWh rating of an appliance tells you how much energy the appliance will use per year under standard test conditions. The lower the number, the lower the energy consumption.

With this number we can also estimate the running cost per year of the appliance. To do this you simply multiply the kWh's per year by the cost of a kWh.

For a general estimation of the cost to run an appliance for a year you can divide the kWh's by 4 (*Based upon $0.25/kWh). So on the example image to the right, running the fridge for a year would cost around $38 (153 divided by 4).

BUYING A NEW APPLIANCE

In Australia it is mandatory for large appliances to carry the Energy Rating Label. This makes it easy to compare the efficiency of appliances at point of sale.

To make the best use of this label, and purchase the most efficient appliance you can, we recommend using these three steps:

1. CHOOSE THE SIZE OF APPLIANCE YOU NEED

Larger appliances typically use more energy. Try to choose the smallest size that adequately meets your needs. Bigger isn't always better!

2. COMPARE THE STAR RATING

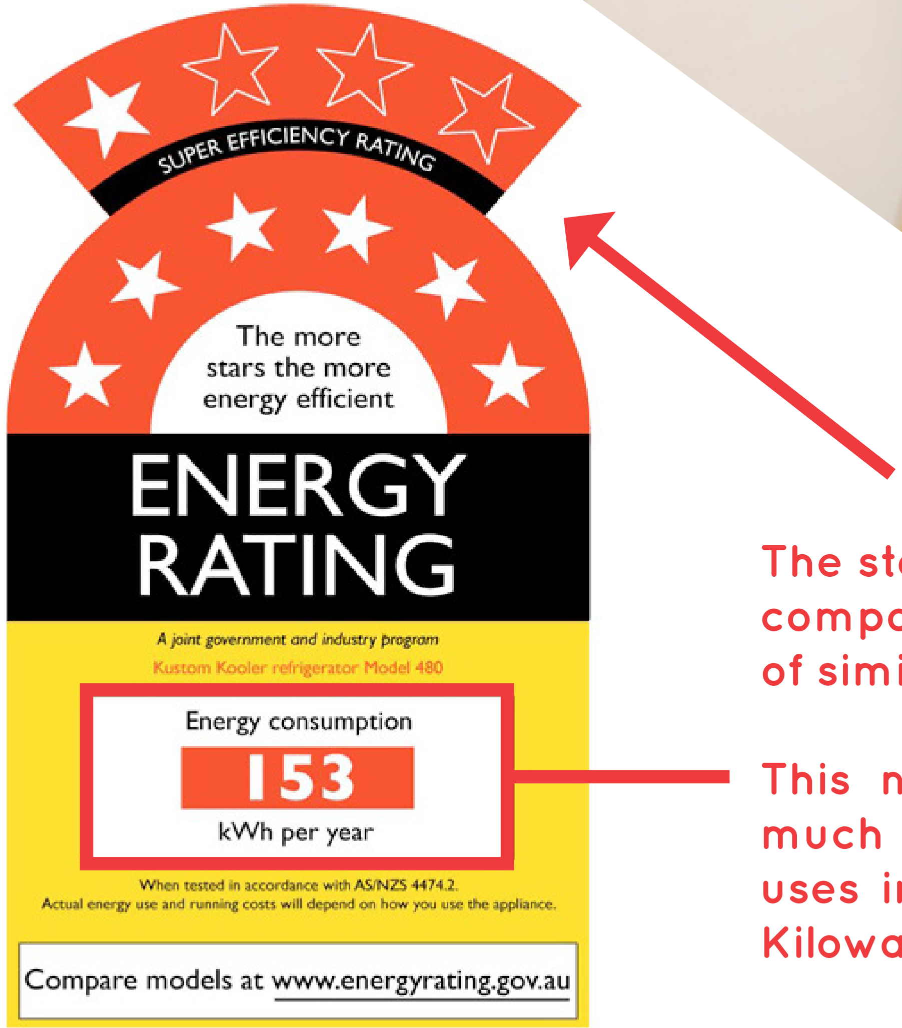
Once you have selected the size of appliance that meets your needs you can now compare the star ratings of appliances in that range. The more stars the more energy efficient the appliance will be.

You can also compare models online at:
www.energyrating.gov.au

3. CONSIDER YOUR BUDGET

Try to get the most efficient appliance you can within your budget. Remember that although the upfront cost may be higher for an efficient model, the energy savings could mean you save money over time.

To help calculate the cost of using an appliance in your home see this useful calculator provided by the NSW Office of Environment & Heritage:
www.smarterchoicecalculator.com.au



The stars help you compare the efficiency of similar sized appliances

This number tells you how much energy an appliance uses in a year, measured in Kilowatt Hours (kWh)

ENERGY + MY FRIDGE

Fridges run all day every day and they make up a large portion of your energy bill (around 18%). Depending on the age and size this could be costing you significant money each year. However there are simple things you can do to reduce this cost.

IS MY OLD FRIDGE COSTING ME MONEY?

A typical fridge manufactured today uses about a third of the energy of a fridge made 15 years ago. Old fridges are very inefficient and could be costing you a significant amount of money in your energy bill.

If you have an old fridge at home it is likely to be very inefficient by today's standards. It may be worth replacing due to the high running costs.

KEEPING A SECOND FRIDGE

Keeping a second fridge is likely to be costing you a significant amount on your energy bill.

Getting rid of your second fridge is an easy way to save considerable money and energy.

If you decide to keep an old fridge for use as a second fridge, even if it is inefficient, then consider only switching it on when you absolutely need to – for example for Christmas or a family function.

IS BIGGER BETTER?

Size matters when thinking about fridges – a smaller fridge may often have a lower kWh rating than a larger fridge.

Only buy the size of fridge that you need, and try to buy the one with the lowest kWh rating in that size range.

DOES OPENING THE DOOR USE ENERGY?

Opening the door of a fridge lets cold air out and warm air in, but this doesn't represent a lot of energy.

Don't worry too much about opening the door of the fridge as this is unlikely to use a lot of energy. Just try not to leave the door open for extended periods of time.

WHAT TEMPERATURE SHOULD MY FRIDGE BE?

Keeping your food and drinks at the best temperature can help you be energy efficient and also keep your food nice and fresh. Temperatures less than 3°C make fruit and vegetables less crisp and can be detrimental to fresh goods. Storing foods at colder temperatures in the fridge also uses more energy. Every degree lower requires roughly 5% more energy.

Storing foods at 3° to 5°C is recommended for fridges and -15° to -18°C for freezers.

You can use a thermometer to help with this. Consider the NSW Food Authority Guidelines for safely storing food in the fridge and freezer: **www.foodauthority.nsw.gov.au**

HOW DO I CHOOSE AN ENERGY EFFICIENT FRIDGE?

When thinking about buying a fridge looking at the amount of electricity it uses each year, it's Kilowatt Hours (kWh) rating, is important. A lower kWh rating means that the fridge will use less energy in the home.

Always look at the kWh rating of a fridge to assess how much energy it will use.

DO FRIDGES NEED MAINTENANCE?

Taking good care of your fridge is important. Make sure that it is located where the ambient temperature is not too high, and that it is well ventilated so that it operates at maximum efficiency. For example, ensure that there is at least 75mm of air space around every side of the fridge, and if you have a fridge with an exposed 'coil' on the back (usually a thin black pipe in a zigzag shape) make sure that it is not covered in dust or cobwebs.

Make sure the door seals are intact. Replace them if they become worn or damaged.

CAN I RECYCLE MY FRIDGE?

If you do decide to dispose of an old fridge it will not go to waste. The materials of a fridge are highly recyclable and there are services available to help manage their disposal. When you buy a new fridge the retailer may even offer to take the old one away for you.

There's also 'Fridge Buyback', an energy savings program that may actually pay you to give up your old second fridge or upright freezer. **www.fridgebuyback.com.au**

> "I needed a new fridge so I went out and bought one. It cost me $800. Best $800 I ever spent. It's amazing how much less electricity the new appliances use"

ENERGY + LIGHTING

HOW MUCH ENERGY DOES LIGHTING USE?

Compared to other things, like your appliances and heating and cooling, lighting takes up a small portion of your energy bill; somewhere between 8 and 15 per cent of the average household electricity budget.

However, most households could reduce the amount of energy they use for lighting by 50% or more by making smarter lighting choices and moving to more efficient technologies.

WHAT'S WRONG WITH INCANDESCENT BULBS?

The traditional pear-shaped incandescent bulbs are highly inefficient and costly to run. These bulbs waste up to 90 per cent of the energy they use, mainly as heat. Because of this the Australian Government phased out these globes in favour of newer much more efficient technologies.

WHAT ABOUT DOWNLIGHTS?

Downlights that are recessed into the ceiling promote air leakage to the outside and waste heating and cooling energy. They are also typically halogen which are inefficient by todays standards.

If you have downlights and wish to replace them it is best to get an electrician to replace the whole fitting. Also ask them to install a downlight cover with insulation safely topped up right around the downlight.

	STANDARD INCANDESCENTS	HALOGEN INCANDESCENTS	CFLs	LED's
COLOUR RANGE	Warm White	Warm White	Warm White to Cool Daylight	Warm White to Cool Daylight
LIFESPAN	1200 Hours	2500 Hours	8000 Hours	15000 Hours
PURCHASE COST PER BULB	No longer available	$1.80	$6	$11
PURCHASE COST FOR PERIOD*	No longer available	$10.80	$11.25	$11
ELECTRICITY COST FOR PERIOD*	$207	$155.25	$44.85	$31.05
TOTAL COST FOR PERIOD*	**--**	**$166.05**	**$56.10**	**$42.05**

*Reference period is the lifetime of an LED bulb (15years if used 3hours every night)
Prices scanned May 2015, Electricity price - $0.23/kWh

WHAT TYPE OF LIGHTING SHOULD I USE?

The current recommendation is to use Light Emitting Diode (LED) lights. Recent price drops have made LED lights by far the cheapest to own and operate. Incandescent and halogen lights should be replaced even before failing (unless used very little, then wait until failure before replacing). For Compact Fluorescent Lamps (CFL's) it is best to wait until they fail, then replace with LED lights.

DON'T LED GLOBES CAST A HARSH LIGHT?

Newer LED lights come in a variety of options, meaning you can choose the style of light that you like. Some globes approach the warm light of incandescents, and some cast a cooler white light.

They also come in a wide variety of shapes and sizes for use in all forms of lighting, from reading lamps to ceiling lights.

HOW DO YOU DISPOSE OF CFLs CONTAINING MERCURY?

Like all fluorescents, CFLs contain trace amounts of mercury (typically 3 to 5 milligrams), although some contain less. This creates the potential for pollution when CFL bulbs are improperly disposed of. To find a recycling center near you that accepts CFL's you can go to the 'recycling near you' website: **www.recyclingnearyou.com.au**

ENERGY + THE LAUNDRY

SHOULD I WASH WITH HOT OR COLD WATER?

Many people now use the cold wash cycle for the majority of their washing, as this can reduce energy use by up to 80%. Wash on a cold wash cycle as often as possible.

It's also a good idea to only use your washing machine when you have a full load of clothing. This saves you extra work and uses less energy.

IS A TOP LOADER OR FRONT LOADER MORE EFFICIENT?

Both top and front loader washing machines can be very energy efficient these days – the important thing is to check and compare their kWh rating and their star rating.

Front loader washing machines also use roughly 50% less water than top loaders.

WHAT TO LOOK FOR WHEN BUYING A WASHING MACHINE

Like all large appliances, washing machines have an energy sticker, so be sure to check the kWh rating.

Check for a cold wash option as this can reduce energy use by up to 80%.

