Energy Saver Study

Final report

Low Income Energy Saver Direct Care and Motivators Project

2 May 2016

SECCCA
South East Councils Climate Change Alliance

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The South East Councils Climate Change Alliance (SECCCA) supports communities, businesses and industries to the south east of Melbourne in responding and adapting to the impacts of climate change. SECCCA is an incorporated association of eight councils committed to delivering high-quality, innovative projects and research programs at a regional level.

SECCCA is:

Our vision is for the communities to the south east of Melbourne to produce zero net emissions and have a high capacity to adapt to climate change.

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Glossary

Word/phrase	Definition
ACM (asbestos containing material)	A material that contains asbestos fibres
ADS (Aged and Disability Services)	Support services provided for frail older people and younger people with disabilities to live in their homes and it includes support for their carers.
Air Exchange Rate	The leakage rate of air through a building measured in ACH (air changes per hour)
CHSP	Commonwealth Home Support Programme
CO (Carbon monoxide)	A toxic gas which is colourless, odourless, tasteless and extremely poisonous. It can result from and be emitted by faulty gas appliances.
Consortium	The group of SECCCA, its 6 participating member councils plus other public, private and non-government organisations that together planned, governed and delivered this study
Database	A structured set of data held in a computer
De-identified data	Data collected and recorded from homes in the study with the name and address of participants removed by SECCCA before it is sent to the Department of Industry, Innovation & Science
DIIS	Department of Industry, Innovation & Science
EAP (Energy Action Program)	A support and information program provided to householders as part of the study to increase their knowledge, capacity and actions regarding energy efficiency at their home which may also benefit their comfort, health and wellbeing
ELO (Energy Liaison Officer)	Staff members hired by SECCCA and local councils to recruit and support eligible householders to participate in the study and improve their energy efficiency
Friable asbestos	An asbestos containing material that is generally quite loose and, when dry, can be crumbled into fine material or dust with very light pressure. These products usually contain high levels of asbestos (up to 100%), which is loosely held in the product so that the asbestos fibres are easily released into the air.

GST (Goods and Sales Tax)	A tax of 10% that is charged on most goods, services and other items sold or consumed in Australia
HACC (Home and Community Care)	Support services provided for frail older people and younger people with disabilities to live in their homes and it includes support for their carers.
IHD (In-Home Display)	An electronic device that shows current and historical information about the energy use in the home i.e. when energy has been used & how much
Interval data	The amount of energy (in kWh or MJ) used during a defined period; e.g. during a 30 minute period
Intervention	An action facilitated by SECCCA to support participating households to improve the energy efficiency, costs, health, comfort and/or wellbeing at their home e.g. i) purchase & installation of energy efficient products i.e. LED lights, draught sealing, insulation, heaters/coolers, hot water service, window furnishings or ii) providing support such as energy efficiency information or advice, awareness of other benefits
LIEEP	Low Income Energy Efficiency Program
Low Income Household	One or more of the following conditions must apply: • Household income is in the bottom 40% of the Australian population's income range • Householder is in receipt of an Australian Government concession card • Household income is mainly derived from income support payments • Householder is a member of a particularly disadvantaged target group e.g. Indigenous, culturally and linguistically diverse, new arrivals, person with a disability • High energy needs due to either individual or locational factors e.g. disability or climate (high energy usage relative to household size and composition)
Payback	The money saved due to more energy efficient design, materials or appliances
Payback period	The length of time required to recover the cost of an investment
RECs/STCs	Renewable Energy Certificates/Small Scale Technology Certificates - entitle the owner of the certificate to a financial rebate for the one tonne carbon dioxide equivalent (CO_2-e) that has been abated due to the specified energy saving

	activity
SECCCA (South East Councils Climate Change Alliance)	The incorporated association of eight councils committed to delivering high-quality, innovative projects and research programs at a regional level
VEECs (Victorian Energy Efficiency Certificates)	An electronic certificate that is provided by the Victorian Government (Essential Services Commission) which entitles the owner of the certificate to a financial rebate for the one tonne carbon dioxide equivalent (CO_2-e) that has been abated due to the specified energy saving activity known as Prescribed Activities being done

Executive Summary

Introduction

The Low Income Energy Efficiency Program (LIEEP) was funded and managed by the Australian Government. The Energy Saver Study (formerly *Residential Energy Efficiency Motivators Program for Low Income Households*) was coordinated by the South East Councils Climate Change Alliance in Victoria. It was one of twenty LIEEP research projects that aimed to trial and evaluate a number of different approaches in various locations that assist low income households to be more energy efficient and capture and analyse data and information to inform future energy efficiency policy and program approaches. This 3-year project aimed to investigate the most effective ways to support low income householders to improve their household energy efficiency. The project also aimed to determine if the support provided to householders decreases the householders' energy costs and has benefits for their health, comfort and/or wellbeing. It also aimed to confirm whether delivery of a support program to low income householders is effective when done through local council Home and Community Care (HACC) departments.

This project received $4.4 million from the Department of Industry, Innovation and Science (DIIS) LIEEP funding Round 1 in April 2013.

This report is designed to provide information to government staff and politicians. It is to help inform future government policy and programs related to supporting and protecting vulnerable, low income community members, to help them reduce their energy and living costs, improve residential energy efficiency, community health and wellbeing.

Project rationale

Low income householders including council HACC clients (those that receive discounted gardening, cleaning, cooking or home maintenance services from council) which are often the most vulnerable in the community to the impacts of climate change, given their socio-economic status and the types of houses in which they live. These homes may be old, inefficiently designed or built (in terms of energy) or poorly maintained. These low income householders may face barriers to improving energy efficiency including no/little access to money, poor physical and/or mental health or they may have acute health conditions, a lack of mobility, limited knowledge of residential energy efficiency opportunities, limited/no English and they often live in homes where they need approval from landlords/property managers to undertake work on the home.

Approaches

The project was delivered in 3 stages:

- Householder recruitment and pre-intervention data gathering
- Interventions
- Post-intervention data monitoring and evaluation

This project recruited participants through already trusted and well regarded organisations: the local council Home & Community Care teams. Householders were then allocated to one of the 4 main study groups as follows (see Table I below):

- Group A: receive home improvements/retrofits (80)
- Group B: receive energy action information and support (80)

- Group C: receive home improvements **plus** energy action information and support (80)
- Group D: receive no support i.e. this is a scientific control group until after the monitoring period (80)

Energy monitoring equipment was then installed in 120 homes to collect and compare with data from energy distributors. 30 of these homes received custom designed In-home displays showing their energy use. A further 30 homes received off the shelf in-home displays. Another 60 homes were draught tested, with 26 of them receiving draught sealing and retesting to determine the effectiveness of draught sealing. A further 60 were assessed for their pre-intervention star rating and 28 had their star rating re-assessed after home improvements.

The intervention approaches the project used to assist low income householders in various locations to become more energy efficient (plus the associated co-benefits) included:

- Employ and train 6 Energy Liaison Officers (ELOs) to recruit and support 320 eligible householders that receive Home and Community Care services
- Deliver a tailored energy efficiency support program through local council HACC Services to reduce the existing barriers of finance, information, capacity, communication and lack of trust in existing providers.

The project captured and analysed data and information to inform future energy efficiency policy and program approaches. It compared between the 4 main intervention study groups to determine the most effective and best value approach to overcome capacity, cost and risk barriers.

The project developed a robust framework, tools, training and a training guide (*House In Order*) for ELOs in the delivery of the additional home retrofit and support services to clients.

An RMIT PhD research project was undertaken simultaneously which identified and described individual and socially shared householder practices. It quantified outcomes in indoor temperatures, energy use, energy costs and householder health and explained how householder practices influenced these outcomes.

An additional Swinburne University Masters research project was added to the project during 2015 exploring social influence on household energy practices. Social influence was being researched through the householder's social network. Interviews regarding social influence patterns on householder actions and their Most Significant Change have been completed and preliminary findings identified.

Characteristics of the target audience

The householders were predominantly retired, aged and had either a chronic or acute health condition. Most but not all were single females. Some were physically and cognitively very able and had the capacity to plan, organise and arrange their life.

Table I: Household study groups and activities

Group	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5	Activity 6	Activity 7
1A (30 households)	energy audit	air-barrier testing (15 houses only)	draught sealing (15 houses only)	star-rating assessment (15 houses only)	energy retrofit		energy monitoring equipment
1B (30 households)	energy audit	air-barrier testing (15 houses only)		star-rating assessment (15 houses only)	basic energy retrofit (post-Activity)	behaviour change program	energy monitoring equipment
1C (30 households)	energy audit	air-barrier testing (15 houses only)	draught sealing (15 houses only)	star-rating assessment (15 houses only)	energy retrofit	behaviour change program	energy monitoring equipment
2A (50 households)	energy audit				energy retrofit		
2B (50 households)	energy audit				basic energy retrofit (post-Activity)	behaviour change program	
2C (50 households)	energy audit				energy retrofit	behaviour change program	
1D Control Group (30 HHs)	energy audit	air-barrier testing (15 houses only)		star-rating assessment (15 houses only)	basic energy retrofit (post-Activity)		energy monitoring equipment
2D Control Group (50HH's)	energy audit				basic energy retrofit (post-Activity)		
TOTAL	320	60	30	60	320	160	120

Results

Councils

It was worthwhile and important that councils participated in the study. All councils were able to identify and recruit householders. Three different models were used to deliver the project across the six councils. Five councils appointed an Energy Liaison Officer and placed them within the councils' Home and Community Care team. One council outsourced their HACC services to a private provider that co-supervised their Energy Liaison Officer. The sixth council was willing for their HACC Home Maintenance team to provide home retrofits to householders. Councils provide good access to client data which can lead to targeted and successful recruitment.

The study helped to improve the credibility of the council among householders who received the retrofitting and behavioural change activities. It improved communication and established links within the councils. It raised awareness and provided information and ideas to both council staff and clients. Both councils and the householders benefited from the project and had increased knowledge and capacity as a result of the project

Companies can be contracted by councils at very competitive rates to supply goods and services. This procurement can be replicated in the future by governments/organisations at the relevant scale.

Future funding of householder support regarding energy efficiency, home safety, comfort, maintenance and modifications could be provided to and via the future HACC providers (CHSP providers, which may be wider than local government from 1 July 2016 onwards).

Impacts of interventions

The combination of home retrofit and behaviour change interventions achieved statistically significant energy efficiency outcomes (compared to control group) including averages of 10-11% reductions in total energy use, 13-18% less gas use and similarly cheaper bills, 14-18% lower greenhouse emissions due to gas use and increasing living room temperatures by 1.6°C in winter. LED light upgrades resulted in 22-36% reductions in lighting electricity use, 22% cheaper bills and lower greenhouse emissions.

'Retrofit only' interventions achieved a statistically significant energy efficiency outcome of 7% reduction in total energy use based on distributor data (compared to control group), whilst simultaneously increasing winter indoor temperatures by an average of 1-1.9°C.

It was noted anecdotally that some 'retrofit only' householders began to improve/increase their energy efficiency actions/practices in their home after they received their retrofits, even though they were not provided with behaviour change support. This could be interpreted to indicate that householders' that receive energy efficiency retrofits/support for little/no cost to themselves are more likely to take actions to improve their energy efficiency at home.

In addition, some of the "low income" householders that received a smaller "thank-you/retention $495 retrofit" at the end of the study co-contributed to this between $100 - $4000 themselves to replace/upgrade faulty/inefficient appliances of their own initiative. This could be interpreted to indicate that i) not all local government Home and Community Care clients are necessarily poor i.e. they may be low income but may have savings that are available for energy efficiency improvements to their homes and ii) that supporting low income householders with relatively small retrofits can trigger them to undertake more significant energy efficiency actions/works themselves at their own cost, rather than at the government's cost i.e. has a low cost: benefit ratio.

Households receiving 'behaviour change only' intervention didn't show a noticeable improvement in any of the energy measures, although the average number of energy efficiency actions by householders in the behaviour change study groups did increase from 16 to 19 actions during the project.