If you sometimes wash with hot water and have an efficient hot-water system (e.g. gas, heat-pump or solar) try to choose a washing machine with both hot and cold water connections. This means that the washing machine gets its hot water from your efficient water heater, rather than heating it in the washing machine.

Some models now have load sensing technology which can adjust the amount of water they use to suit your load size.

Another important issue is the maximum spin-dry speed available on your washing machine. The more you spin-dry your clothes, the less water is left when you come to dry them – and the less energy you will use if you use an electric dryer. If you dry your clothes on a line, you may consider using lower spin speeds so that clothes crease less.

WAYS TO USE YOUR DRYER MORE EFFICIENTLY

As many of us know dryers can be quite a large expense on our energy bills.

For example, if you have an older, small (4kg capacity) and inefficient (1-Star) electric dryer that you use on average twice a week, this might cost about $130 a year to run.

So we recommend you dry all of your washing on an outside line whenever the weather is dry.

However when you need to use your dryer there are ways to do it more efficiently:

- Try to separate your heavy and lightweight clothing and not overload the dryer.

- Dry several loads one after the other to make use of the heat in the machine from the previous load.

- Keep the surrounding area well ventilated to minimise the build up of humidity. You could leave a window open or install a venting kit, as this will expel moist air directly outside.

- Clean the filter before each use. Not only does this save energy but a blocked filter can be a potential fire hazard.

WHAT TO LOOK FOR WHEN BUYING A NEW DRYER

Older electric dryers are very inefficient. There are a number of newer dryer technologies, such as heat pump and gas dryers, that are much more efficient and may be worth considering if you use your clothes dryer frequently.

Avoid buying a bigger drier than you need. If you buy a big drier, but only partially fill it every time you use it, this will result in higher energy use as the big drier takes more energy to heat up.

Check the star rating of the dryer and buy one with a high star rating.

Look for models with auto sensors that can help you to avoid over-drying and using excess energy.

STAND-BY POWER

Like many modern appliances, washing machines and dryers will use some energy when they are on stand-by, i.e. when they are off but connected to the power socket (usually one or more lights will be glowing). So try to switch your washing machine and dryer off at the powerpoint (if you can reach) when they are not in use. This could save you tens of dollars, or more, each year.

NEXT ISSUE

Keep an eye out for our next issue "Energy+Winter Warming" where we discuss options for heating your home, hot water systems, the contribution cooking makes to your energy consumption, and other strategies to keep warm in winter.

Australian Government
Department of Industry and Science

ENERGY +
WINTER WARMING

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ENERGY +
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ENERGY+ ILLAWARRA

WHAT IS ENERGY+ILLAWARRA?

ENERGY+ILLAWARRA is a program developed with the community, for the community. It aims to support energy efficiency in the home, without sacrificing comfort or well-being. The Energy+Illawarra program features a range of activities that will help bust myths and misconceptions about energy use, and provide you with facts and various forms of support to use energy efficiently in the home.

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IS THERE A WEBSITE OR FACEBOOK PAGE?

Yes, we have both! You can find the website for the program at:

www.energyplusillawarra.com.au

The website expands on some of the points in this brochure and contains lots of extra information and resources about energy efficiency. Don't forget to keep visiting the website over the coming months, as additional resources and tools will be added throughout 2015-16 providing key facts on energy use. There will also be educational videos featuring real people, real homes and real lives from our community.

You can find the Facebook page at:
facebook.com/energyplusillawarra

The Facebook page is constantly updated with energy saving tips, facts and resources to help you save money and maintain your well-being, so be sure to give us a like.

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WHY SHOULD I BE ENERGY EFFICIENT? WHAT IS THE VALUE?

There are a number of reasons and benefits to becoming energy efficient:

SAVE MONEY – Being energy efficient can save money on your energy bills. It's that simple. The money you save on electricity bills could be better spent elsewhere to help support your well-being.

SAVE THE ENVIRONMENT - Using less energy means we save on precious natural resources, cut down pollution, and ensure a sustainable world for future generations.

LIVE WELL - Knowing how to use energy efficiently and having the key facts can help you run your home and live the lifestyle you want without hassle. Finding better ways to use energy and your home appliances can help you maximise comfort whilst minimising energy consumption.

FEEL GOOD - Knowing that you are using energy efficiently can make you feel happy and confident about how you run your home. You may also feel good about doing your little bit to help create a better world.

SET A GOOD EXAMPLE – By using energy efficiently in the home you can set an example to family, friends and for future generations that you know the benefits of being energy efficient. People could see you as a good source of advice and knowledge meaning you can help others as well as yourself.

ARE THERE WORKSHOPS I CAN ATTEND?

Yes! WEA Illawarra are conducting 2-hour workshops across the Greater Illawarra. You can learn about energy efficiency practices, the latest technologies, and what small improvements in your home can make a big difference. For more information on these workshops you can visit:
www.energyplusillawarra.com.au
or contact WEA Illawarra on:
(02) 4226 1622 - info@weaillawarra.com.au

ENERGY + HEATING

Heating is one of the larger uses of energy in the average Australian home. However there are a number of ways to maintain a comfortable temperature at home whilst being energy efficient.

BODY TEMPERATURE

We each carry around our own little food-powered engines and heaters inside our bodies that "burn off" a little heat energy when we move around. When we generate more heat than we are getting rid of we feel hot; and we feel cooler when we are losing more heat than we generate.

How warm you feel depends on a combination of body heat generated during physical activity, the surrounding air temperature, humidity and "wind-chill" factor, how fast you allow this heat to escape (by layers of clothing) and any radiated heat.

Personal comfort varies greatly between individuals, but our bodies naturally adapt to the seasons and outdoor temperature each day. You may be comfortable at indoor temperatures of around 18°C during winter and acclimatise to around 25°C during summer.

Clothing helps reduce heat loss and maintain body temperature so dress appropriately and consider lightweight blankets while watching TV. Keeping active is good for your well-being and also generates body heat. Even walking around your home during an ad break will help make you feel warmer.

DRAUGHTS

In our temperate climate, many people have their windows and doors open a lot of the time, even in winter. But when you want to keep the inside warmer (or cooler) than outside, it is important to seal off draughts.

Particular areas to consider when trying to keep your home sealed are:

• DOOR AND WINDOW SEALS

Draughts and air movement make us feel colder. In winter, cold air will come in under external doors and through gaps around windows. By installing draught excluders at the base of doors, as well as draught seals around doors and windows, you can stop the cold air from getting in and the heat from getting out in winter. Don't forget the garage door or internal access door from the garage.

Do-it-yourself, cheap draught stripping can be purchased at local hardware stores. Seal gaps around the outer edges of door and window frames with caulking.

• DOWNLIGHTS

Downlights that are recessed into the ceiling promote air leakage to the outside and waste heating and cooling energy. If you have downlights consider installing a downlight cover with insulation safely topped up right around the unit. Contact a certified insulation installer for this; **www.licensedtrades.com.au** will help you find certified tradies in your area.

FREE HEATING

In winter, try to keep your curtains open during the day to make the most of the sun's heat, especially north and west facing windows. Then close them at sunset to prevent the heat escaping overnight. You might want to leave south facing windows covered on cold days however to limit the amount of heat loss, as these don't capture any direct sunlight.

INSULATION

Insulation acts as a barrier to heat loss and gain. In many homes, insulation is the most practical and cost effective way to make a house more energy efficient, keeping it cooler in summer and warmer in winter.

The cheapest and easiest areas to insulate are windows. Window coverings insulate the room by trapping an air pocket between the window and covering. Curtains which extend below the window frame and have fully enclosed pelmets work best. Close fitting top-down bottom-up honeycomb blinds offer an excellent alternative to curtains.

Ceilings are the second priority for insulation as they are a significant source of heat loss. Contact a certified insulation installer for information and advice on your home.

Floorboards promote air leakage and heat loss. Carpets are a great option to insulate a floor. Area rugs are another good option as you can put them away in summer when you want a cooler floor surface. However, be aware of your rug placement as these can be a trip hazard. For under floor insulation installation contact a certified installer.

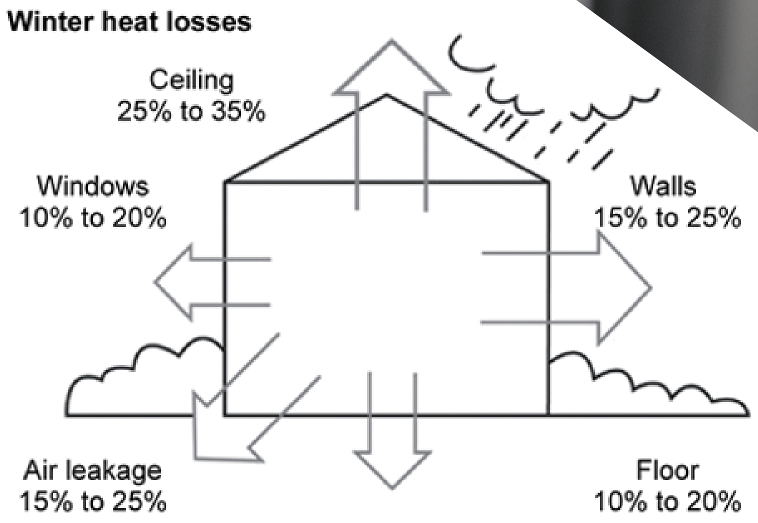
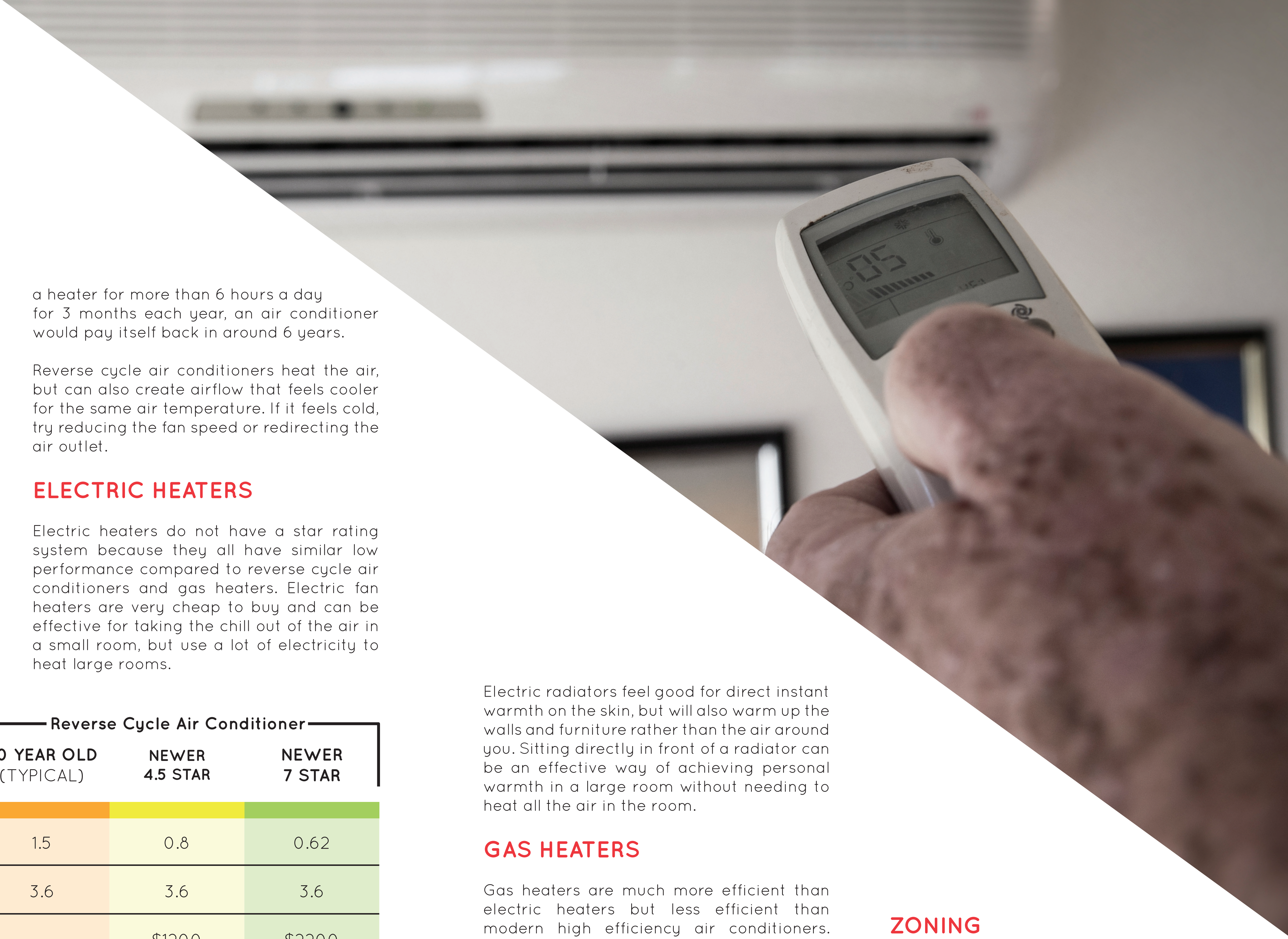


Image - ***Your Home*** www.yourhome.gov.au/passive-design/insulation

ENERGY + HEATING



Even with keeping active, dressing in layers, and reducing thermal leaks in your building, you will probably choose to use gas or electricity to heat the air in your home in winter to live comfortably.

REVERSE CYCLE AIR CONDITIONERS

Reverse cycle air conditioners are a far more efficient way to heat the air in your home compared to an electric heater, such as a fan heater or an oil column heater. For the same heat output, an air conditioner will be 2.5 to 6 times more efficient than an electric heater (see the table below).

Air conditioners are more expensive up front and may not be worth the cost if you do not use very much heating. However if you used a heater for more than 6 hours a day for 3 months each year, an air conditioner would pay itself back in around 6 years.

Reverse cycle air conditioners heat the air, but can also create airflow that feels cooler for the same air temperature. If it feels cold, try reducing the fan speed or redirecting the air outlet.

ELECTRIC HEATERS

Electric heaters do not have a star rating system because they all have similar low performance compared to reverse cycle air conditioners and gas heaters. Electric fan heaters are very cheap to buy and can be effective for taking the chill out of the air in a small room, but use a lot of electricity to heat large rooms.

	2 ELECTRIC HEATERS (EXISTING)	Reverse Cycle Air Conditioner		
		20 YEAR OLD (TYPICAL)	NEWER 4.5 STAR	NEWER 7 STAR
INPUT POWER (KW)	3.6	1.5	0.8	0.62
OUTPUT HEAT (KW)	3.6	3.6	3.6	3.6
PURCHASE COST	-	-	$1200	$2200
INSTALLATION COST	-	-	$500	$500
ELECTRICITY COST ($/HOUR)	**$0.83**	**$0.35**	**$0.18**	**$0.14**
PAYBACK PERIOD (HOURS)	-	-	2600	3900

*Prices are indicative of market costs at time of publishing (July 2015) and quotes should be obtained from a local installer.

Electric radiators feel good for direct instant warmth on the skin, but will also warm up the walls and furniture rather than the air around you. Sitting directly in front of a radiator can be an effective way of achieving personal warmth in a large room without needing to heat all the air in the room.

GAS HEATERS

Gas heaters are much more efficient than electric heaters but less efficient than modern high efficiency air conditioners. Many people prefer the feel of gas heaters because of the warm radiated heat onto the skin and because they increase moisture in the air, which helps you feel warmer at the same temperature. However gas heaters also remove oxygen from the indoor air and produce carbon dioxide and carbon monoxide, so un-flued (portable) gas heaters require fresh air ventilation for health and safety. This creates a thermal leak to the outside, which makes them less efficient.

ZONING

In every home there are areas that we utilise everyday and some that we rarely visit. When trying to heat up a home there's no point wasting energy heating up rooms that are rarely used. Where possible shut off parts of the house by closing doors and windows to ensure that you only heat the parts you need. Where no doors exist, consider installing curtains or petitions to section off unused spaces.

ENERGY + HOT WATER

Heating water is the second largest segment of household energy use in Australia, accounting for between 21-50% of your energy bill.

So one of the best ways to reduce energy bills is to reduce hot water consumption. More than half of hot water use in the home happens in the bathroom, so installing water efficient shower-heads and taps is a great energy saver. Washing clothes and rinsing dishes in cold water will also help.

GOVERNMENT INCENTIVES

Households across Australia that install an eligible hot water system may be able to receive a benefit under the Small-scale Renewable Energy Scheme (SRES) to help with the purchase cost.

To check your eligibility and for more information go to: **yourenergysavings.gov.au/rebates/renewable-power-incentives**

HOW DO SOLAR HOT WATER SYSTEMS WORK?

A solar hot water system could provide 50-90% of your hot water needs by taking advantage of Australia's supply of sunshine to heat water.

Solar hot water systems use solar collectors, usually located on the roof of your home (best positioned facing north), which absorb energy from the sun to heat water for your home. The heated water is then stored in an insulated tank for when you need it.

On cloudy days, or when hot water usage is higher than usual, your hot water system may need a boost. The booster will come on when the temperature of the water in the storage tank falls below the thermostat setting, and turn off automatically when the water reaches the required temperature.

Boosters ensure that you always have access to hot water and can either be electric or gas.

HEAT PUMP HOT WATER SYSTEMS

Heat pump hot water systems are a newer, more efficient, type of storage water heater that extract heat from the air to heat water.

They work on the same principle as a reverse cycle air conditioner, but instead of pumping heat from outdoors to indoor air, they pump heat from outdoor air into the water.

They run on electricity but are roughly three times more efficient than conventional electric water heaters. Efficiency decreases significantly in cooler climates.

IS IT WORTH THE EXTRA UPFRONT COST?

Solar and heat pump hot water systems cost more to buy and install than other types of hot water systems. However the energy savings will recover your costs well within the life of the system, and they add value to your home.

Most people wait until their existing hot water system fails (typically at around 10 years old) before thinking about replacing it, at which point the upfront cost of an energy efficient upgrade seems too high in the urgency of the moment.

If your hot water system is more than 5 to 10 years old, consider getting quotes and advice on energy efficient replacements so you can start saving and be ready to make the best long term decision if your system fails.

GAS HOT WATER SYSTEMS

Gas hot water systems are more energy efficient and cheaper to run than electric storage systems. All gas hot water systems have an energy star rating to help compare models. Gas-instantaneous systems are generally more efficient than gas storage systems as they only heat the water that is required at the time. A gas-instantaneous boosted solar system is one of the most efficient hot water systems available.

EXPOSED PIPES

Exposed copper hot water pipes can lose heat energy if they are not insulated. Insulate your pipes, valves and fittings with foam pipe insulating tube and wrapping (13mm thick for external tanks and 9mm thick for internal tanks). Insulate at least 2 metres or to the nearest wall penetration. Cheap insulation can be purchased at local hardware stores.

WHAT TEMPERATURE SHOULD MY WATER BE?

Hot water safety regulations specify that hot water outlets in bathrooms and kitchens must be no more than 50°C. Tempering valves are now installed on all systems to mix some cold water in with the hot water from the tank to reduce the temperature at the taps. Setting your tempering valve at around 40°C will save significant energy.

Health regulations stipulate that hot water tanks must hold water above 50-60°C.

ENERGY + COOKING

Cooking accounts for about 4-5% of your total energy bill. By using your cooking appliances efficiently, and changing the way you prepare food, you can make a difference to your energy use, without sacrificing your well-being. After all, food is one of the great joys in life!

OVENS

When it comes to cooking, one of the largest energy consuming appliances is your oven. But, like most appliances, there are ways to use it more efficiently:

- Check the door seals for any air leakage. Replace the seals to prevent wasted heat, energy and money.
- Try to avoid pre-heating the oven unnecessarily.
- If possible, cook several things at once.
- Reheat food in the microwave instead of the oven.
- Consider using smaller appliances like electric fry pans, slow cookers or microwaves as an alternative.

MICROWAVES

Microwaves use far less electricity than traditional electric ovens and can cook food much faster. Using a microwave can use up to 80% less energy when reheating food than a standard oven.

Some people think that microwaves can contaminate food. This is untrue. Microwaves cause water molecules in food to vibrate which produces heat needed to cook the food. This makes foods high in water content, like vegetables and soups, great for cooking in the microwave.

ELECTRIC & GAS STOVE TOPS

Electric and gas stove tops are great for cooking but can be a substantial source of wasted energy.

When cooking on the stove top, using the right size pan matters. You want your pans to be as close as possible to the size of the burners. If your pan is only 6 inches and you are cooking on an 8 inch burner, over 40% of the heat will be wasted. Using the right pots and pans will also help cook food more evenly.

Other things to consider when using an electric or gas stove top are:

- Keep the lid on pots when possible to reduce heat loss. It makes the food cook faster and keeps the kitchen cooler.
- Pots and pans with flat bases allow for more contact with the heating elements, which heats your pan more efficiently.

INDUCTION COOK TOPS

Induction cook tops heat the surface of the pans directly without needing to heat an element or lose heat to the air. These are around twice as efficient as a standard electric element and the stove top does not get hot so they are safer and easier to clean. They provide very fast cooking with excellent temperature control, but cost more to purchase.

BOILING WATER

When boiling water for a cuppa, be it on the stove or in the kettle, only boil what you need. The more water you boil, the more energy is required to heat it. If you do accidentally boil too much, consider using it to wash the dishes when it cools down to a safe temperature.

SLOW COOKERS

Slow cookers use significantly less energy than a stove top and are great for soups or stews that could take hours to cook. Slow cookers use just a little more energy than a traditional light bulb, and you can leave your food to cook slowly while you get on with other things.

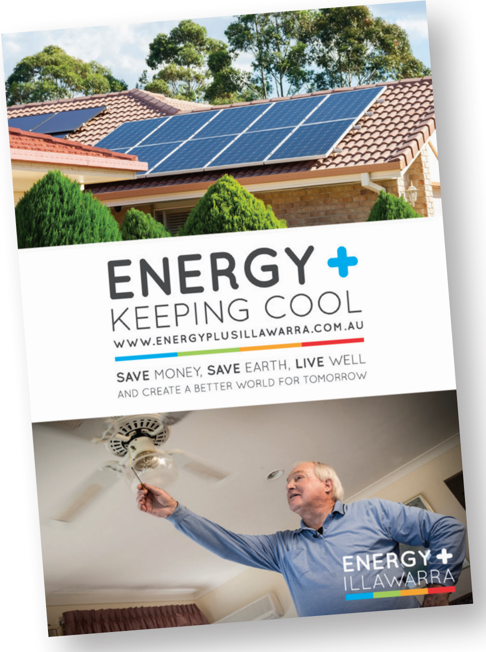
FREEZING MEALS FOR LATER

Cooking in bulk and reheating meals later with a microwave is a convenient way to save time and effort but it does use energy to freeze, defrost and reheat the food.