Householder feedback

The retrofits met the expectations of householders and improved their comfort. Householders indicated their strong endorsement of the Energy Saver Study in the post-intervention survey. Over 95% of householders would recommend a similar program to others. When asked why, the major reasons were it helped lower energy bills, they enjoyed the visits by project staff, it helps keep people in their homes, they trust the home care service and it was educational.

Future delivery

The existing HACC delivery model will not exist from 1 July 2016 and will be replaced by the Commonwealth Home Support Programme (CHSP). Future funding of householder support regarding energy efficiency, home safety etc could be provided to and via the CHSP providers. They will determine how the householders' goals are put into practice and are likely to offer home maintenance/modification services (but need to be funded by the Australian and/or state governments to do so).

Future providers will need to either make themselves aware of the goods and services required to deliver residential energy efficiency, safety and client wellbeing, or be trained/supported to do so. This will need to include identifying how a home can be modified and made safe in terms of indoor temperatures, affordable energy bills, satisfactory performance and low operating costs.

Additional research findings

The RMIT PhD study has identified that the contextual factors (i.e. the physiological capabilities of the householder, the modes of energy bill payment and the social construction of the adequacy of indoor temperatures) are additional pathways to health outcomes that go beyond the material qualities of the dwelling. The study identified coping and adaptation practices that may be able to build resilience.

The combination of a retrofit to the building envelope and the upgrade of the heating system may be more effective in providing benefits in warmth, affordability and householder satisfaction than just retrofits to the building envelope. Further work is needed to establish the validity of this.

The attention in residential energy efficiency initiatives should shift to the systems-approach of housing, energy and health. Initiatives that target energy consumption have to be sensitive to the prevalence of cold homes in Victoria, its causes and its effects.

The retrofits of fuel poor households may fall short of expectation due to the pre-bound effect. Voluntary underheating in this study concurs with the results of other studies. Non-heating of bedrooms, and allowing living room temperatures to drop below recommended levels during the night, seem to be practices that are socially shared. Exposure to temperatures below certain thresholds constitute a health risk, especially for older people. This may help explain Australia's winter excess death rate, which is surprisingly high considering Australia's temperate climate.

From the Swinburne Masters Research the overall story of Most Significant Change chosen by householders was to manage the use of standby power.

Challenges

A wide range of challenges facing the study were identified. Many were transitional and overcome overtime, while others possibly restricted the outcomes of the study. Challenges included:

1. the complex nature of the study
2. the tight and changing timeframe and the workload of the ELOs who were all employed part-time
3. involving and communicating effectively with vulnerable householders in the project, the ELOs needed to develop trust, overcome householder resistance to participate, understand and work effectively with participants
4. the amount and diversity of data required by the project design and accessing the data over a wide project area and limited timescale
5. dealing in vulnerable peoples' homes with private sector contractors and tradespeople who are time poor and profit driven - their work was often invasive of people's homes and lives
6. safety issues such as electrical hazards, gas leaks and carbon monoxide emitting heaters, asbestos, working at heights, lone worker issues, multiple contractors onsite simultaneously and the age of homes
7. ensuring tenants security of tenure was protected

Future research opportunities

A priority for future research is to trial the efficacy of different intervention subtypes i.e. trial each of the different home improvement retrofits against each other, and different behaviour change methods against each other to identify the most effective interventions. Studies are also recommended into epidemiological patterns of indoor cold and health outcomes and to investigate the ability of coping strategies to protect people from cold related ill health.

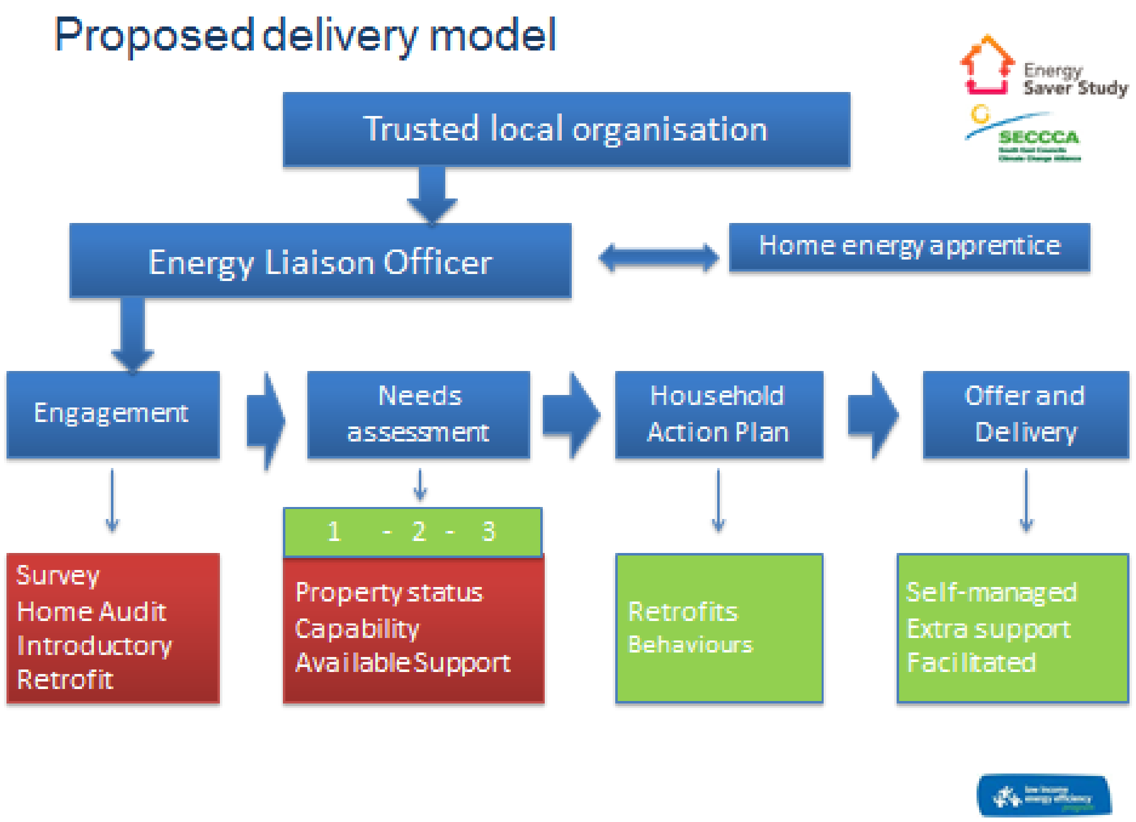
Recommendations

For future policy and program design the project makes the following recommendations:

- focus on strategies which provide home retrofit **plus** behaviour change support programs to low income households as this is the most effective pathway
- focus on a broad range of simultaneous outcomes including improve energy efficiency, energy bill costs, indoor temperatures and safety, householder health and wellbeing i.e. aim to make homes warmer and more comfortable during cold weather,

as well as cooler and safer during extreme hot weather, rather than just more energy efficient

- redefine and fund the role of organisations that provide future CHSP home maintenance/modification services to provide combined energy efficiency support programs (branded as home safety and affordability of living) as a core responsibility of supporting the community to age in place (thereby improving the safety of the homes)
- provide leadership, resources and organisational change support to existing/potential providers to facilitate this redefinition of CHSP role and responsibility
- ensure that as part of the process to identify and support first the most vulnerable people, assessment of clients' eligibility to receive support services takes into account the client's current income, the value of their assets and their access to cash
- investigate/consider the proposed home energy efficiency support delivery model as indicated below which:
    - recruits low income households through an existing trusted organisation (local government and/or CHSP service providers, not-for-profit NGO's)
    - supports clients via both and Energy Liaison Officer and low-cost Energy Efficiency Apprentice/Trainee, together with energy efficiency rebates/low cost finance options
    - provides support based on client capacity and needs, the condition and design of each home and the opportunities for the improvement of energy efficiency, comfort, energy costs, health and wellbeing
    - resource/educate/inform existing CHSP assessment, team leader, direct care and home maintenance workers of the opportunities and benefits to improve the energy efficiency of homes and in doing so, increases their capacity to provide clients with relevant resources and support
    - support CHSP providers to have and provide useful energy efficiency information to clients about how they can improve the energy efficiency at their home, as well as the additional benefits of energy efficiency i.e. reduced energy bills, improved comfort, health and wellbeing



Proposed future energy efficiency support delivery model

1 Introduction

1.1 Description of the project

The Energy Saver Study (formerly *Residential Energy Efficiency Motivators Program for Low Income Households*) is a three-year research project that aims to investigate the most effective ways to support low income householders to improve their household energy efficiency. The project also aims to determine if the support provided to householders decreases the householders' energy costs, has benefits for their health, comfort and/or wellbeing.

The project is to produce findings that can be used to inform future policies and programmes to assist low-income households become more energy efficient. The project also seeks to confirm whether delivery of a support program to low income householders is effective when done through local council Home and Community Care (HACC) departments.

A council's HACC clients (those that receive discounted gardening, cleaning, cooking or home maintenance services from council) are often the most vulnerable in the community to the impacts of climate change, given their socio-economic status and the types of houses in which they live. These homes may be old, inefficiently designed or built (in terms of energy efficiency) or poorly maintained. Householders may face barriers to energy efficiency improvement, including no/little access to money, a lack of mobility and limited knowledge of residential energy efficiency opportunities, limited English and they often live in homes where they need approval from landlords/property managers to undertake works on the home.

The project seeks to investigate these and other barriers to energy efficiency for householders and the best interventions to overcome them. This project aims to see if it can overcome these barriers through i) delivery of support to households by a trusted organisation i.e. the local council, ii) supporting households financially to access energy efficiency improvements and iii) providing information and awareness to households about energy use, efficiency and supply options.

The project also aims to identify how much home improvements cost (average $ cost/home) to improve the energy efficiency, comfort and health and reduce the energy costs for low income householders.

Householders and homeowners/managers were supported to improve the energy efficiency of their homes with home improvement retrofits, behaviour change support, a combination of retrofits and behaviour support, or no interventions. This was so that the contributions of home improvements and energy efficiency information/awareness could be quantified, allowing a determination of the most effective interventions that resulted in improvements in energy efficiency, energy costs, health and/or comfort.

In cases where householders were tenants living in a rented home, terms of agreement between the homeowners /property manager and tenants were negotiated so both parties stood to benefit and the security of tenure was maintained.

The expected outcomes of the project are to:

- identify the most effective ways to support low income householders to improve their household energy efficiency, either retrofits, behaviour change support or a combination of both
- demonstrate that the targeted support provided to householders decreases the householders' energy costs and has benefits for their health, comfort and/or wellbeing
- produce findings that can be used to inform future policies and programmes to assist low-income households become more energy efficient
- confirm that delivery of a support program to low income householders is really effective when done through local council Home and Community Care (HACC) departments, or trusted existing organisations
- confirm that barriers to energy efficiency for low income householders can be overcome by them when they are supported by a trusted organisation with home retrofits **and** energy information and awareness
- confirm whether financial support of between $200-$3000 to each home for home energy efficiency retrofits will improve energy efficiency significantly and produce co-benefits of improved comfort and reduced energy costs
- confirm whether low income householders will have high regard for an energy efficiency support program that includes home retrofit and behavioural support

1.2 Lead organisation and consortium members

The lead organisation is South East Councils Climate Change Alliance (SECCCA). SECCCA is a network of eight councils committed to delivering high-quality, innovative projects and research programs at a regional level. SECCCA supports communities, businesses and industries to the south east of Melbourne in responding and adapting to the impacts of climate change. Additional information about SECCCA can be found at www.seccca.org.au

The consortium members include:

- 6 member councils
    - Bass Coast
    - Baw Baw
    - Bayside
    - Cardinia (including MECWACARE as the private HACC provider)
    - Casey
    - Mornington Peninsula
- Air Barrier Technologies
- Aspect Studios
- Briar Consulting
- CSIRO
- Energy Makeovers
- Energy Monitoring Solutions
- Just Change
- RMIT

Air Barrier Technologies is a company that tests the rate at which air moves through buildings, identifies where air leaks are occurring and take actions to seal the leaks to reduce the air and energy flow in and out of buildings.