There are some things you should know in order to always ensure the food is safe to eat. When it comes to freezing and thawing food, the NSW Food Authority recommends:

- Never thaw food at room temperature, bacteria grow best at this temperature. Food defrosts safely in the fridge.
- Only thaw food once. Bacteria can multiply when food defrosts.
- Never refreeze raw food, especially meat and poultry.
- Only refreeze food after it has been cooked thoroughly.
- Cooked leftovers should only be frozen once. After defrosting discard what is not eaten and never refreeze a second time.

For more information on food safety visit:
www.foodauthority.nsw.gov.au/



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SAVE MONEY, SAVE EARTH, LIVE WELL
AND CREATE A BETTER WORLD FOR TOMORROW

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NEXT ISSUE

Keep an eye out for our next issue "Energy+Keeping Cool" where we discuss solar power, options for cooling your home, dishwashers, and the contribution standby power makes to your energy consumption.

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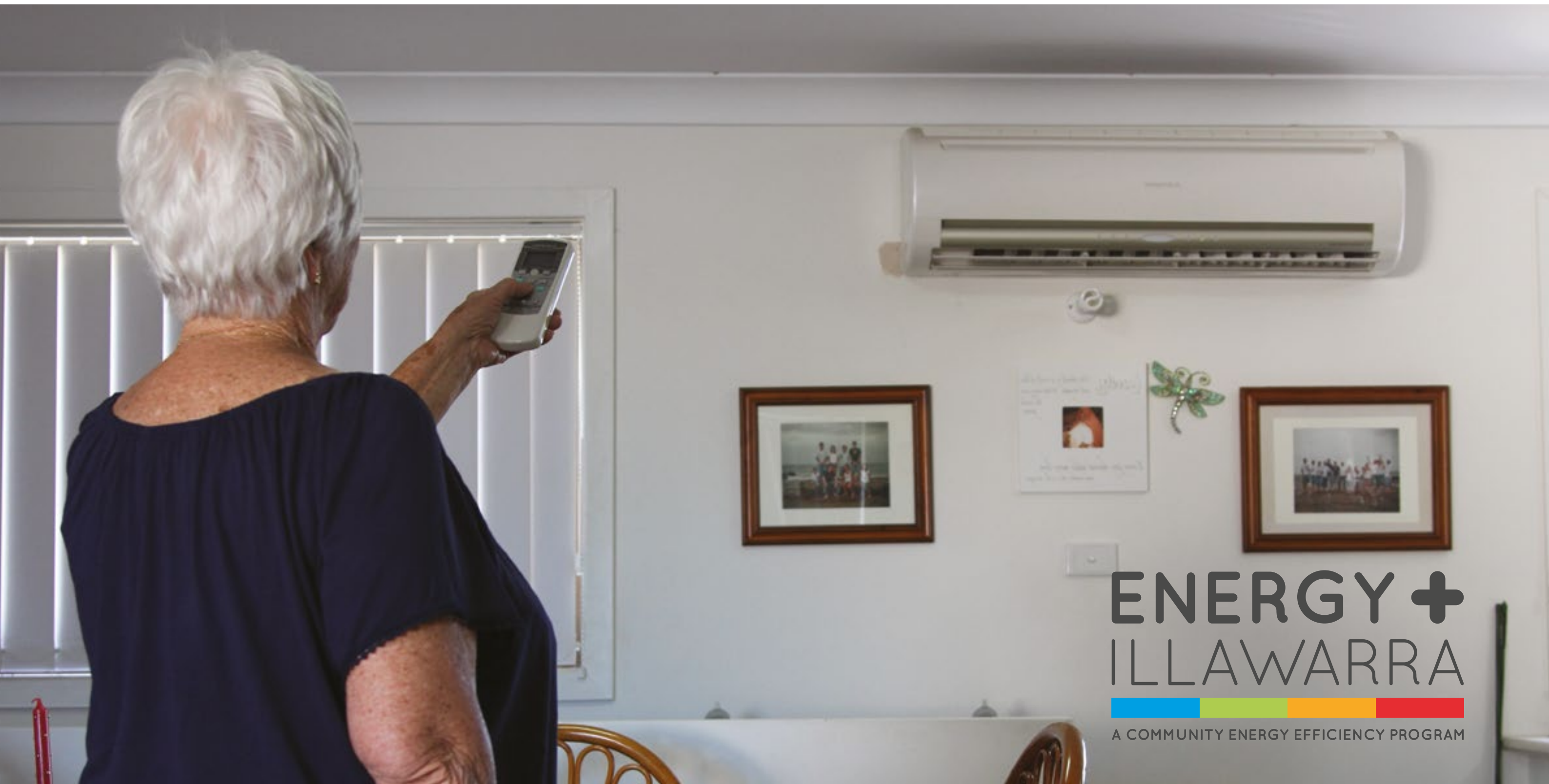

ENERGY+
ILLAWARRA
A COMMUNITY ENERGY EFFICIENCY PROGRAM

ENERGY+ ILLAWARRA

A COMMUNITY ENERGY EFFICIENCY PROGRAM

WHAT IS ENERGY+ILLAWARRA?

ENERGY+ILLAWARRA is a program developed with the community, for the community. It aims to support energy efficiency in the home, without sacrificing comfort or well-being. The Energy+Illawarra program features a range of activities that will help bust myths and misconceptions about energy use, and provide you with facts and various forms of support to use energy efficiently in the home.

WHO IS INVOLVED IN ENERGY+ILLAWARRA?

ENERGY+ILLAWARRA is based on extensive engagement and research with community members who are at the heart of the project. The program involves partnerships between the University of Wollongong, Macquarie University, Regional Development Australia Illawarra, Warrigal, IRT Group, Royal Freemasons' Benevolent Institution, Illawarra Forum, WEA Illawarra, and the Illawarra Pilot Joint Organisation. This activity received funding from the Australian Government.

IS THERE A WEBSITE OR FACEBOOK PAGE?

Yes, we have both! You can find the website for the program at:

www.energyplusillawarra.com.au

The website expands on some of the points in this brochure and contains lots of extra information and resources about energy efficiency. Don't forget to keep visiting the website over the coming months, as additional resources and tools will be added throughout 2015-16 providing key facts on energy use. There will also be educational videos featuring real people, real homes and real lives from our community.

You can find the Facebook page at:
facebook.com/energyplusillawarra

The Facebook page is constantly updated with energy saving tips, facts and resources to help you save money and maintain your well-being, so be sure to give us a like.

WHAT DO YOU MEAN BY ENERGY EFFICIENCY?

ENERGY EFFICIENCY IS USING ENERGY WISELY AND ECONOMICALLY TO SUSTAIN EVERYDAY LIFE, LIVE COMFORTABLY AND SUPPORT WELL-BEING

Being energy efficient doesn't always mean doing more with less, sometimes it's doing more with what you have. For us it's about maintaining quality of life whilst reducing energy consumption where possible.

WHY SHOULD I BE ENERGY EFFICIENT? WHAT IS THE VALUE?

There are a number of reasons and benefits to becoming energy efficient:

SAVE MONEY – Being energy efficient can save money on your energy bills. It's that simple. The money you save on electricity bills could be better spent elsewhere to help support your well–being.

HELP THE ENVIRONMENT - Using less energy means we save on precious natural resources, cut down pollution, and contribute to a more sustainable world for future generations.

LIVE WELL - Knowing how to use energy efficiently and having the key facts can help you run your home and live the lifestyle you want without hassle. Finding better ways to use energy and your home appliances can help you maximise comfort whilst minimising energy consumption.

FEEL GOOD - Knowing that you are using energy efficiently can make you feel happy and confident about how you run your home. You may also feel good about doing your little bit to help create a better world.

SET A GOOD EXAMPLE – By using energy efficiently in the home you set an example to family, friends and younger people that you know the benefits of being energy efficient. People could see you as a good source of advice and knowledge meaning you can help others as well as yourself.

ENERGY +
PERSONAL COOLING

When trying to stay comfortable in summer a great place to start is with your body.

ACCLIMATISATION

Your body naturally adjusts to the temperature of your environment. This process is called acclimatisation and plays an important role in how you tolerate heat and cold.

Acclimatisation occurs over a period of about two weeks in healthy people. The process is faster in response to heat, but slower in the cold.

Your physical condition, age, and other factors also affect how your body copes with heat and cold. For example lean people tolerate heat better than obese people.

As a person ages the body's response to temperature change (i.e. sweating in high temperatures and shivering in low temperatures) is delayed and reduced.

KEEP AIR CIRCULATING AGAINST SKIN

Evaporation of sweat is the most effective bodily cooling process. If you have air circulating next to your skin, it will help to evaporate the perspiration, and this will make you feel cooler. Typically, the air flow created by a fan provides a similar improvement to comfort as reducing the air temperature by around 3°C. Wearing short sleeves maximises this benefit.

DRINK WATER

Staying hydrated is key. If you don't drink enough water, you can start to become unwell, with symptoms of headache and tiredness. Remember, beverages with alcohol, caffeine and high sugar content are not as effective at keeping you hydrated.

LUKEWARM BATH OR SHOWER (5 MINS)

A very cold shower or bath will lower your body temperature so quickly that the body will scramble to raise it again to regain homoeostasis, or balance. As a result it's better to use lukewarm water (between 20°C and 30°C) rather than very cold water. This should be cool enough to lower the deep body temperature but warm enough not to restrict the blood flow to the surface of the skin.

APPROPRIATE CLOTHING

Natural fabrics like linen and cotton absorb sweat and allow air circulation to your skin. They're much better than man-made fibres like polyester, which can leave you hot and uncomfortable.

When it comes to the colour of your clothes, white is good if you're out in direct sunlight a lot - it will reflect the heat better than any other colour. So wear lightweight, light-coloured, loose clothing that covers as much of your skin as possible when outside in the sun. But if you're spending time in the shade or indoors, black or dark short sleeved clothing is more effective as it radiates out heat into your environment, cooling you down.

Dampening your clothes can also help. In order for the water to evaporate (changing its state from a liquid to a gas) there needs to be an input of heat energy. This energy will come from the heat of your body, which produces a cooling effect to your skin, lowering your body temperature. If you use a fan as well, the air blowing over your skin speeds up the process of evaporation, helping you to feel even cooler.

RESTING DURING THE HOTTEST TIMES OF THE DAY

Rushing around or exercising vigorously in hot and humid weather can be challenging and even dangerous. Try to schedule outdoor activities such as gardening or trips to outdoor shops and markets, for earlier or later in the day, and avoid physical exertion during the hottest part of the day between 11am – 4pm.

USE A WATER SPRAY BOTTLE

Try using a spray bottle to spray water on your face. You can also carry around a wet face washer on the back of your neck, or bathe your feet in a basin of water. At night you can try spraying your sheets before going to bed, or have a damp towel handy.

COOL PUBLIC PLACES (AIR CONDITIONED)

If your accommodation is too hot, consider going to a cool public place such as an air conditioned store, shopping centre, movie theatre, gallery or public pool to keep cool, or visit a friend or family member that has an air conditioned home. The Free Bus in Wollongong also has air conditioning.

HEAT STRESS

Heat can cause illness such as cramps, heat exhaustion and heat stoke. More importantly heat can worsen the condition of someone who already has a medical issue such as heart disease or diabetes. For information on staying healthy in the heat visit **www.health.vic.gov.au/environment/heatwaves**

ENERGY+

KEEPING COMFORTABLE

When it comes to keeping the heat out of your home in summer there are a lot of simple things that you can do to stay comfortable without paying for energy.

SHADING & WINDOW COVERINGS

Unprotected glass is often the greatest source of heat entering a home. Radiant heat from the sun passes through windows and is absorbed by walls, floors and furnishings, which then heat up the room. Direct sun through each square metre of a window may generate similar heat to a single bar radiator, but this varies a lot with the angle of the sun onto the windows, the season and time of day.