ASPECT Studios is a design firm which specialises in Landscape Architecture, Urban Design and Digital Media. Aspect Studios role in this project was to create the project brand, look and feel and to create communications material that aims to improve energy efficiency outcomes in participating households e.g. brochures, documents, webpages, videos and computer software.

Briar Consulting Pty Ltd is the project evaluator and has been providing research, evaluation and curriculum development services to governments, businesses and community groups for over 19 years. The major areas of evaluation have been in education and community sustainability. The principle Dr Brian Sharpley has a Masters in Environmental Science and a PhD. Over the past few years he has focused on evaluating projects where behavioural change and community involvement are central and has developed a range of tools to monitor projects, provide ongoing feedback and data collection, analysis and interpretation.

CSIRO have delivered on large and small projects requiring the characterisation of energy consumption in residential buildings. These projects have typically required assessment of buildings, household services and appliances across large numbers of residential buildings. CSIRO has internationally recognised expertise in this area includes analysis of house, appliance and householder energy efficiency, cost effectiveness of energy saving measures and characterisation of behavioural influences on energy consumption to name a few. Their role in this project was to store and analyse building, energy, intervention and cost data, determine and report on energy use and their findings.

Energy Makeovers is an Australian energy services company dedicated to assisting families and businesses achieve a sustainable future. Their focus is to provide and promote practical information, more efficient use of energy and renewable energy to residential, commercial and industrial building owners and tenants. Their role in the project was to provide and complete home energy audits on all homes and to calculate, report and recommend home improvements to improve energy efficiency in the homes.

Energy Monitoring Solutions operates to provide its clients and business partners with energy monitoring tools and knowledge to optimise investments in energy efficiency and their energy usage. Their role in this project was to identify suitable homes to receive energy monitoring equipment, install the equipment, collect and transfer data to CSIRO and monitor, maintain and remove the equipment where required. They also designed and supplied energy use In-Home Display devices in homes so households can access their energy use easily.

Just Change work to activate relationships between low income tenants, landlords and property managers to enable energy efficiency improvements to rental properties. Their role in the project was to facilitate recruitment by SECCCA of rental households & homes into the project and support SECCCA staff to ensure that tenants are treated fairly by property owners and managers.

Nicola Willand is a PhD Candidate at RMIT University with a particular interest in the holistic approach to sustainability in the built environment. As an architect, Nicola finds that initiatives towards a more sustainable built environment tend to focus on environmental and economic outcomes, while the social aspects are often neglected. In order to facilitate triple bottom line sustainability, Nicola is aiming to develop strategies for the built environment that will minimise environmental impacts and life cycle costs while maximizing productivity, health and social equity. Her PhD research focusses on the multiple benefits of residential energy efficiency initiatives.

1.3 Objectives of the project

The objectives of the project were to:

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

The project specifically aimed to:

- Deliver a new and innovative energy efficiency retrofit and behaviour change program to low income households through local government Aged and Disability Services using Direct Care Workers (Energy Liaison Officers (ELO's)) to overcome the barriers of information, communication and trust barriers.
- Establish through the delivery of the project a comparison between different household groups. These groups will be subject to a range of interventions to determine the most effective and best value approaches to overcome capacity, cost and risk barriers.
- Establish the project components that can be transferred to other regions and councils to overcome barriers of reach and scalability.

1.4 Benefits

The likely benefits of this project are to:

- Assist low-income households to implement sustainable energy efficiency practices to help manage the impacts of increasing energy prices and improve the health, social welfare and livelihood of low-income households.
- Build the knowledge and capacity of consortium members to encourage long-term energy efficiency among their customers or clients.
- Build the capacity of Australia's energy efficiency technology and equipment companies by maximising the opportunities for Australian industries to participate in the projects

1.5 Approaches

The approaches that the project used to assist low income householders in various locations to become more energy efficient included:

- Employ and train 6 Energy Liaison Officers (ELOs) to recruit and support 320 eligible low income householders that receive Home and Community Care services

- Deliver a tailored energy retrofit and/or support program through local council HACC Services using ELO's to overcome the barriers of information, communication and lack of trust in existing providers
- Capture and analyse data and information to inform future energy efficiency policy and program approaches
- Establish a comparison between different household study groups that receive different interventions to determine the most effective and best value approach to overcome capacity, cost and risk barriers
- Establish the project components that can be transferred to other regions and be delivered almost anywhere in Australia
- Collaborate with the RMIT PhD student Nicola Willand to investigate the correlations between buildings, human health and wellbeing

1.6 Methods

Householders to participate in the project were recruited by random selection from the retired, elderly or disabled low income HACC clients at each of the 6 participating councils using an online random number selection tool. Each of the randomly selected clients were then assessed by the Energy Liaison Officer (ELO) for their eligibility to participate i.e. the HACC clients invited to participate in the project needed to have the physical and cognitive capacity to participate in this 3 year study until it ends e.g. be able to receive numerous visits from a wide range of staff and contractors and answer a series of surveys including questions about self, living arrangements and actions.

The eligibility of randomly selected HACC clients was judged by ELOs after consulting with the council HACC client database, the HACC client assessors and existing direct care workers.

From the 320 householders that were judged as eligible to participate and accepted the invitation to participate, householders were then allocated to one of the 4 study groups as follows (see Table 1 below):

- Group A: receive home improvements/retrofits (80)
- Group B: receive energy action information and support (80)
- Group C: receive home improvements **plus** energy action information and support (80)
- Group D: receive no support i.e. this is a scientific control group until after the monitoring period (80)

Table 1: Household study groups and activities

Group	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5	Activity 6	Activity 7
1A (30 households)	energy audit	air-barrier testing (15 houses only)	draught sealing (15 houses only)	star-rating assessment (15 houses only)	energy retrofit		energy monitoring system
1B (30 households)	energy audit	air-barrier testing (15 houses only)		star-rating assessment (15 houses only)	basic energy retrofit (post-Activity)	behaviour change program	energy monitoring system
1C (30 households)	energy audit	air-barrier testing (15 houses only)	draught sealing (15 houses only)	star-rating assessment (15 houses only)	energy retrofit	behaviour change program	energy monitoring system
2A (50 households)	energy audit				energy retrofit		
2B (50 households)	energy audit				basic energy retrofit (post-Activity)	behaviour change program	
2C (50 households)	energy audit				energy retrofit	behaviour change program	
1D Control Group (30 HHs)	energy audit	air-barrier testing (15 houses only)		star-rating assessment (15 houses only)	basic energy retrofit (post-Activity)		energy monitoring system
2D Control Group (50HH's)	energy audit				basic energy retrofit (post-Activity)		
TOTAL	320	60	30	60	320	160	120

Allocation of householders to a study group was relatively random i.e. using random number selection tool again, except that those householders which were most capable to receive high numbers of visits and contact were placed in Study Group C which was likely to receive lots of visits. This was to maximise the number of householders that participate in the project until the project ends to make the research data as complete as possible. This process recognised that all householders were not comfortable to receive a high number of visits and contact, and if they did, they were more likely to stop participating.

The project developed a robust framework, tools and training to guide ELOs in the delivery of the additional home retrofit and support services to clients.

Home energy audits were undertaken at all homes soon after recruitment. High level audits were completed at 60 of these homes to establish the characteristics and star ratings of houses that these clients live in and to determine the most cost effective energy efficiency improvement services to implement. All other homes received a 100-point audit to inform future interventions.

The project provided the Behaviour Change Program (hereafter referred to as Energy Action Program [EAP]) to 160 households. The EAP trialled and tailored language, messages and use of technology to encourage the adoption of new energy related actions by households to improve their energy efficiency. Embedding these approaches in councils' range of services attempted to demonstrate the potential of energy efficiency improvements to low income households and establish the transferability of this support service to other municipalities.

After each householder joined the project, energy distributors were asked to provide energy use information about each participating home for the previous 1-2 years. This was so that SECCCA could compare the historical energy use with the energy use after householders joined the project and received energy efficiency support. 120 homes also had energy monitoring equipment installed in them. This equipment monitored electricity and gas use at the homes (and generation in the case of solar electricity) including when and how much. This onsite energy use data was compared with the energy use data provided to SECCCA by energy distributors to see if the energy use data was similar.

An RMIT PhD research project investigated the correlations between buildings and human health and wellbeing. It investigated the effects of energy efficiency improvements and support services on householders' health and wellbeing in this project.

An additional Swinburne University Masters research project was added to the project during 2015. The Masters researcher was exploring social influence on new, failed and sustained household energy practices. Social influence was being researched through the householder's social network, including the number and type of relationships, frequency of contact, relationship priority and the type of information and feedback received. This is a longitudinal, mixed methods study which is still in progress. Stage 1 & 2 interviews regarding social influence patterns on new and failed householder actions and Most Significant Change have been completed and preliminary findings have been identified.

1.7 Problems or limitations in the scope of the project

The design of this project is complicated in that it includes 4 main study groups, plus sub – groups within each study group that receive different interventions. This, for some purposes, can make the numbers of homes receiving an intervention sub-type (e.g. hot water services) too small to achieve statistical significance or comparison with other similar sub-types. In contrast, for the 2 types of In-home Display intervention sub-type, the number of each of them was 30 and this allowed a level of statistically significant comparison of their effectiveness versus homes without them.

Home retrofits were provided to householders in at least 10 different ways e.g. LED lights, draught sealing, insulation top-up in the ceiling or floor, replace old appliances including heaters/coolers, hot water services, TVs or fridges, provide window furnishings etc.

At some homes the home improvement support included numerous simultaneous interventions e.g. they received LED lights, draught sealing plus ceiling insulation. This meant the project was not able to say that any single retrofit action was the best thing to do.

This retrofit situation (with numerous different retrofits being made available) occurred because during householder recruitment the project committed to provide 160 householders with at least $2500 each of home improvements. This was to maximise householder retention in the project. The home improvements needed to have a high chance of improving the energy efficiency at each home and the home owner needed to agree to the works. To achieve these two criteria a diverse range of retrofit options was offered and provided to participants.

In contrast, some homes received one retrofit intervention only e.g. a new heater/cooler. If there was a statistically significant number of homes receiving a single intervention e.g. 30 or more homes, then the project may be able to indicate that a single intervention is likely to be a beneficial intervention. It is likely that the project will only be able to identify if any of the interventions at study group level led to particular outcomes i.e. were home retrofits the most effective, was behaviour change most effective? Was a combination of retrofits plus behaviour change most effective? The project cannot guarantee that it will be able to determine nor recommend specific actions to achieve specific outcomes due to the complexity of interventions.

The behaviour change program also provided support to householders in different ways e.g. face-to-face visits, information sheets and brochures, group information workshops, videos, in-home displays. The project will be able to assess the behaviour change intervention type as a whole, but it may be impossible to scientifically determine if any particular sub-type of behaviour change support led to a particular outcome.

Participation in behaviour change programs usually needs to be voluntary to be effective but in this project, participants in behaviour change study groups were obliged to participate in it, which may have reduced its effectiveness/skewed the results.

1.8 Funding sources and trial duration

This project received $4.4 million in funding from the Department of Industry, Innovation and Science (DIIS) Low Income Energy Efficiency Program (LIEEP) funding Round 1 in April 2013. Consortium partners provided $1.5 million of in-kind contributions e.g. intellectual property, survey content, house survey software, analysis, recommendations, staff time and resources.

The project commenced in April 2013 and concluded in May 2016.

1.9 The context of this report

This report was written as a requirement of the contract that SECCCA has with the DIIS to complete the LIEEP project that was originally titled “Low Income Energy Saver Direct Care and Motivators Project”. The project was retitled “Energy Saver Study” to attract householders to participate as volunteers. The project was one of twenty similar LIEEP projects being undertaken in Australia, but focused uniquely on delivery of energy efficiency and community support services through local government community services departments.