External window shading can block up to 90% of this unwanted heat gain. A variety of fixed or adjustable shutters or awnings can help. Consider deciduous trees and vegetation for west and east windows to allow winter sun through and block summer sun.

White backed curtains or blinds will also help reflect much of the unwanted solar heat back out through the windows during the heat of the day. Thicker curtains and hollow core "honeycomb" blinds also act as effective insulation barriers to windows to slow down heat being conducted from the hot air outside. Thick, dark-backed curtains will absorb the sun's rays and heat up the room so are not as effective on sunny windows.

COOL NIGHT AIR

Cool night air is a reliable source of cooling. If the room you are in is actually cooler than the temperature outdoors then keep the windows closed. But if the room is warmer – and this is much more likely to be the case at night – then opening the windows will help cool down your home. The coolest part of the day is usually between 4am and 7am so try and close your windows after 7am. Please also consider home safety and security when it comes to leaving windows and doors open.

COOL BREEZES

Unlike cool night air, these breezes tend to occur in the late afternoon or early evening when cooling requirements usually peak.

Open windows when there is a cool breeze. People with sash windows don't always remember this, but opening both the top and bottom windows by equal amounts is a very efficient way of cooling down a room. This lets rising warm air out of the top while drawing cooler air through the bottom.

Coastal breezes are usually from an onshore direction (south-east and east to north-east in most east coast areas).

AIR LEAKAGE

Sealing your home against air leakage is one of the simplest upgrades you can undertake to increase your comfort while reducing your energy bills by up to 25%. Air leaks can contribute to significant unwanted summer heat gain and are particularly important to seal up if an air conditioner is used.

A good principle is to have a well-sealed home to keep out hot air during times of high outside temperatures, and then open up doors and windows to provide maximum natural ventilation when outside air is cooler than inside your home.

Air typically leaks through:

- unsealed or poorly sealed doors and windows
- unsealed vents, skylights and exhaust fans
- gaps in or around ceiling penetrations (e.g. downlights, pipes and cables)
- gaps around wall penetrations (e.g. pipes, conduits, power outlets, switches, air conditioners and heaters)
- poorly fitted or shrunken floorboards.

Close off any draughts to keep cooler air in your house by applying weather stripping, foam sealant or silicone caulking around windows, doors, and the dog or cat door.

INSULATION

Insulation acts as a barrier to heat gain and loss by conduction through materials. In many homes, insulation is the most practical and cost effective way to make a house more energy efficient, keeping it cooler in summer and warmer in winter.

Contact a certified insulation installer for information and advice on your home.

ZONING

Zoning is a good tip for saving energy. Just cool the room you are in and give your cooling device a chance to work properly, instead of trying to cool a bigger area than it's capable of cooling. Shut the doors to this room and seal the gaps so your nice cool air doesn't sneak out under the door.

ENERGY+

ACTIVE COOLING

Even if you are using natural ways to keep comfortable when temperatures are high, you may still feel too warm and choose to use electrical appliances to cool the air in your home during summer. However changing the air temperature takes a lot of energy, so here are some tips to get a balance that works for you.

FANS

Fans should be the first choice for mechanical cooling. They are the cheapest cooling option to run and have the lowest greenhouse impact. Typically, the air flow created by a fan provides a similar improvement to comfort as reducing the air temperature by around 3°C.

Fans can be either portable (pedestal fans) or fixed (ceiling/wall fans). Fixed fans are often better in areas like the bedroom where they are out of the way and always required in the same location. Portable fans are more suited to areas like the living room where you can position the fan wherever it is needed throughout the day.

If you use a fan, direct the flow of air to your face. It's more effective because the face has so many receptors on it.

If the outside temperature is lower than the temperature in your home then the fan will be much more effective if it is placed next to an open window, as this will draw air from outdoors, which should be cooler.

Portable fans vary considerably in how much they move and how much noise they make. Choose one that suits your situation - for example, a quiet fan is usually the best option for a bedroom.

AIR CONDITIONERS

Air conditioning can give greater control of comfort in any climate. An AC will typically consume 10 times more energy than a fan.

For efficient air conditioning, the house or room should ideally be well sealed and well insulated. Windows should also be shaded from the summer sun.

Avoid leaving the air conditioner running when no one is home. It is cheaper to cool the house down when you arrive home.

BUYING THE RIGHT AIR CONDITIONER

When buying an appliance always choose the most efficient model for your application. You can use the Australian Institute of Refrigeration, Air Conditioning and Heating online tool **www.fairair.com.au** to help you choose the right system for your specific room characteristics.

Once you know the size of system you need you can compare the star ratings to get the most efficient model you can afford. If you expect to use it often, then getting the highest star rating is important as running costs may quickly add up to be more than the purchase cost.

Fixed systems need to be installed by a licensed refrigeration mechanic/electrician.

REPLACING AN OLD AIR CONDITIONER

For existing or old air conditioner units consider how often you use it for cooling before buying a new one. If you rarely use your old unit then it doesn't make sense to buy a new one. If it is old but you use it a lot, then you may be better off buying a modern and more efficient air conditioner. You could also buy a reverse cycle air conditioner, as these are actually a very efficient way to heat the home in winter, though you should still try to manage how often you use it to keep costs down.

WHAT TEMPERATURE SHOULD I SET MY AIR CONDITIONER?

Hot weather can make you want to set the cooling all the way down to 21°C. But cooling to just 26°C should keep your home comfortable and save you money. Setting your thermostat just 1°C cooler can increase your cooling bill by 15%. Remember bodies do acclimatise to the heat so the main thing is to just take the edge off and get the temperature to something comfortable, rather than over cooling the room or home.

Setting the thermostat at a temperature lower than you need will not make the unit cool faster, so this is unnecessary.

COMBINING AIR CON/FAN

Using fans in combination with an air conditioner means you can set the air conditioner to a higher temperature in summer (add at least 3°C) and still feel the same. The combined energy cost will be far less than running an air conditioner alone.

ENERGY +
SOLAR POWER

There is good news if you are interested in getting a solar power system. Prices keep falling, the technology keeps getting better, and the upfront costs are getting lower. This means that the payback period from installing a solar power system is reducing.

FALLING PRICES

The past 5 years has seen a dramatic fall in the cost of solar power systems, and particularly rooftop solar panels. Falling manufacturing costs are pushing this trend, in turn driven by improving manufacturing techniques. Already today solar panels only cost around 60c per kilowatt peak capacity in Australia, and the cost of the panels themselves is no longer the main cost for installing a solar system.

So, while solar buy back rates might change, the key benefits of solar power systems is not all about selling energy back to the grid, but in producing energy you can use in your home.

RENTING SOLAR POWER SYSTEMS

Some of the major energy providers have recently launched rental schemes for solar power systems. Generally the plans include installation, monitoring and ensuring the system performance is maximised for the duration of the rental. Some plans exist with $0 upfront cost; you simply pay for the power that is produced. Plans are offered for a variety of terms with 7, 10 or 15 year plans currently available. Read the conditions carefully for how you can opt out or transfer the system to new owners if your circumstances change or you move houses.

LONGER GUARANTEES/ WARRANTY

Many solar power system manufacturers now offer longer guarantees. If the manufacturer is reputable then the warranty period should be at least 25 years. However, research has shown that solar power systems often last much longer, and recent modern systems are very durable. If you do decide to buy a solar power system make sure to buy from a reputable and well-established manufacturer that is more likely to still be in business if you have any issues.

GOVERNMENT SUBSIDIES ARE AVAILABLE

There are some government subsidies available for installing solar power systems under the Small-scale Renewable Energy Scheme. Eligible systems may be entitled to small-scale technology certificates which can be sold to recoup a portion of the cost of purchasing and installing the system. This can often be arranged through an installer, see **www.cleanenergyregulator.gov.au**

BATTERY SYSTEMS ARE NOW AVAILABLE

Technology is improving! There are now solar power systems available that can store the energy produced in a battery for use when you need it at any time of the day or night. This can really help you save on your energy bills as you can use solar energy at night when energy use in the home is often greater and when energy tariffs are often higher. Search on **www.solarcitizens.org.au** for more details.

DIRECTION OF PANELS

In general you want to make sure that your solar panels are installed on the sunnier side of the roof of your home. However, it is also worth considering what time you normally use energy in the home.

If you are often at home and use more energy during the day then it is best to have your solar panels facing north.

If you are out a lot during the day and normally use more energy in the evening then it is worth looking into battery storage systems as they emerge.

SOLAR ENERGY MONITOR

If you do install a solar power system consider purchasing a Solar Energy Monitor – which currently cost around $250 (Dec 2015). Some of these monitors have a handy feature that lights up green when your solar power system is producing more electricity than is being used in the home. This surplus of solar power means it is a perfect time to do your washing, use the dishwasher, or any other activities in the home that use electricity.

SOLAR CITIZENS

If you do decide to go ahead and have a solar power system installed try to avoid cold callers, and always make sure to use a trusted, reputable and reasonably priced company. For advice on installation you can use **www.solarcitizens.org.au**.

KEEP AN EYE ON NEW DEALS

Even if you have decided its not worth installing a solar power system right now, keep an eye on new deals as the technology is ever changing and becoming cheaper.

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Australian Government
Department of Industry, Innovation and Science

Regional Development Australia
ILLAWARRA INC NSW

ENERGY + ILLAWARRA

xxxxxxx
xxxxxxx
Wollongong 2500

Sunday, 1 May 2016

Dear xxxxx,

Re: Energy + Illawarra
Agreement to proceed with energy efficiency improvement

Thank you for your continuing participation with us in the Energy + Illawarra project.

As described in the Participant Information Sheet provided to you by the University of Wollongong, Regional Development Australia Illawarra (RDAI) will be arranging the next phase of this project - the installation of an energy efficiency improvement to your home.

You will find in this package a description of what to expect for the next visit by an Energy + Illawarra project representative/s to your home. As agreed with you previously, our visit to your home has been scheduled for:

Visit Date:	**Thursday 25th June 2015**
Visit Time:	**11:00am**
Visitor Name:	**xxxx xxxx**

If you have any questions or need to reschedule please feel free to contact RDA Illawarra on 02 4227 4500 or phone your research contact at the University of Wollongong on 02 4239 2165.

As discussed with you, we are ready to arrange the installation of the energy efficiency improvement to your home. Using the information collected during our last visit of your home, researchers at the Sustainable Buildings Research

Centre (SBRC) have recommended an energy efficient improvement suitable for your home. Before we provide your contact details to the installers to arrange a convenient time for the installation, we want to ensure that you are agreeable to the items that have been recommended and the terms and conditions associated with the installation. Attached is an *Agreement to Install Energy Efficient Improvement*, simply for your information for now. If you are content, we will complete this agreement on the day of our visit.

Signing of this Agreement will:

1. Confirm your agreement to install the items outlined (which will be described when we visit)
2. Gain your consent to provide your contact details to installers
3. Confirm that you will allow access to installers to your home to complete the work
4. Make you aware that there are some risks involved in proceeding with the installation work

Our scheduled visit will focus on reviewing the recommended energy efficient improvement for your home and for answering any questions. We also wish to finalise the enclosed agreement on the day to enable us to proceed with arrangements for the installation as soon as possible. We expect the visit will take no longer than one hour. During the visit we welcome any other family members or friends who you would like to be present.

We are delighted to have you on board for this next stage of the project and thank you again for your continued cooperation.