This report is designed to provide information to government staff and politicians. It is to inform future government policy and programs related to supporting vulnerable, low income community members, to help manage peoples' energy and living costs, improve residential energy efficiency plus community health and wellbeing. The lead author was Adam Shalekoff and contributing authors were Michael Ambrose, Melissa James, Brian Sharpley, Nicola Willand and Lucy Allinson.

After reading this report the reader should be able to identify and describe a range of policy and program opportunities. The reader may be able to provide advice to inform future policies and programs that are likely to improve energy efficiency, reduce the cost of living and improve comfort, health and wellbeing in the homes of vulnerable people and low income earners.

2 Methodology

2.1 Location

The project occurred in 6 of the local councils to the south east of Melbourne CBD i.e. Bayside, Casey, Mornington Peninsula, Cardinia, Baw Baw and Bass Coast (Figure 1).

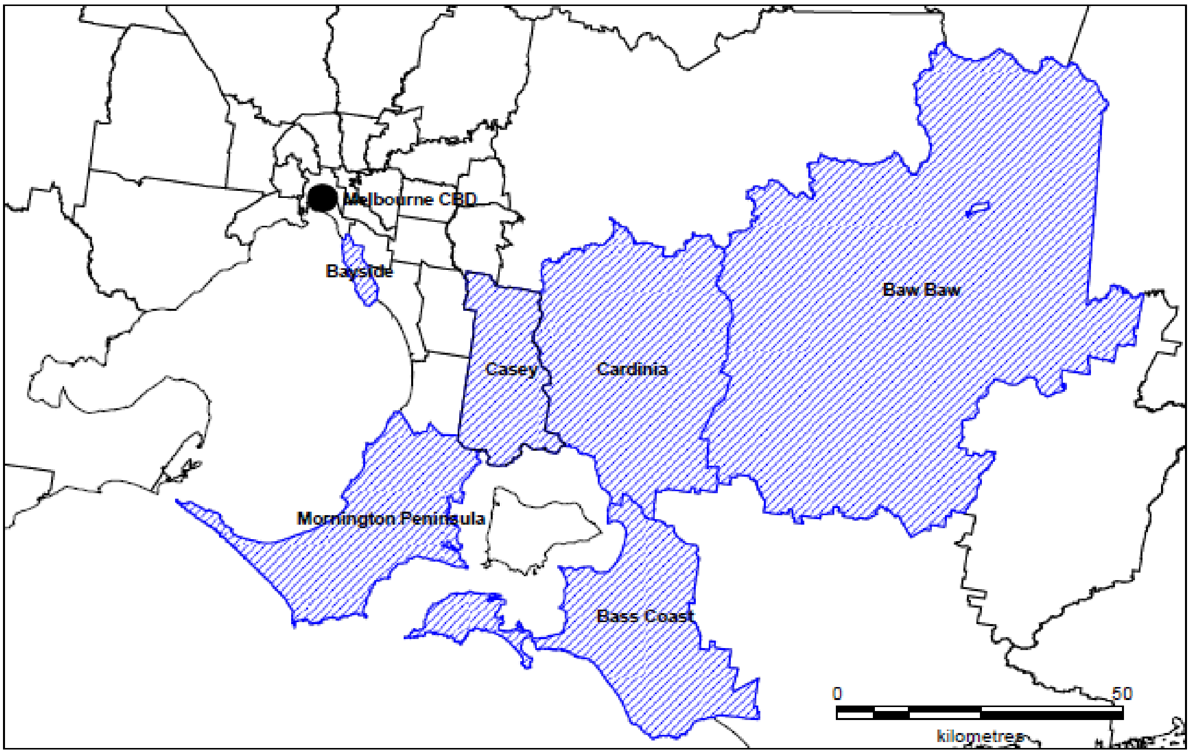


Figure 1: Participating local council areas

Bayside is an urban area adjacent to Port Phillip Bay close to Melbourne's CBD. Casey and Cardinia are peri-urban growth areas. Bass Coast and Mornington Peninsula are predominantly coastal peri-urban/rural areas with many small to medium sized towns, green wedge areas plus numerous coastal/rural villages that are also undergoing significant population and urban growth. Baw Baw is a peri-urban/rural area with many small to medium sized towns, green wedge areas plus numerous rural villages.

The approximate locations and the study group of each participating household are shown in Figure 2 below.

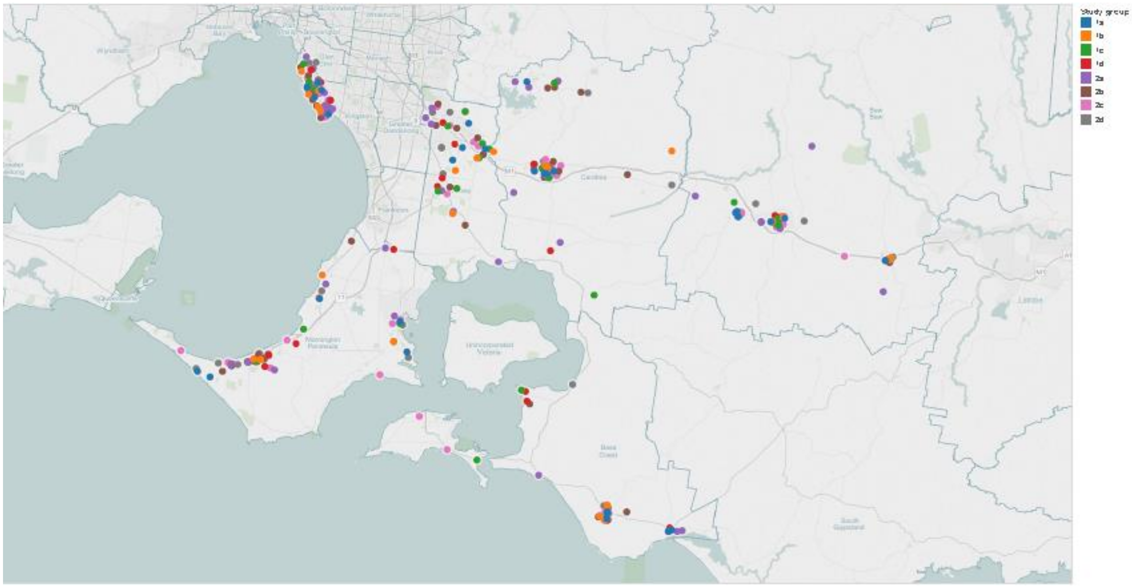


Figure 2: House locations by study group

2.2 Project planning

The project was initiated and planned by SECCCA and its member councils. SECCCA approached other organisations, discussed opportunities and formed a consortium to apply for the project funding from DIIS. A draft Project Plan and subsequent sub-plans (Risk Management, Data Collection & Reporting, Evaluation and Compliance) were developed and formed collateral materials to accompany the funding application and guide the project delivery after funding was received. The project plan and supporting plans were updated during the project.

The project plan was to identify and test the effectiveness of new, ambitious, innovative ways to engage low income householders and support them to improve energy efficiency at their homes. This was the project's focus because low income householders can be hard to engage in energy efficiency projects. This can be due to their age, health, disabilities, income status and/or their distrust in cold calling, private sector marketing and sometimes questionable levels of honesty practiced by goods and services providers.

2.3 Privacy

All personal information and energy use data collected by the project was stored and used as per the Privacy and Data Protection Act 2014. Each household that was provisionally accepted to participate in the project was provided with the DIIS LIEEP Privacy Notice (see Appendix 1) to read prior to them agreeing in writing to participate in the project.

When each household joined the project they were assigned a unique identifier. All project data with the participants' personal data attached to it had the address and personal information removed from it and linked to the unique identifier before data was provided to DIIS.

2.4 Project governance

A Project Steering Committee was formed in late 2013 to oversee the project. This committee met at least four times/year and committee members from the respective organisations included:

- SECCCA:
    - Executive Officer - Greg Hunt
    - Climate Change Projects Coordinator - Daniel Pleiter
    - Business Support Officer – Janet Armstrong
    - Energy Saver Study Coordinator – Adam Shalekoff
    - Energy Saver Study Team Leader – Lucy Allinson
    - Energy Saver Study Research & Training Officer – Andrew Cooper
- Baw Baw Council:
    - Environment Education Officer – Olivia Lineham
    - HACC Team Leader – Robert Barr
- Bass Coast Council:
    - Climate change & sustainability Coordinator – Eliza Horsburgh Price
    - Aged & disability planning & programs Coordinator – Sam Wightman
- Bayside Council
    - Environmental Sustainability & Open Space Coordinator - Rachael Murphy
    - Environmental Sustainability & Open Space Officer – Leanne Stray
- Casey Council:
    - Climate Change & Energy Officer - Mark Akester
    - HACC Team Leader – Ros Pruden
- Cardinia Council:
    - Environment Team Leader – Desiree Lovell
    - mecwacare HACC services – Anne Wright
- Mornington Peninsula Council
    - Renewable Resources Team Leader – Jessica Wingad
    - Intake & Assessment Aged & Disability Services Coordinator – Peter Cracknell
- Briar Consulting – Brian Sharpley

A schematic representation of the project governance and delivery is provided in Figure 3 below.

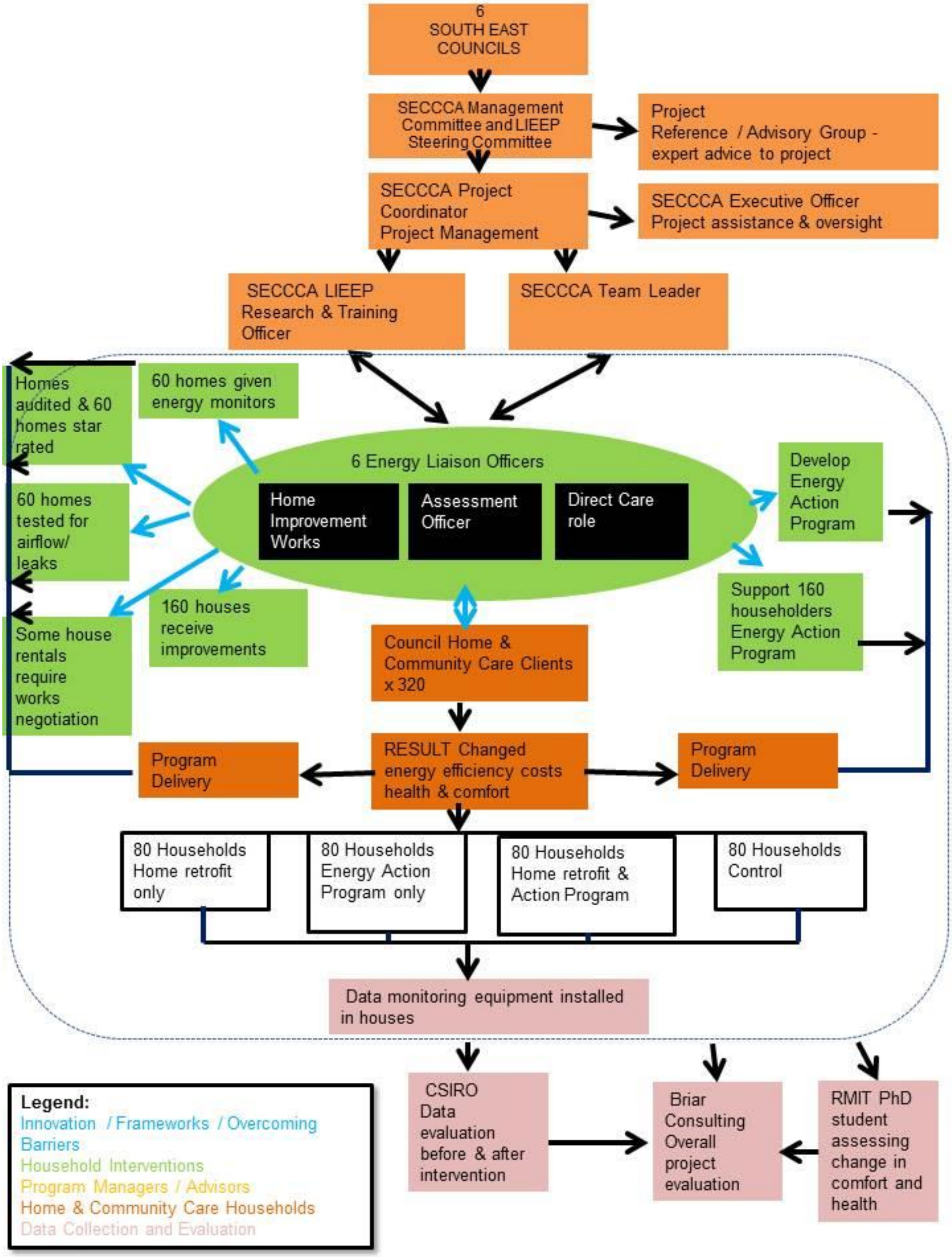


Figure 3: Energy Saver Study governance and delivery arrangements

A Data Committee was formed which met at least twice per year, with attendees varying depending on which stage the project was at. It included the following people:

- SECCCA:
    - Energy Saver Study Coordinator – Adam Shalekoff
    - Energy Saver Study Team Leader – Lucy Allinson
    - Energy Saver Study Research & Training Officer – Andrew Cooper
- CSIRO:
    - Urban Systems Land and Water Team Leader - Michael Ambrose
    - Cities Research Program Experimental Scientist - Melissa James
- EMS
    - Geoff Clarke
    - Adam Baker
- Energy Makeovers
    - Melanie van Rees
- Briar Consulting – Brian Sharpley

The Project Delivery Team met approximately fortnightly (or as required) to manage progress, delivery, monitoring, review, improvement and reporting of the project and consisted of:

- Coordinator – Adam Shalekoff
- Team Leader – Lucy Allinson
- Research & Training Officer – Andrew Cooper
- Briar Consulting – Brian Sharpley

A Project Reference and Advisory Group (PRAG) was formed in late 2013. The PRAG members were highly regarded professionals in the home and community care and/or environmental science. The purpose of the PRAG was to provide technical advice and critical reflection to the project, particularly with regard to local, regional and state and national contexts for the delivery of services within the health and community development sectors. Members of PRAG also provided comment on the delivery of services to participants including energy efficiency and behaviour change. The PRAG met four times during the project and its members were:

- Jenny Van Riel: Manager, Aged & Disability Services at Mornington Peninsula Shire Council.
- Mary Rydberg: Manager Community Care & Library Services at City of Greater Dandenong
- Daniel Voronoff: Senior Project Officer, Environmental Management Unit at Department of Human Services
- Rita Battaglin: Pathway and Support Services Manager at Springvale Community Aid and Advice Bureau.

Reports were provided to the SECCCA Management Committee by the Project Coordinator approximately 9 times per year which included project progress, budgets, successes, challenges and key learnings.

SECCCA and DIIS formulated a milestone schedule in the funding contract with 13 milestones throughout the project. SECCCA provided a milestone report to DIIS by each milestone date. DIIS approval of milestone reports was required and was followed by payment of the relevant funds to SECCCA.

2.5 Arrangements for collaborating with local councils

The project and local councils' roles in the project were integrated in a range of ways.

Firstly, an environment team representative from each council became a member of the project steering committee. As the project moved from the planning phase to implementation within a HACC services context, representatives from each council's HACC team were invited and some occasionally attended the steering committee meetings. HACC coordinators were co-supervising the ELOs. To do this effectively they needed to be aware of the project procedures, arrangements and progress at any time.

In late 2013 SECCCA and the then 7 participating councils advertised for and appointed 7 ELOs. The ELO roles were framed within the guidelines provided by the Project Delivery Team but were also influenced by the internal dynamics of the appointing council.

The project originally aimed to have 7 councils participating. One council (Kingston) appointed an ELO and the ELO was employed in the role for approximately one month. The ELO decided to leave the role, Kingston then decided it no longer wished to participate in the project and withdrew due to concerns around staffing, workload and risk to council. Other councils absorbed the 'lost' homes by increasing the number of homes they recruited to participate. This was to keep the total number of homes at 320.

The Project Delivery Team provided the direction of the project and developed the timelines, specific tasks (such as recruitment, auditing, interventions) and training workshops for the ELOs. Five of the ELOs were staff members of their council's HACC team, but all were substantially independent of the councils. They were co-supervised by the SECCCA Team Leader and a HACC representative. This required the ELOs to be self-motivated and self-reliant. For most this meant they were isolated with minimal support within their workplaces. ELOs also liaised between themselves via phone and email to develop a 'community of practice' which complemented the regular training and workshops.

2.6 Variations between council arrangements

Cardinia council does not provide HACC services to clients itself, but engages 'mecwa*care*' to provide HACC services to clients. Mecwa*care* is a private not-for-profit organisation which provides care to the community on behalf of Cardinia council and other organisations. As a result the ELO for Cardinia was selected by an interview panel including SECCCA, Cardinia and mecwa*care* representatives and the ELO was employed and co-supervised by SECCCA, with mecwa*care* co-supervising as well and providing staff in-kind to identify suitable clients from its client database to participate in the project.

Mornington Peninsula council decided to trial having its HACC Home Maintenance team (team leader plus 4 staff) providing some home retrofits to clients i.e. draught sealing, light globe changing and improving insulation of hot water services.

The remaining 5 councils decided that SECCCA was to identify, arrange and supervise contractors to deliver home retrofit works to their participating clients. Bayside and Cardinia both had a common preferred supplier (Urban Maintenance Systems P/L, or UMS) to maintain their council facilities and SECCCA hired this contractor and their subcontractors for some home retrofit works. This was to trial the model of using councils' existing preferred suppliers (of building/appliance maintenance) to provide home retrofit works to HACC clients' homes, to see if this might prove effective and be attractive to councils to continue after the project.

2.7 Training of Energy Liaison Officers

Training and project information was provided to Energy Liaison Officers at regular 3-hour sessions throughout the project. This was to ensure the ELOs had the skills, knowledge, resources and support required to complete their jobs i.e. communicate with and recruit householders, facilitate and provide support to participants and facilitate and carry out data collection.

Training was focussed on two key areas:

- Effectively recruiting, retaining and supporting the householders
- Residential energy efficiency

Both were delivered as weekly/fortnightly 3-hour sessions during 2014.

In 2015 the workload was greater for ELOs and training was transformed into monthly 3-hour information sessions which were attended by the Project Delivery Team and ELOs and sometimes by consortium members. These sessions were designed to facilitate a 2-way discussion which included information sharing, ELO debrief and feedback opportunity to maximise continuous review and improvement, and high quality delivery of the project.

2.7.1 Training about recruiting and supporting the participants

Project information and practical training about recruiting and supporting the participants was provided to ELOs by the ELO Team Leader to ensure they had the tools and skills to deliver the job. This focussed on the overall project schedule and timelines, interpersonal skills, record keeping, activity scheduling, understanding the participants and reporting. Active learning with role plays using different participant character types was a priority, to emphasize the importance of using different communication styles for each individual client. An atmosphere was created to encourage questioning, sharing, learning and understanding of the different successes and challenges for Energy Liaison Officers.

The training included:

- Understanding and working effectively with participants
- Communication with participants
- Recruitment
- Working with tenants
- Lone Worker procedure
- Home audits and householder surveys
- Energy monitoring equipment
- Sources of financial advice
- Client databases
- Embedded energy networks
- Energy Action Program

Access to specialist HACC training was also provided. This training is offered to HACC staff for free by the Victorian Government (Department of Health & Human Services) – for more info go to https://hacc.chisholm.edu.au/. Examples of training offered and received by project staff included Managing Grief and Loss, Managing Challenging Behaviours, Work Within A Relevant Legal And Ethical Framework, Providing Support for People with Dementia and Support Older People to Maintain Independence.

2.7.2 Training about residential energy efficiency

The Research and Training Officer provided residential energy efficiency training to ELOs with topics covered including:

- How the house works and building terms
- Energy use and bills (including calculating energy use and cost)

- The rebound effect
- Insulation
- Draughts, ventilation, draught testing and sealing
- Lighting
- Hot water
- Heating and cooling
- Windows and shading
- Passive design
- Appliances, energy rating labels and standby energy use
- Solar power

This energy efficiency training content was later summarised to create the *House In Order*: *How to achieve energy efficiency and performance in your home* training/information manual and is available via http://energysaver.seccca.org.au/ . This is designed to be used in the following ways:

- as a reference document for future programs for HACC/environment/other staff that have a role to support householders to improve their energy efficiency/productivity, comfort, health and wellbeing and/or reduce energy bill costs
- for householders to improve their energy efficiency/productivity, comfort, health and wellbeing and/or reduce their energy costs
- for building designers and tradespeople to increase their awareness of things that can be included and done in sustainable building design, renovation and construction.

2.7.3 Monitoring, evaluation, feedback and improvement of training

The external evaluator observed over 90% of the staff training and information sessions, surveyed ELOs about the training, then evaluated the sessions and provided written feedback to the Project Delivery Team.

2.8 Householder recruitment

2.8.1 Background

Recruitment of volunteers to participate in projects can be done in many different ways, many of which are successful e.g. inviting members of established groups to participate through their leader/mentor, inviting respected people to invite their stakeholders one at a time, writing personally to target persons and social media campaigns. Other methods are often unsuccessful e.g. letterboxing householders with generic/impersonal addressing, emailing and phone calling. Participants can either be recruited successfully and retained until the project ends, can be recruited but they drop out during a project, or recruitment can be unsuccessful in the first instance and miss its potential target audience.

2.8.2 Recruitment method

This project recruited participants through already trusted and somewhat well regarded organisations: the local council Home & Community Care teams. The HACC clients already received support from these council service providers and often had high levels of trust in the staff that provided the personalised service. The process for SECCCA and member councils to recruit householders to participate in the project is shown in

Figure 4.

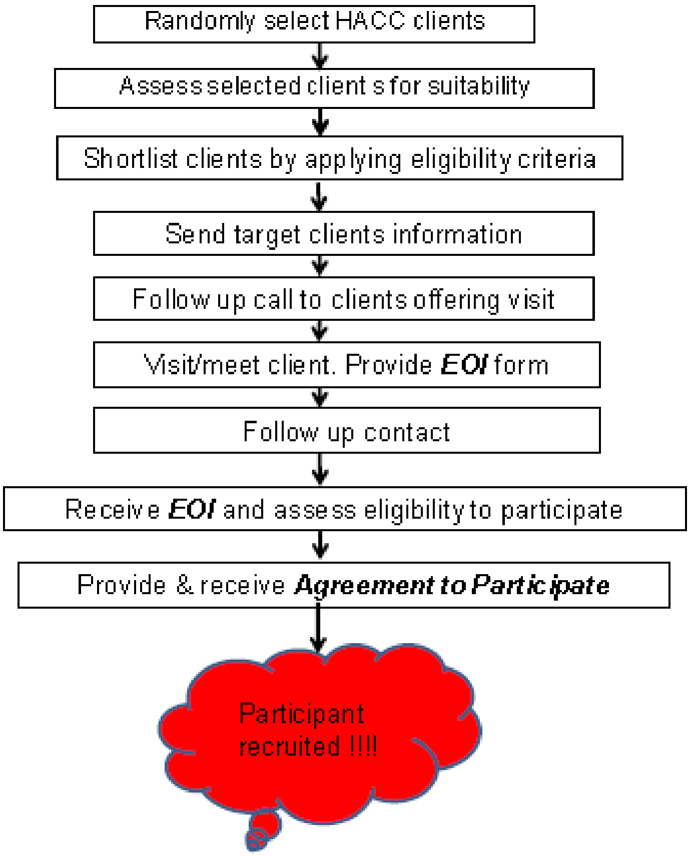


Figure 4: Householder recruitment process

The target householders that were invited to participate in the project were selected by random selection of 100 clients from the HACC clients at each of the participating councils using an online random number selection tool. Each of the randomly selected clients were then assessed by an Energy Liaison Officer for their eligibility to participate after consulting with the council HACC client database, the HACC client assessors and existing direct care workers. The clients needed to have the physical and cognitive capacity to participate in this 3 year project until it ends including being able to receive numerous visits from a wide range of staff and contractors and answer a series of questions about self, living arrangements and actions. A further 100 clients were randomly selected at each council to achieve the required number of participants if the first list was exhausted and more clients were still required.