Yours sincerely

Project Manager, RDA Illawarra

AGREEMENT TO INSTALL ENERGY EFFICIENCY IMPROVEMENT

PROJECT: Energy + Illawarra - Building Energy Efficiency Improvements

This Agreement is between:

Regional Development Australia Illawarra (ABN 46 389 260 571) of 87-89 Market Street, Wollongong NSW 2500 ("**RDAI**")

AND

____ (**"You"**)

The Australian Government has provided funding for the project entitled *Energy + Illawarra* (the project). The aim of the project is to install energy efficient technologies in 200 homes. RDAI and the University of Wollongong (UOW) are part of a consortium that is conducting the project. The purpose of the project is to improve the energy efficiency of your home or increase your thermal comfort. It is important that you realise that this is not directly linked to a reduction in your energy bill.

You have agreed to participate in the project by allowing an energy efficiency improvement to be installed in your home in accordance with the attached *Energy Efficiency Improvement Outline*. The installation will be carried out by contractors who are engaged by RDAI. All contractors and installers have in place all applicable qualifications and insurances as well as health, safety and quality procedures.

It is important that you have a copy of the *Participant Information Sheet (PIS) for Householders* associated with this project which outlines the purpose of the project in detail. A UOW representative should have given you a copy of this information at the time of the Building Characterisation of your home and provided you with an opportunity to consider the information and ask questions. Please let us know if this was not the case.

The purpose of this agreement is to set out the terms and conditions upon which the installation of the energy efficiency improvement will be conducted in your home. The agreement will start from the date that you sign and continue until the 30 June 2016 when the project is due to be completed.

Installation of energy efficiency improvements

The Contractor will install the building improvement to your home. By signing this agreement, you agree to allow RDAI to provide Contractors with your contact details, and for those Contractors to have access to your home at a mutually agreed time and date so they can install the energy efficiency improvement.

When the installation of the energy efficiency improvement has been completed, you will become the owner of the items installed in your unit. This means that you will be responsible for repairing and maintaining the items that were installed.

For the purpose of repairing and maintaining the energy efficiency improvement items, the Contractor will provide you with any relevant warranty documentation at the time the items are installed.

RDAI's commitment in relation to installation of the energy efficiency improvements

RDAI will use reasonable endeavours to ensure Contractors will not inconvenience you during the installation of the building improvement. However it is important for you to understand that there are inherent risks associated with the installation. By signing this agreement you are willingly and freely agreeing to allow the installation of the building improvement to your home with the knowledge that there are associated risks and inconveniences. It is important that you discuss the risks with your research contact, Michael Tibbs, at UOW on 02 4239 2165 if you are unsure of what this means for you.

On the basis that you are participating in the project freely and willingly, by signing this agreement you agree that RDAI will not be liable for any losses arising from the installation of the energy efficiency improvement or your involvement in the project.

RDAI will use all reasonable endeavours to ensure the improvement is installed in your home in accordance with the *Energy Efficiency Improvement Outline* in the Attachment to this Agreement. However it is important that you realise that in unlikely circumstances that are outside the control of RDAI and the Contractors, it may result that it is not possible for the installation to be undertaken. RDAI will provide you with written notice if it becomes aware that the installation is not possible. You cannot make a claim against RDAI in the event that it is not possible for the building improvement to be installed.

RDAI strongly recommends that you have up to date building and contents insurance for the duration of your participation in the project as is relevant and applicable to your property.

You can change your mind about participating in the project at any time. If you change your mind please contact UOW on 02 4239 2165 in the first instance.

If you do not understand any of the terms of this agreement, RDAI recommends that you obtain independent legal advice.

SIGNED FOR AND ON BEHALF OF RDAI	**SIGNED FOR AND ON BEHALF OF The Participant**
Signature	Signature
Print Name	Print Name
Date	Date

ATTACHMENT

ENERGY EFFICIENCY IMPROVEMENT OUTLINE

Insect / Security Screen

In Home Energy Display

Door/Window seals

Pipe lagging

RETROFIT ALLOCATION METHODOLOGY

INTRODUCTION

The Energy + Illawarra project team are seeking to trial a range of retrofit options on individual homes and Independent Living Units.

This document establishes the objectives, principles, approach and specific steps taken in the allocation of household retrofits. It follows on from the 'Home Assessments', which have established how each retrofit has been assessed for suitability at each home from a technical perspective (e.g. whether the proposed retrofit is already present, technical feasibility, WHS risks, and likely energy and occupant comfort impact). The allocation of retrofits are described here to guide how the budget for this portion of the works is distributed, and reflects project budgetary, schedule, and procurement parameters.

The methodology described here reflects the stage of the retrofit allocation process that occurs after individual Home Assessments, and before consultation with residents.

ALLOCATION OBJECTIVES AND PRINCIPLES

- ✓ Overall, a range of retrofit technologies/packages are to be trialled which vary in the monetary value and complexity of installation
- ✓ There is a pre-determined spread of each retrofit per batch (e.g. desire to have at least one of each item in each batch) that is established by project team members
- ✓ Whilst it is not always possible to quantitatively identify which retrofit will have the greatest reduction in energy or increase in occupant comfort, those retrofits deemed as lower cost, higher impact approaches will be prioritised
- ✓ Where possible, there is a minimum of $700 spend on each home, inclusive of GST
- ✓ There is a maximum spend of $6,000 (unless a solar hot water system) for 'community' homes
- ✓ Both budget thresholds and retrofit types on Independent Living Units are established in collaboration with each of the Aged Care Providers
- ✓ There are 'mandatory' and 'non-mandatory' retrofit types, defined by impact, technical feasibility and cost, as described below

APPROACH

- If there is a home with only one retrofit highly recommended for it, then that retrofit is allocated to that home.
- Each time a home is allocated a retrofit that exceeds the minimum established budget (e.g. $700 for community homes), it is not considered in the allocation process again until all homes in the batch have been allocated retrofit(s) that each meet the minimum budget level, to ensure every home is given an allocation, or allocations, to the value of at least $700.
- Non-mandatory retrofit types are numbered in order of likely installation cost, and are approached in the allocation process in this order, e.g. a solar hot water system is allocated before an air-conditioning system.
- In-Home Displays exist to provide homes with a retrofit that otherwise need no other kind of retrofit. Where budget permits, they will be allocated to 50% of community homes overall, prioritising homes with the least spent on them.
- After mandatory retrofits have been allocated, and where, during the allocation of a particular non-mandatory retrofit there are numerous homes that are 'eligible' for that retrofit, the home(s) with the lowest number of other retrofit options are prioritised.
- If, whilst during the allocation process (and after 'mandatory' retrofits have been allocated) the 'average $ per home' remaining in the budget goes below the estimated value of a retrofit item, then all allocations for that retrofit item stop during that 'pass' (see below).
- Retrofit types are prioritised in the following table:

Retrofit Allocation Methodology V3

RETROFIT TYPE	**PRIORITY**		**COMMENTARY**	**TARGET ALLOCATION (BUDGET-DEPENDENT)**
Ceiling Insulation	M	'Mandatory' To be undertaken at all homes where recommended	Downlight covers are to be paired with ceiling insulation, where applicable	100% of homes recommended for this retrofit are to be allocated this retrofit (unless receiving a third-party procured fridge/freezer) In intensively monitored homes, 30% will *not* receive *pipe lagging*
Lighting bulb replacement	M	'Mandatory' (light bulb replacement) To be undertaken at all homes where recommended		
Door and window seals	M	'Mandatory' To be undertaken at all homes where recommended		
Pipe lagging	M	'Mandatory' To be undertaken at all homes where recommended		
Solar Hot Water	1			50% of ILUs to be allocated a *hot water system* retrofit
Heat Pump Hot Water	2		Allocated only where solar hot water is not possible	
Reverse Cycle A/C	3			10% of community homes to be allocated *A/C*
Sub-floor Insulation	4	Allocated to intensively monitored homes if recommended	In Southern Highlands, sub-floor insulation takes priority over hot water retrofits.	100% of homes recommended for this retrofit received it (unless receiving a third-party procured fridge/freezer) in Southern Highlands.
Internal Blinds	5			5% of all homes to be allocated *internal blinds*
Fridge/freezer replacement	6		Homes that have been allocated a fridge/freezer replacement do not receive other retrofits (as these are procured differently), other than 10 homes whereby fridges will be returned to SBRC. When allocating fridge / freezer replacement, any two of the following three take precedence: Lighting upgrade, Door and window seals, Pipe lagging, (plus In-Home display)	
External shading	7			
Ceiling fan	8			
AC isolation switch	9			
Lighting upgrade	10		This relates to light fittings, rather than bulb replacements	15% of all homes to be allocated *lighting upgrade*
Large gap sealing	11		Large gap sealing is prioritised for intensively monitored homes with highest air leakage rates that are identified in blower door tests	
Pedestal fan	12			
In Home Energy Display	IHD	These are not 'counted' for retrofit suitability but are allocated after all other retrofits have been allocated.	The aim of this retrofit is in particular to provide homes with a retrofit that otherwise need no other kind of retrofit	50% of community homes to be allocated *In Home displays*

ALLOCATION STEPS

ESTABLISH PARAMETERS

1. Establish a budget for batch, accounting for contingency;
2. Establish retrofit types applicable to that batch (dependent on tenure); and,
3. Establish the ‘average $ spend per home’ allowable in the budget, i.e. the batch budget divided by the number of homes in the batch, after removing 20% contingency

ASSIGN ‘MANDATORY’ RETROFITS

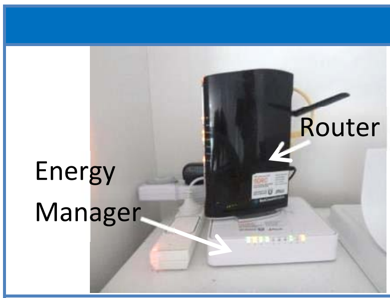
1. Allocate ceiling insulation (and if relevant, accompanying downlight covers), light bulb replacement, draught-stripping and pipe lagging to all homes where it has been recommended;
2. Ascertain the homes that have only one potential retrofit option and allocate each of those single retrofits to those homes that fall under this category;
3. Ascertain retrofit types that require a certain distribution of retrofit allocations, and allocate those retrofits to those homes, e.g. in ‘Batch 1’, each retrofit type is to be allocated at least once.

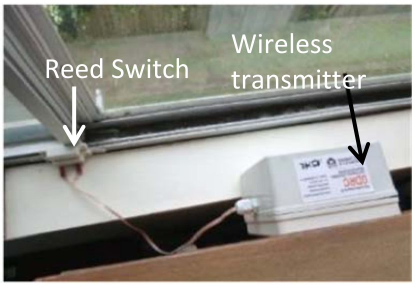
ASSIGN REMAINING RETROFITS

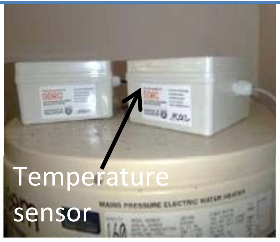
4. Once mandatory retrofits have been allocated, pass from the highest cost to lowest cost retrofit list (whereby each time a given retrofit item is allocated to relevant homes, that is termed a 'pass'). Where several homes are ‘eligible for that retrofit type, use a digital randomisation process to indiscriminately rank the homes for that pass. If the average $ per home remaining in the budget drops below the estimated cost of that retrofit item, then do not continue allocating that retrofit type - all allocations for that retrofit item stop during that sweep (all passes from the top to the bottom of the retrofit list is termed a 'sweep'). Each pass allows a retrofit to be allocated to at least one of the eligible homes. If that home has had $700 spent on it, is not considered for further retrofits during that sweep.
5. For second and subsequent sweeps: only include homes which have not been allocated anything, or whose current retrofit item value is less than $700 inc GST.
6. At the end of the last sweep, homes that have been allocated less than $700 of value are allocated an *In Home Display*. Note that ‘low priority’ retrofit items are still to be considered during the consultation process, should budget allow.
7. If budget permits, allocate remaining In Home Displays at random so that 50% of the batch are allocated *In Home Displays*

Appendix I – In home monitoring equipment

Some of the equipment used for the in-home intensive monitoring is shown below.