An introductory letter was sent to suitable HACC clients (see Appendix 2). A phone call was provided to target clients by the ELO indicating they are from the HACC team, asking if the client is interested in the ELO visiting and describing the project to them. At the visit the ELO provides:

- a flyer about the project (see Appendix 3)
- an *Information sheet,* describing the project in more detail
- an *Expression of Interest* form, plus a reply paid envelope
- discussion about the project and questions to the HACC client to learn about them and their suitability to participate in the project.

The client could then submit an *Expression of Interest* form and if this was approved, they needed to complete an *Agreement to Participate* form.

2.8.3 Allocation of participants to study groups

The 320 recruited householders were allocated to one of four study groups. The study groups were designed to allow cross comparison of different intervention strategies to try and determine the effectiveness of the intervention techniques. The four groups were:

A. Home Retrofits (80) – providing energy efficiency upgrades to the house and appliances, such as insulation or draught sealing, appliance repair or replacement.

B. Behaviour Change (80) – providing information and support to householders which aimed to improve their residential energy efficiency, comfort, health and wellbeing.

C. Retrofit and behaviour change (80) – provide both the home retrofits and behaviour change program.

D. Control group (80) – these households only partook in the surveys and monitoring and received no other intervention program. They can be considered the "business as usual" households.

Households were allocated to a study group using a random number selection tool. Exceptions to this process occurred to maximise the participation of householders until the end of the study so that as much data as possible could be collected. For example, householders that were judged by ELOs as most capable to receive high numbers of visits and contact were placed in the retrofit and behaviour change study group, and/or the sub-groups that received the installation of onsite energy monitoring equipment.

Those householders that appeared to be less inclined to receive a high number of visits and contact were allocated to either the control group or to another study group, but did not receive energy monitoring equipment. This process recognised that all householders were not comfortable to receive high numbers of visits and contact, and if they did, they would be less likely to complete the study. The allocation of each householder to a study group was a critical part of the project's experimental design to ensure that the project would produce scientifically credible and reliable data, findings and recommendations.

2.9 Energy Monitoring

Energy monitoring was a critical part of the project design. Three methods of monitoring and collecting energy use data (gas and electricity) were adopted in this project:

1. Bill data
2. Energy distributor interval data
3. Onsite monitored interval data.

These three energy monitoring methods were included so that if one method failed or was problematic, other methods could be used to get energy data. Baseline measurement of energy use in homes was an important part of the project method to inform interventions at each home. This also provided information for analysis of results.

2.9.1 Bill data

Home energy bills for the year before the project started were collected from 60 homes that were to receive a high level (120 point) energy audit (these are described below). This bill data informed the recommendations that auditors provided to SECCCA in their high level home audit reports. The recommendations in the high level audit reports informed the interventions that were made at each home.

2.9.2 Energy distributor interval data

Energy use data (30 minute interval data) for each participating house was requested from energy distributors e.g. United Energy, AusNet, Envestra and Multinet retrospectively for the 1-2 years prior to householders joining the project (2012 -13) and again until the energy use monitoring phase of the project ended (2014-15). This enabled the project to i) be aware of the baseline energy use of householders ii) use this information to inform interventions provided to householders and iii) to note the changes in energy use following interventions.

Electricity and gas distributor data provided an alternative measure of energy consumption in some of the households. The distributor interval data analysis was conducted using this data. 237 households had electricity distributor data, and 183 households had gas distributor data. As with the monitored data, there is little summer data to include in the analysis. The set of houses used in this analysis is not the same as the set of houses used for the monitored house analysis, although there is some overlap.

2.9.3 Onsite monitoring of energy use

Onsite monitoring of energy use at 120 homes commenced between December 2013 - August 2014 and continued until 31 January 2016. The commencement date depended on when each householder was recruited to participate in the project. This onsite data was collected to test and compare if the energy use reported by the energy distributors was close to or equal to the actual onsite monitored energy use. It also allowed analysis of energy use by circuit e.g. hot water, heating/cooling, lights.

An Ecofront Energy Monitor was installed by a licensed electrician at these homes to collect and record energy use data (see Figure 5). The Ecofront is usually installed in the existing electricity switchboard (if it, the required electronic and communications equipment will fit). If the Ecofront plus the extra equipment did not fit in the switchboard then a 'remote enclosure' (a suitable box with a hinged door) was mounted on a wall in a location that the homeowner agreed to (see Figure 6). This can be installed inside or outside the home or in the garage.

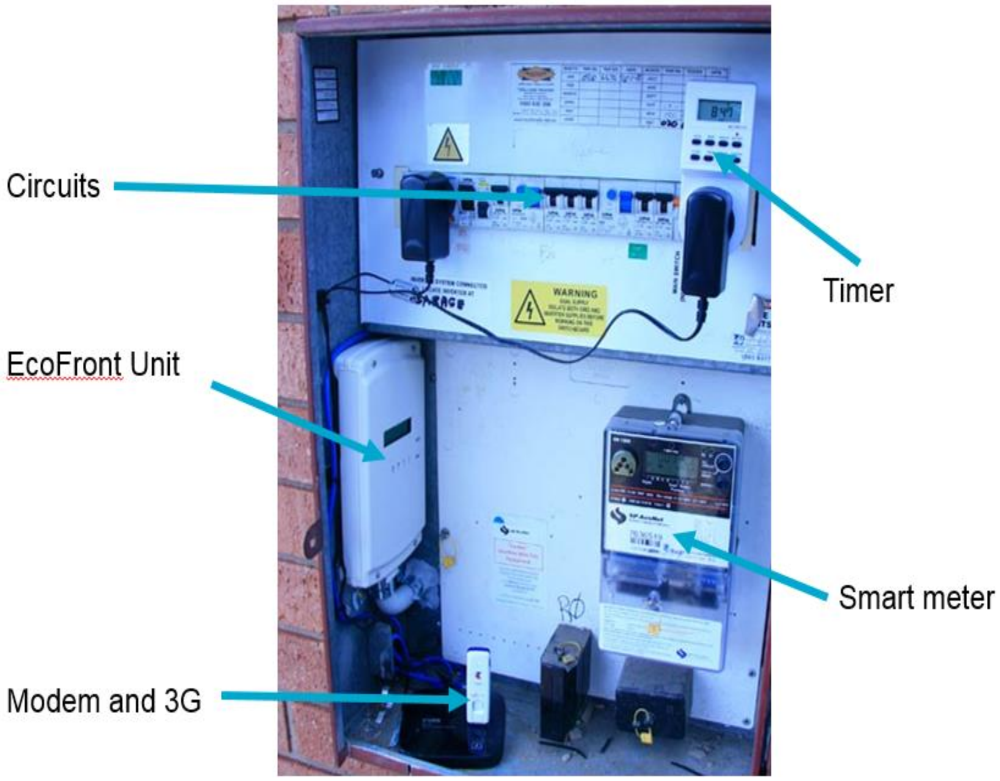


Figure 5: Ecofront Energy Monitor plus communications equipment installed in an existing electrical switchboard

Figure 6: Remote enclosure with Ecofront and communications equipment

The Ecofront Energy Monitor was connected to an inline gas meter to measure gas use (see Figure 7). The additional Accutherm diaphragm gas meter (either ZG4S or ZG6S; depending on each home's gas appliance requirements) was installed by a licensed plumber between the existing gas distributor's meter and the home.

Figure 7: The existing gas distributor's gas meter (left) plus an additional gas meter (on right) which was installed to monitor gas use onsite

To measure and record electricity use onsite, current transformer sensors (commonly known as CT sensors) were installed by a licensed electrician around electrical wires in the switchboard. These sensors were not visible after installation, are non-invasive (they do not switch any circuits on or off) and monitor how much electricity is being used on each of the electrical circuits in a home and the total energy use on the main circuit.

The Ecofront Energy Monitor also included the use of a timer to reset the unit each day, a Wi-Fi router and a 3G modem with a data plan. This allowed remote access for data downloads and ongoing maintenance checks. The data was stored on an SD card in the energy monitor prior to CSIRO (Victoria) downloading the de-identified energy use data to a Postgre SQL database. A system health report was generated twice a day from the updated data to rapidly diagnose and manage network failures.

2.9.3.1 Selecting the homes to receive energy monitoring equipment

The process to select 120 homes that were eligible/suitable to receive energy monitoring equipment was used as described below (up to 30 in each study group).

Selection of homes to receive energy monitoring equipment involved consideration of the following factors:

i) Presence of asbestos – if asbestos containing materials (ACMs) were present/suspected to be present and likely to be mobilised during the installation of energy monitoring equipment, then a home was generally not eligible to receive the monitoring equipment. 'Federal' electrical switchboards and other asbestos containing switchboards prevented installation of onsite energy monitoring equipment. If disturbed, friable asbestos products may have been dangerous because the asbestos fibres can get into the air very easily and may be inhaled by people living or working in the area. NB: Bonded asbestos products (e.g. old fuses) that have been damaged or badly weathered (including hail damage) may also become friable.

ii) Was the householder likely to be physically and mentally capable/receptive to numerous home visits by project staff and contractors? If not, then the home wasn't eligible to receive energy monitoring equipment.

iii) Access: does suitable access exist to allow installation and possibly removal of energy monitoring equipment? If not, then the home wasn't eligible to receive energy monitoring equipment.

iv) Was removal and reinstatement of the home to its previous condition likely to be practical and affordable at the end of the project? If not, then the home wasn't eligible to receive energy monitoring equipment.

Energy Liaison Officers together with the supplier and installer of energy monitoring equipment identified households that were suitable to receive the equipment and offered it to them. An information sheet about the equipment and terms of installation was provided to homeowners. If the homeowner agreed for the equipment to be installed they were required to sign an *Energy Monitoring Equipment Agreement*.

2.10 Temperature data

2.10.1 External temperatures

External temperatures were obtained from local Bureau of Meteorology (BoM) weather stations. Due to the spread of house locations in the study, data was obtained for four BoM stations. The location of the four BoM stations that were used are shown in Figure 8. Each council area was then assigned to one of these BoM stations (

Table 2) and then houses were linked to the BoM station assigned to their council.

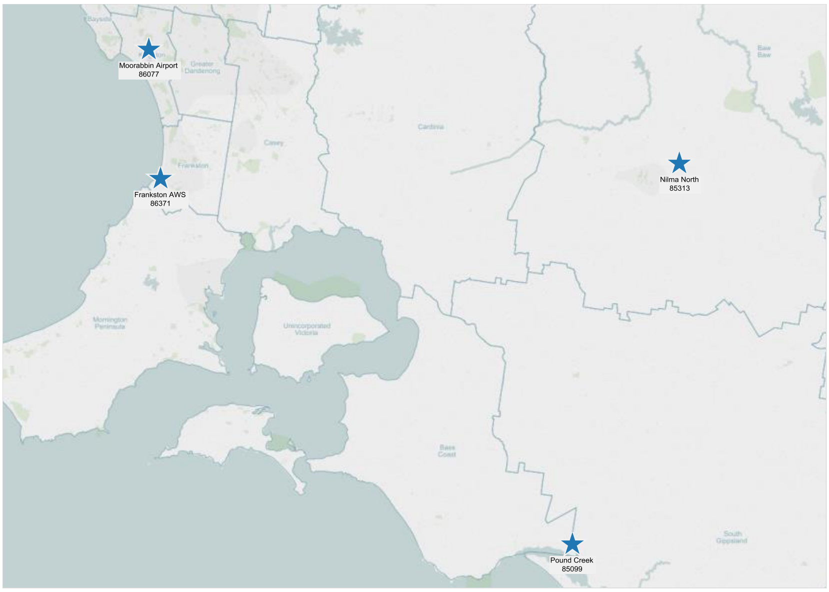


Figure 8: Bureau of Meteorology weather station locations

Table 2: Council assigned BoM station

Council	Postcode	BoM Station
Casey City Council	3805	Moorabbin Airport
Bayside City Council	3191	Moorabbin Airport
Cardinia Shire Council	3809	Moorabbin Airport
Mornington Peninsula Shire Council	3931	Frankston AWS
Baw Baw Shire Council	3820	Nilma North
Bass Coast Shire Council	3995	Pound Creek

2.11 Collection of data about the homes

A range of data was collected about the homes that were participating in the project both before the project provided support/interventions at the homes and following interventions.

The data about participating homes was collected in separate tasks as follows:

1. Home energy audits:
    a. High level
    b. Low Level
2. Draught testing
3. Internal temperature monitoring

2.11.1 Home Energy Audits

A home energy audit was done at each home by an energy auditor from Energy Makeovers. Each home received either a high or low level audit. The high and low level audits took approximately 1-2 hours each.

2.11.1.1 High level audits

High level audits were undertaken during visits to 60 randomly selected homes. 120 points of data were recorded about each home including the building materials, number of bedrooms, insulation and presence/absence of draught sealing, the appliances present and their approximate amount of use. The size of all the rooms was measured and a house plan created.

The National House Energy Rating Scheme (NatHERS) computer software was used with the high level audit data to calculate the star rating for each of the 60 homes. The star rating was recalculated at 28 of these homes after they received retrofits (draught sealing and insulation).

A high level audit report was produced for each home using the high level audit data. This report listed the characteristics of the home and its current energy use estimates by energy use type i.e. lighting, heating, cooling, hot water, cooking, other appliances etc. The report recommended a list of priority works that were affordable for approximately $2250 to improve the energy efficiency of the home. The recommended home improvements also had their projected payback period stated in years i.e. the length of time it is likely to take to recover the cost of the works due to reduced energy use and the projected cheaper energy bills. Prioritisation of recommended home improvements from high to low placed short payback period works first, followed by works with longer payback periods.

SECCCA used this information when deciding which home improvement works and support it offered to householders/owners.

High level audit report data was made available during the project to householders that are in the Behaviour Change study groups (B & C). The reports provide householders with facts which may help them either improve the energy efficiency at their home, reduce energy costs or lead to improved occupant comfort, health and/or wellbeing.

High level audit report data was made available to householders that are in the home retrofit only and control study groups (A & D) towards the end of the project in 2016. This was after the scientific monitoring period of the project had ended.

2.11.1.2 Low level audits

Low level audits were done for the remaining 260 homes. 100 points of data were recorded including the building materials, number of bedrooms, insulation and presence/absence of draught sealing, the appliances present and their approximate amount of use.

A summary of useful data collected during low level audits was produced for each home and made available to homeowners in 2016 towards the end of the project after the scientific monitoring period. This summary listed the characteristics and materials of the home.

SECCCA used the low level audit information when deciding the home retrofit works and support it offered to these householders/owners.

2.11.2 Draught testing

2.11.2.1 Background

Air draughts can move in and out of most Australian homes after they are built, even when the doors and windows are closed. Householders often struggle to keep their home at a comfortable temperature all year round as a result, due to the air (and energy) movement in and out of their home.

Homes can either be built to be relatively air tight, or existing homes can have existing air draughts better sealed. This can result in homes being relatively draught proof or air tight, much more energy efficient, comfortable and healthier to live in with lower energy costs.

Common air draughts in homes are through exhaust fans, wall vents and chimneys, around doors, windows, architraves, skirting boards and wall penetrations (plumbing and /or electrical) and between gaps in building materials. Many of these draughts can be sealed in most (but not all) existing homes. The design, condition and structure of existing homes determines firstly, if draught sealing can be done successfully and secondly, the cost of draught sealing.

2.11.2.2 Draught testing and sealing process

This part of the project aimed to test the air exchange rate of 60 homes to see how draughty they were. It also aimed to identify what it costs to draught seal homes and what are the most cost effective draught sealing actions.

Draught testing was done using a technique known as ‘blower door testing’. The technique is described in the *Draught Testing Information Sheet* that was provided to homeowners of homes that were offered draught testing (see Appendix 4).

Following draught testing, draught sealing specialists identified the homes from the 60 tested that appeared to be of a design, condition and structure that could be sealed more effectively for an average budget of approximately $1600 per home. Before the proposed homes to be draught sealed were identified, homeowners were informed about the draught testing, sealing and retesting process and asked to sign a *Draught Sealing Works Agreement*.

26 homes were then draught sealed. After this draught sealing their air exchange rate was retested and re-calculated. The average change in air exchange rate was then determined.

2.11.3 Internal temperature monitoring

Internal temperature data in both the main living area and inside the main bedroom was monitored separately from February 2014 until at least November 2015. House selection for internal temperature sensors was based on study group, with all houses in groups A and B being temperature monitored, as well as the houses in study groups C and D that had energy monitoring equipment installed. Initially this was to determine the internal temperatures in homes at different times of day and in different seasons and inform the interventions offered to homeowners. Internal temperature monitoring was continued until the project ended after interventions to determine if internal temperatures changed significantly following interventions to either the home or changed householder behaviours. The temperature data could also be compared with post-intervention householder feedback regarding comfort levels in the homes. Changed internal temperatures may have impacts on the comfort and health of householders and their wellbeing.

The temperature sensors installed by SECCCA were the Hobo UX100-003. These are capable of holding a year's worth of temperature data at 30 minute intervals. The data from each sensor was downloaded to a data logger approximately twice per year and transferred to CSIRO's database.

2.12 Collection of data from householders

As a research project it is critical that data about the householders was collected at the start, during and end of the project. The data collected was to provide a basis for comparison of changes achieved during the project and the effectiveness of the project to support householders and improve the energy efficiency of their homes. Householder surveys were developed by the Data Committee to collect data about the householders.

2.12.1 Pre-intervention householder survey

The pre-intervention householder survey took into account the project's objectives and the requirements of DIIS (see Appendix 5 for the survey). The Data Committee had access to a large number of questions from previous similar surveys - many of these questions were used. The pre-intervention householder survey was trialled and ELOs were trained to administer it. The ELOs used computer tablets to record the householder's responses and the results were sent to CSIRO and collated.

The pre-intervention survey data was used to design and provide support to householders in the Study Groups B & C (Behaviour Change component). The Behaviour Change program (described in detail in the 'Interventions' section below) aims to improve the energy efficiency at homes by providing targeted support to each householder i.e. providing relevant information about energy efficiency, energy supply plans, appliances, time of use, energy monitoring. This in turn aims to increase householders' interest in and awareness of energy efficiency and actions they can do to improve energy efficiency/costs, comfort etc.

2.12.2 Post-intervention survey

The post-intervention householder survey was developed by the Data Committee (see Appendix 6). It contained most of the questions asked on the pre-intervention survey[1] as well as a range of questions that asked the householders about their views on various aspects of their involvement in the project. This survey of 272 householders was administered by the ELOs in late 2015. The householders were from all four of the study groups.

[1] A few extra responses to a small number of questions that clarified the 'Other' category were included in the post-survey and these minor changes were taken into account during the analysis.

In the post-intervention householder survey the householders were asked whether the home improvements met their expectations. In addition, on both the pre- and post- survey, all householders were asked to rate the comfort of their home on a five-point scale from uncomfortable to very comfortable. These questions provided a way of assessing the views of the householders to the retrofits and enabled a comparison of their opinions about comfort levels before and after the intervention, and against those who we not given retrofits.

2.12.3 Householder survey about IHDs

Householders that were given IHDs were surveyed in late 2015 about the IHDs. At the time of writing this report, 23 of the householders that had been supplied with the custom designed android tablet (deluxe IHD) and 21 householders that were issued with the Watt's Clever (standard IHD) had been interviewed.

The householders were asked a number of questions that explored:

- how many people used the device
- how they used the device
- how easy they were to use
- how often they used the IHD
- whether they were still using it
- has the IHD influenced their energy/appliance/lighting use

2.12.4 Analysis of the householder survey data

Analysis of the householder survey data aimed to help answer some of the research questions that were posed during the project's design e.g. What is the householder feedback about the various aspects of the program? What views do the household participants hold regarding energy efficiency pre intervention? How do the views change? Does the use of IHD assist in changing behaviour of low income households to reduce energy consumption?

On both the pre- and post-intervention surveys, all householders were asked to rate the comfort of their home on a five-point scale from uncomfortable to very comfortable. On the post-survey these householders were asked whether the home improvements met their expectation and had it led to improvements in comfort. These questions provided a way of assessing the views of the householders to the retrofits and enabled a comparison of their opinions about comfort levels before and after the intervention, and against those who were not given retrofits.

The householder survey data was evaluated and analysed statistically. As well as simple statistics, tables and graphs, this analysis used two measures, when appropriate, to help interpret the data collected from the pre and post surveys: Statistically significance to the $p < 0.05$ level and 'effect size'.

A statistically significant result (usually a difference) is a result that is not attributed to chance. Analysis of variance (ANOVA) was used with the numerical data to see if there were any differences between groups. The Chi Square test was used with the data that could be split into groups. The effect size is a way of quantifying the magnitude, or size, of an effect and was applied to relevant numerical data. An effect size of 0.2 can be interpreted as 'small', 0.5 as 'medium' and 0.8 as 'large'.

Other tests used were T-Tests and the Bonferroni correction, which were applied to counteract the problem of multiple comparisons; while the measure of internal consistency (Cronbach's alpha) was applied to determine the reliability of combining the results from four survey questions to create an index. An alpha of 0.7 indicates acceptable reliability and 0.8 or higher indicates good reliability.

2.13 Collection of data about householders from ELOs

Energy Liaison Officers were expected to develop a significant body of knowledge about participating householders from recruiting, supporting and surveying them between late 2013 and early 2016. Focus groups were held in each of the six councils that participated in the Energy Saver Study near the end of the project during November and December 2015. A relevant HACC staff member, a council staff member and their Energy Liaison Officer (ELO) met with the project evaluator to discuss how they viewed the project (Appendix 7 lists the questions used to frame the discussion).

2.14 Interventions

Of the 320 households recruited to the study, 230 underwent one or more interventions designed to improve the efficiency of energy consumption including:

- 75 houses received retrofit interventions only
- 74 houses received behaviour change interventions only
- 81 houses received both retrofit and behaviour change interventions.

The 80 remaining houses did not receive any intervention and were used as a control group. 10 houses withdrew from the study before interventions were implemented. The number of houses in each study group, the interventions they received and whether onsite energy monitoring occurred are shown in Figure 9 (houses which withdrew before study completion are excluded).

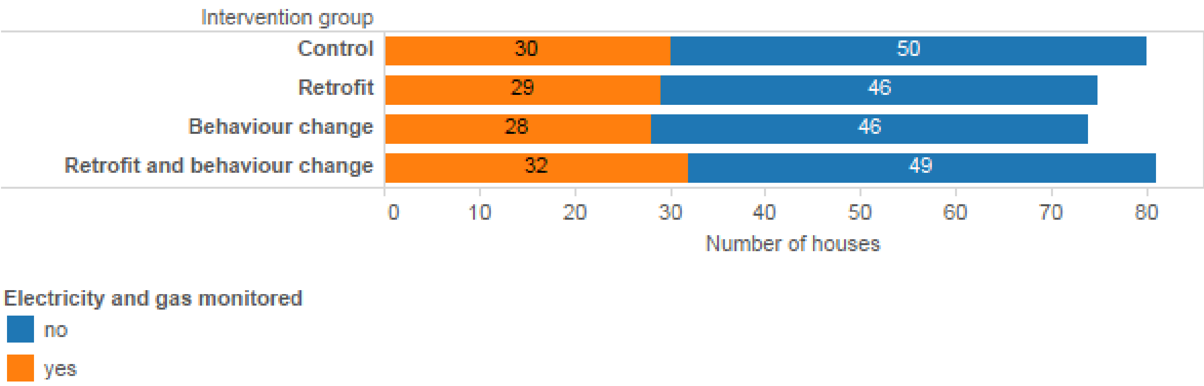


Figure 9: Household interventions

Altogether 1,043 individual interventions were made during the monitoring phase on 230 houses: 622 retrofit interventions, and 421 behaviour change interventions. The interventions were carried out between 5/12/2014 and 9/11/2015 (Figure 10).