<table>
<tr><th></th><th>Description</th></tr>
<tr><td>
</td><td>The Router and the Energy Manager were used as a central communication point and data logger for all of the devices installed around the home. They were typically deployed in a central location either on top of the fridge, behind a cabinet or behind a couch.</td></tr>
<tr><td>


</td><td>The Circuit Meter measured the electrical consumption of individual electrical circuits and the total load. Current Transformers were clipped around the supply wires and connected to the circuit meter.
They were installed behind the front panel of the electrical distribution board. Typically a single circuit meter was used for each phase and a current transformer for each circuit.</td></tr>
<tr><td></td><td>The appliance modules measured the electricity consumption of appliances that plug into wall sockets. Typically five of these were located within the home and monitored fridges, heaters, dryers, microwaves and entertainment devices.</td></tr>
<tr><td></td><td>Temperature and humidity sensors measured the temperature and humidity in various living spaces and were typically installed on a wall or piece of furniture ~1m above floor level. Typically 6 of these were placed within the home in living rooms, main bedrooms, bathrooms, outside on the southern wall, in the ceiling cavity and other commonly occupied spaces.</td></tr>
<tr><td>
</td><td>Reed switches enabled the project team to monitor household practices around opening and closing windows and doors. The reed sensor was wired back to a wireless transmitter box.
Typically four of these were located within the home on external doors and windows in primary living areas such as the main living room and main bedroom.</td></tr>
<tr><td>


</td><td>Temperature sensors measured the hot water system temperature while a pulse counter monitored the hot water flow. One temperature sensor was deployed on the delivery hot water line, for a small number of homes an additional temperature sensor was placed on the cold water supply line.</td></tr>
</table>

Stage 1: Semi-structured interview 'Getting to know you'

Biography (10 mins)

Aim: Understanding of the participant in relationship to energy

1. Firstly, we are interested to know a bit about your history – so would you mind telling me about yourself, for example **where** you grew-up; **different places** you have lived; different **qualifications** or **job** you have done; your **family life**.
    - Have you ever lived without electricity or gas?
    - Have you ever lived without hot water?
    - Tell me about how you've coped in very hot or very cold climates?
    - Have you lived in many different houses?

Home Narrative (20 mins) Tell me about when you moved into this home:

Aim: Understanding of the participant in relationship to the house as home

1. **Some things we may have already covered…**Why did you move to this house?
2. Since moving in, what sorts of things did you do to **make it homely, make it feel right** for you?
3. Are there things you would still like to do to make it feel right?
4. As a home, how does this house compare with other houses you have lived in over your life?
    - Does it lack particular things that make it feel right as a home?
5. **Taking you back to something a bit more mundane** now, tell me, was the way you would heat the house in winter an important consideration before moving in?
    - Or what about how you would cool the house in summer?
    - What about the type of hot water system – was that a consideration when moving in?
6. What did you do with your **electrical appliances** when you moved in from your old home – fridges; heaters; fans?
7. If you bought new heaters/fans/air conditioners when you moved in, why that particular one?
8. When at home I often think about myself as **juggling my roles** as a partner, a parent and a researcher. You have lived her for x years. Tell me about **how you see yourself** in this home.
9. My brother sees me as a great place to visit for a holiday – How do you think **family members see you in your home**? What about **friends**?

Futures (10 mins)

Aim 1: Understanding of hopes and worries for the future (may or may not be related to energy efficiency)

Aim 2: Understanding of the importance of energy saving in context of their home and a wider context

10. **OK, we're going to change the direction of the discussion now**, moving on to the future. What do you think are the most pressing issues for future generations living in Australia?
11. OK, the focus of this project is on energy efficiency. Can you tell me what you **understand** by energy efficiency?
    - **When** did you become aware of this idea of energy efficiency?
12. **Why** do you think that energy efficiency has become **important** to different governments?
    - **What sorts of things** are people being asked to do by different government agencies (individual actions)?
13. Can you tell me whether energy efficiency is important to you in the context of your home?
    - **When** did it become important?
    - **Why** is it important?
    - What are the **three most important things** you do?

Sketch of floor plan & hot water system (20 mins)

Aim – an interactive activity to reveal how energy is consumed to sustain comfort

14. OK, now I'd like to move onto the drawing I mentioned earlier. Drawing one's house sometimes reminds people of different ways they move around or live in their house. So, could you please **sketch or doodle** the different **floor plans** of the different levels of your home – including outdoors.
    - **Start with the room that is most important to you.**
    - Tell me about what you like and dislike about these rooms as you doodle.
15. Tell me about what you have doodled.
16. Summer locations:
    - In **blue** – please shade the **'comfortable'** locations in your home in **summer**.
        - What makes them 'comfortable'?
    - In **red** – please shade the **'uncomfortable**' locations in your home in **summer**.
        - What makes them 'uncomfortable'?
17. Winter locations:
    - In **brown** – please shade the **'comfortable'** locations in your home in **winter**.

    - What makes them 'comfortable'?
  - In yellow – please shade the **'uncomfortable**' locations in your home in **winter.**
    - What makes them 'uncomfortable'?

18. Do you know if you have **insulation** in the walls/ceiling?
19. Could you please indicate on the sketch where the **hot water system** is? Would it be ok for you to show me the hot water system now?
20. Tell me what you know about the hot water system -
    - (even if not solar hot water system) Do you use a booster switch?
    - Do you know the thermostat level? Please explain further.
    - Do you change the thermostat level? Please explain further.

Well that's all the questions I have for you today. Is there anything else you'd like to mention this time?

Thank you very much for your time.

SECOND HOME VISIT: Home video tour - the sensory aesthetic of home ('feel' right)

Introduction & set up of equipment

Appendix J

Room insights – making rooms ‘feel’ right

Start in the room that the participant considers most important.

Rooms to cover:

1. Kitchen
2. Dining
3. Lounge
4. Bedrooms
5. Hallway
6. Laundry
7. Bathroom

Common questions for each room

1. What have you **done since you moved in**?
   [I am interested in how you have gone about making this room ‘feel’ right for you]

2. Tell me about **why this room is the way** it is – why did you make it this way?
   [Prompt only if needed to start: How do you make it cosy in winter/cool in summer?]

3. Show me what sorts of things you have **changed**?

4. **Why** did you change this?
   [eg. ill health of partner, less mobility, bereavement, draught, policy, winter, summer?]

5. How do you **maintain** the room the way it is – **(cosy / cool,** cleaning, airing, heating/cooling, lighting)

6. Show me what sort of things you **would still change** about this room to make it ‘feel’ right?

7. **Will you** make these changes? If not, why not?

Kitchen has extra questions (PTO)

In each room, pay attention to items related to energy consumption – how energy is used to maintain the room the way it is:

- **floor** coverings
- **curtains**, blinds
- awnings, shutters
- **windows/ventilation/ideas around ‘fresh’ air**
- double glazing
- **draught** excluders, if mentioned - where do draughts come from, when noticeable?
- **lighting** eg dimmers, down lights, bulbs, lamps
- **heaters &/or air-conditioners**
  – **can prompt in terms of investigating contingencies** eg. Was this heater a gift? **Household dynamics** around the heater or a/c use If money wasn’t an issue would you use heater or air con more than you do?
- other appliances eg – **washing machine, exhaust fan**

Be alert to tensions between aesthetic, comfort and energy

eg floorboards may look good – but cold in winter.
eg Efficient lighting too white for desired ambience.
Eg TV/radio – do you keep on for company?

Version at 20Nov14

Kitchen

Common questions, plus

Fridges – look inside

1. Describe the location of the fridge
2. Why is the fridge in this location, is this the right location for the fridge?
3. What is the history of this fridge – why did you purchase this fridge?
4. What do you like about your fridge?
5. What do you dislike about your fridge?
6. What do you store in the fridge – do you have plan inside the fridge?
7. Have you changed the layout of the fridge? Why?
8. Do you know what the temperature setting is for the fridge?
9. Do you have a second fridge? **If yes – visit and repeat**.

Sinks, dishwashers and washing up of dishes (only ask here if NOT doing washing up enactment later)

1. how do you wash up?
2. why is this the right way to wash up?
3. when do you wash up?

EXPLORING PAST, PRESENT, FUTURE

1. **How, where, when** tasks related to routines were **formed.**
2. How does the task or routine make the home **'feel' right** (sensory aesthetics of the home)?
3. How are the tasks/routines **linked to other** activities/routines?
4. How are the tasks/routines linked to the **material dimensions of the home** – eg. size of room, temperature, what things are made of?
5. Anything they **plan to change**?

Asking participant to enact everyday routines

Thank you for showing me each room of the house. Now I'd like you to show me how you do certain routines, and then how you move about the house at certain times of the day. So the first one is (laundry) or (washing up) or (bringing groceries home on a winter day).

IF DOING LAUNDRY ROUTINE (not all participants)

Could you enact how you do your washing? I'm interested in the whole routine of **doing the laundry in winter**:

1. Please show me how you move through the house when you do the laundry in winter.
2. Tell me about the different activities you do - i.e.
3. When are things considered in need of washing (clothes, curtains, sheets)?
4. Where are things requiring washing stored?
5. When do you do the washing?
6. How they are washed?
7. Why a particular cycle/ hot and cold wash?
8. Why is this the right way to wash?
9. How they are dried?
10. How do you know they're clean?
11. When they are put away? Do you iron them?
12. In summer, show me how your routine may be different.

EXPLORING PAST, PRESENT, FUTURE

1. **How, where, when** tasks related to routines were **formed.**
2. How does the task or routine make the home **'feel' right** (sensory aesthetics of the home)?
3. The smell of clothes – and categories of clean/dirty
4. The touch of clothes – and categories of clean/dirty
5. The touch of sheets and categories of clean dirty
6. How are the tasks/routines **linked to other** activities/routines?

IF DOING WASHING DISHES ROUTINE (not all participants)

Ask the participant to enact **washing the dishes:**

- show me how your routine for washing-up the dishes –
- Where does the water come from?
- What is the right temperature of water for washing up?
- How do you wash up?
- Why is this the right way to wash the dishes – where did you learn this technique?
- When do you wash up?
- Observe how the participant uses the hot tap/mixes hot and cold water. Is it too hot?

EXPLORING PAST, PRESENT, FUTURE

1. **How, where, when** tasks related to routines were **formed.**
2. How does the task or routine make the home **'feel' right** (sensory aesthetics of the home)?
3. How are the tasks/routines **linked to other** activities/routines?
4. How are the tasks/routines linked to the **material dimensions of the home** – eg. size of room, temperature, what things are made of?
5. Anything they **plan to change**?

IF DOING Arriving home on a winter's day after grocery shopping (only do if not laundry or dish washing routine):

1. Show me how you **move** through the house when you arrive home on a **winter**'s day after being grocery **shopping** –
2. Tell me about the different **activities** you do:
    a. Eg. *Heating – taking off clothes – putting away groceries in the fridge*.
3. In **summer**, show me how your routine may be different.

EXPLORING PAST, PRESENT, FUTURE

1. **How, where, when** tasks related to routines were **formed.**
2. How does the task or routine make the home **'feel' right** (sensory aesthetics of the home)?
3. How are the tasks/routines **linked to other** activities/routines?
4. How are the tasks/routines linked to the **material dimensions of the home** – eg. size of room, temperature, what things are made of?
5. Anything they **plan to change**?

ALL DOING

1. Staying home during the day in winter.

- Show me the different activities that you do to make yourself comfortable if you stay home during a winter's day. *(regulating doors/windows; heating/cooling systems; hot drinks, clothes, blankets, lights, blinds, curtains, pets)*
    - Be alert to heater or a/c thermostat – how do you use these
    - Show me how your routine may be different in summer.
    - Is your routine different when you have family/friends visiting?

2. Staying home in the evening in winter.

- Show me the different activities that you do to make yourself comfortable if you stay home during a winter's evening. *(regulating doors/windows; heating/cooling systems; hot drinks, clothes, blankets, lights, pets)*
    - Show me how your routine may be different in summer.
    - Is your routine different when you have family/friends visiting?

3. Getting-up in the morning in winter:

- Show me how you move through the house when you get up in the morning in winter. Tell me about the different activities you do. – *Showering, making tea, turning on/off heaters, lights.*
    a. *Could be done in bathroom or kitchen-* Observe or ask how the participant uses the hot tap/mixes hot and cold water. Is it too hot?
    - In summer, show me how your routine may be different.

4. Going to bed in winter:

- Show me how you move through the house when go to bed at night. Tell me about the different activities you do. – *Showering, making tea, turning on/off heaters, lights.*
    - In summer, show me how your routine may be different.
    - In summer, show me how your routine may be different.

Well that's all the questions I have for you today.

1. Is there anything else you'd like to mention this time?
2. Confirm interest in follow-up visit to review video.
3. Thank you very much for your time.

Jan-Feb 2016 Energy+Illawarra Post-energy efficiency upgrade interview questions (Upgrade & Intensive Monitoring participants)

Hand participant sheet that lists categories of questions.

Today's questions are separated into seven categories: Project impressions; Energy ideas; Energy efficiency upgrades; Energy practices; Your home comforts and wellbeing; Unexpected outcomes; and final questions.

PROJECT IMPRESSIONS

You have been involved in this project that focused on energy efficiency in peoples' homes. All parties involved need to learn from your experience as a participant.

The project has involved four key stages and we'd like to explore each stage with you. They were:

- marketing;
- building characterisation and energy monitoring;
- consultations about energy efficiency upgrades; and then
- installation of the energy efficiency upgrade.

1) <u>So firstly, Marketing.</u>

Over the course of the project, you have received a number of materials branded Energy + Illawarra. So, tell me about your impressions of the marketing material in the Energy + Illawarra campaign:

a) Do you have the <u>thermometer</u>? Do you use it? Could you tell me how you have used it?

  - Did you move it around?
  - Did you look at it?
  - Did it figure in considerations of when to heat or cool areas?
  - Or change routines or practices?
  - Did you use it inside the fridge or freezer?

b) How have you found the r<u>emote control power socket</u>? Has it been useful or not?

c) Did you read the newsletters?

- What did you think of them (e.g. language used, information provided, and relevance to you)?
- Did you find anything in the newsletters that you thought was a good idea and put into practice? Or that confirmed that you were doing the 'right' thing already?

d) Did you connect with the project's Facebook page? What did you think of it? Did you tell family and friends about it? Did you contribute at all (e.g. liking, sharing page)?

e) Did you visit the project's website? Watch the videos?

f) Have you looked at any other websites about energy efficiency or sought out other information about energy efficiency?

[If yes]:

- Which ones (e.g. Government websites, energy providers)?
- Was that during this project or before? If during this project was it because of questions raised by the project that you sought out the information?

OK thanks, that was the marketing side of the project. Now moving on to…

2) The Building Characterisation

This was the stage of the project when a team from the University of Wollongong visited your home to measure its physical characteristics.

a) So, tell me about your impressions of the building characterisation.
[looking to see if people indicate stressful/useful etc]

Back in early to mid-2015, an energy monitoring system was installed as part of the building characterisation.

[Everyone: not just those with displays:]

b) Tell me about your experience living with this system in your home?

c) Could the project team have done more to help you understand the purpose/function of the monitoring system?

- If so, what aspects? How could the project team have helped more?

[If this is a home with a display unit installed in early-mid 2015:]

d) We're interested in your experience living with the energy monitoring display. Do you think it has made you more or less concerned about energy use? How/why?

e) How did you use it? (e.g. if you look at it, when you look at it and why?)

f) Where is the display unit positioned in your home? Could you show me where it is?

- Do you think this is the right spot for it? Are there other places you would have liked to have it? Why is that?

g) *[if not already covered]* Does it change your actions? If yes, how?

[Everyone]

3) The Home Consultation

This was the part of the project when you were consulted about the energy efficiency upgrade and signed documents allowing these to occur in your home.

- Tell me about your experience of this process. How could it be improved?

4) <u>Installation of the energy efficiency upgrade.</u>

This was when installers visited your home to provide the energy efficiency upgrade.

a) Tell me about your experience of this process. How could it be improved?

b) What is it like living with the upgrade(s) themselves? Have they improved your comfort? What about your wellbeing? Or have they provided other benefits?

YOUR ENERGY IDEAS

1) In a previous interview we asked you to tell us your ideas about energy efficiency. As a result of this project, does energy efficiency mean anything different to you? Do you draw on different ideas or similar ideas? If so what are these ideas?

- What accounts for this change? *[list the different parts of the project as below]*
  - Marketing
  - Social interaction with the range of people coming to your home
  - Building characterisation including energy monitoring
  - Consultation
  - Installation

2) As a result of this project, have you had conversations with family or friends about energy efficiency? *[if a couple household talk about themselves, ensure to ask if they have also talked with others]*

[If yes]

- Have these conversations been useful, do you think, in explaining to others how you use energy efficiently to keep comfortable at home?

3) Do you give advice to others about how they can use energy efficiently and be comfortable at home? *[If no]*: Why are you reluctant to give advice to others about the ways people use energy more efficiently about their home? [*potential prompts]*....Not being knowledgeable about the topic.... not a topic of conversation how to use energy efficiently, ... friends are more knowledgeable about energy efficiency, how people use energy is a private matter?

4) Having been involved in the project, would you see yourself as a champion of energy efficiency?

YOUR ENERGY EFFICIENCY UPGRADES

1) So in this project you've received advice on how to improve the energy efficiency of your home. What was your reaction to the advice about energy efficiency upgrades?

   [Prompts if necessary]:

   - Was the information, and/or the upgrade you received in line with your expectations about what would be the most effective energy efficient upgrade for your home?
   - If not, how was it different to what you expected?

2) Did anything prevent you from accepting the advice provided in the project?

   [Prompts if necessary]:

   - Is that about thermal comfort, another type of comfort, aesthetics [eg. view], routine, different priorities or knowledge? Lighting or draughts [eg. prefers fresh air/open house so wouldn't take air conditioning; wouldn't want blinds as prefers view/natural light]? Concerns about running costs, health, household dynamics? Emotional attachments to appliances/other things?

3) Did you independently make energy efficiency upgrades to your home as a result of being a participant in this project?

   [If yes]:

   a) What were the changes?
   b) Why? What was the motivation behind the action?

   [Looking to understand was this related to cost, comfort, information, self-efficacy, something else?]

   [If necessary]: What stopped you in the past?

   c) *[If not already covered]:* Which part of the project triggered this action of yours?

4) Having been involved in the project will you undertake future energy efficiency upgrades to your home?

   [if yes]:

   - What is your motivation for this?

   [If no]:

   - Tell me more.

Let’s move on to the next section, which is about…

YOUR ENERGY PRACTICES

As you know we’ve been asking questions and investigating how people use energy in and around their home.

1) So firstly having been involved in this project, have you found that you are doing things differently in and around home (this can be related to energy use or other things too)? Can you give me any examples?

   [Prompts if necessary]:

   - Is that about thermal comfort, another type of comfort, aesthetics, routine, different priorities or knowledge? Lighting or draughts? Concerns about running costs, health, household dynamics?
   - Are you doing anything different in relation to <u>hot water</u>?
   - Do you <u>move</u> around your home differently?

   [if necessary]: So was that [example] related to the project in some way?

2) *[if related to the project]:* Having been involved in which part of the project do you think accounts for this changed behaviour? *[list the different parts of the project as below]*
   - Marketing
   - Social interaction with the range of people coming to your home
   - Building characterisation including energy monitoring
   - Consultation
   - Installation

3) Did anything prevent you from accepting advice provided in the project?

YOUR HOME COMFORTS AND WELLBEING

These questions cover different dimensions of your home comfort.

1) Thinking about <u>thermal comfort</u>, has being in this project made your home a more or less comfortable place to live?

2) Thinking about the <u>everyday practices</u> that you've told me about that you've changed, have they made it a more or less comfortable place to live?

3) Thinking about comfort in terms of your energy bills, has the project helped you to feel more – or less – in control of your energy bills?

[Prompt if necessary]:

a) Could you explain how this has come about (or not)?

[If more in control]:

b) Has this had any flow on effects for you do you think? Like you might feel you can invite people over, or feel you can afford to do other things…like go out with friends.

[If no, or less in control]:

c) What might help you to feel more in control of your energy bills?

YOUR UNEXPECTED OUTCOMES

1) Can you think of any <u>unexpected</u> outcomes that have arisen for you from this project – not necessarily even to do with energy efficiency or comfort?

   - As an example, one participant in the project was able to take up crochet after a more energy efficient and powerful lightbulb was installed in her living room (increasing the lighting level, but also reducing energy consumption); and then she went on to join a crochet club. Can you provide any examples of unexpected outcomes?

[if not already covered]:

2) Were you surprised by any of the information that the project staff gave you? Or was that knowledge that you already had? (in relation to energy, energy efficiency, and comfort (thermal and otherwise)).

FINAL FEW QUESTIONS

1) Knowing what you know now, what advice would you give to others that might encourage them to act?

2) Thinking about the homes of older people on low incomes, I have two questions for you:

    a) If you could tell the government one thing about energy efficiency in relation to comfort at home, what would it be?

    b) And if you could tell the government one thing about energy efficiency in relation to wellbeing what would it be?

Thank you for your time and responses throughout this project.

Jan-Feb 2016 Energy+Illawarra interview questions (Intensive Monitoring – only participants)

Hand participant sheet that lists categories of questions.

Today's questions are separated into seven categories: Project impressions; Energy ideas; Energy efficiency upgrades; Energy practices; Your home comforts and wellbeing; Unexpected outcomes; and final questions.

PROJECT IMPRESSIONS

You have been involved in this project that focused on energy efficiency in peoples' homes. All parties involved need to learn from your experience as a participant.

The project has involved two key stages:

- marketing; and
- building characterisation and energy monitoring.

[Expand if necessary]:

By marketing I mean items such as the newsletters, the website, and products sent to you such as thermometer. And the 'building characterisation and energy monitoring' includes when a team from the University of Wollongong measured the physical characteristics of your home, and also installed the energy monitoring system.

1) <u>So firstly, Marketing.</u>
Over the course of the project, you have received a number of materials branded Energy + Illawarra. So, tell me about your impressions of the marketing material in the Energy + Illawarra campaign:

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[Prompt if necessary]:

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FINAL FEW QUESTIONS

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2) Thinking about the homes of older people on low incomes, I have two questions for you:

    a) If you could tell the government one thing about <u>energy efficiency in relation to comfort</u> at home, what would it be?

    b) And if you could tell the government one thing about <u>energy efficiency in relation to wellbeing</u> what would it be?

Thank you for your time and responses throughout this project.