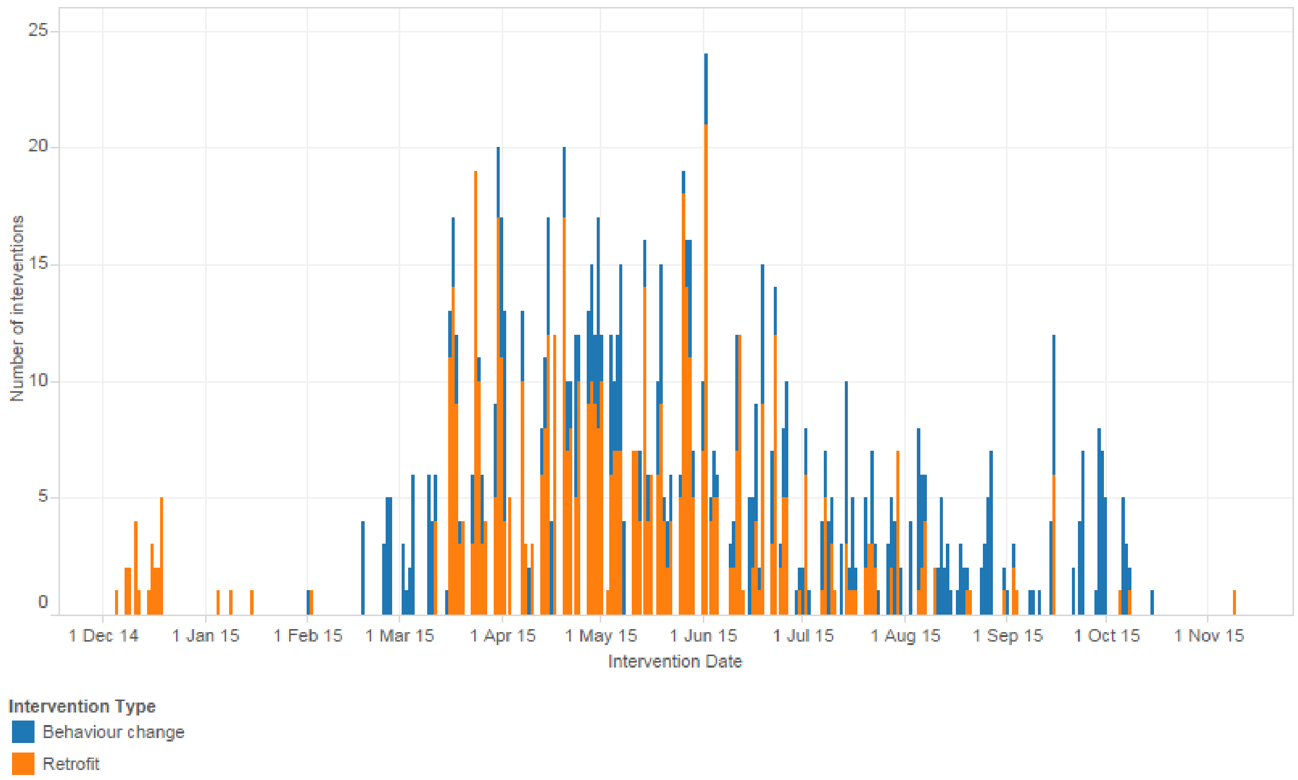


Figure 10: Intervention dates and numbers

2.14.1 Intervention subtypes

Houses which received retrofit interventions received one or more of eleven different retrofit intervention subtypes (Table 3). Houses which received behaviour change interventions received one or more of five different behaviour change intervention subtypes (Figure 11). Houses received a tailored package of interventions resulting in many house receiving different combinations of intervention subtypes. The number of houses receiving each intervention subtype varied (Figure 11). For instance, 67 of the houses in the retrofit group received draught sealing, whilst 35 received LED lighting, and 7 received appliance upgrades.

Table 3: Intervention subtypes

Intervention type	Intervention Subtype	Description
Retrofit	Appliance upgrade	Replacement of existing appliance (e.g. plasma/CRT TV) with energy efficient equivalent appliance
Retrofit	Draught sealing	Sealing gaps in the thermal envelope of a home to minimise unwanted air and energy flow in and/or out
Retrofit	Heater/cooler maintenance	Servicing a heater/cooler so it operates as efficiently as possible
Retrofit	Heater/cooler upgrade	Replacing an existing heater/cooler with a more energy efficient heater/cooler
Retrofit	Hot water service insulation	Insulating the pressure relief valve and hot water outlet pipes of a hot water service with lagging/similar material
Retrofit	Hot water service maintenance	Servicing a hot water service so it operates as efficiently as possible
Retrofit	Hot water service upgrade	Replacing an existing hot water service with a more energy efficient hot water service
Retrofit	Insulation	Installing insulation to the thermal envelope of a home
Retrofit	LED lighting	Replacing existing low efficiency lights (e.g. halogen/incandescent) with LED lights
Retrofit	Window treatment	Installing materials (e.g. blinds, curtains, perforated foil, additional glazing) to existing windows to minimise energy flow through the window
Retrofit	Zoning	Installing an internal door in a home to minimise the size of the conditioned space
Behaviour change	EAP first visit	One to one meeting to discuss motivations and choice of energy actions
Behaviour change	EAP second visit	One to one meeting to discuss motivations and choice of energy actions
Behaviour change	EAP group session	Group meeting to discuss energy actions taken, challenges and share learnings
Behaviour change	IHD install Standard	Watts Clever EW4500 In Home Display
Behaviour change	IHD install Deluxe	EMS Ecofront energy monitor In Home Display

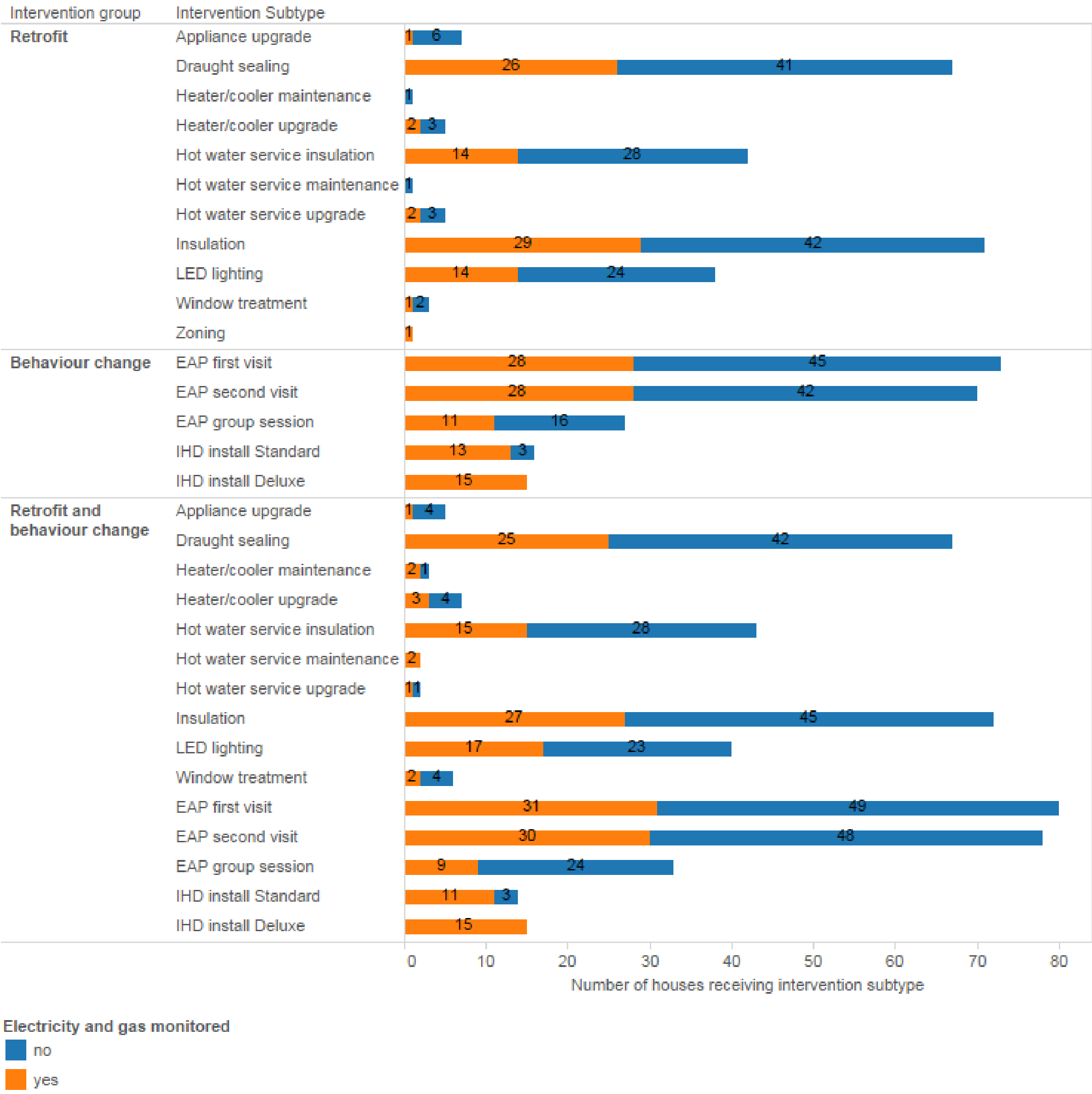


Figure 11: Intervention subtypes

2.14.2 Home Retrofits

Home retrofits were provided to 156 homes. The range of specific home retrofits and related products, brands and models were selected based on market research, product testing, reviews, staff experience and advice provided by SECCCA's Research and Training Officer and are listed in Table 4 below.

Table 4: Home retrofit works and related products

Home retrofits	Brand	Model	Description
Replacing incandescent light globes with LED globes	Mirabella	9w G70 Warm 2700k & Cool 4000k BC ES	General LED light globes
LED downlights replacing halogen downlights	Ledified	EVA	An efficient, remote controllable LED downlight with adjustable light colour and brightness made to replace MR16 downlights
	Primsal Brilliance	6w MR16 PM166WWHPF	A non-dimmable LED MR16 downlight that is compatible with approximately 90% of existing transformers
	Ledified	Gen 1 - 6W 360 (2700K)	An efficient, non-dimmable LED MR16 downlight supplied with a new driver
	Ledified	COB800	An efficient, dimmable downlight that can replace MR16 downlights
Increasing downlight safety	Tenmat	FF130 Flanged Loft Cone	Cone ensures that insulation and combustibles are kept away from the downlight when installed in ceiling spaces.
Draught sealing	Raven	RP3 RP78	Door flap Door perimeter seal
	ecoMaster	Range of products	Doors & window, ceiling fan and other seals
	Fullers	UltraClear	Water based gap sealant that is white when applied and clear when dry (not invisible)
	Advantec	DraftStoppa ®	Self-seal casing for ceiling exhaust fans
	Various, including EcoMaster	Invisible Pelmets	Acrylic clear plastic pelmets installed on top of window curtain tracks that manage airflow and heat transfer
	Various	Pelmets	Wooden or other box pelmets above window architraves that manage airflow and heat transfer
	Various	Internal	Internal doors to zone/reduce the area of the conditioned space
Insulating hot water service components	Valve Cosy	Valve Cosy™	Covers pressure relief valve and pipe unions to reduce heat loss
	Thermotec	E-Flex 13mm Wall	Hot water pipe lagging to reduce heat loss
	Fletchers	Armaflex Pipe Insulation	Hot water pipe lagging to reduce heat loss
Insulation	Knauf	Earthwool	R4, 195mm thick, bio soluble ceiling batts and R2 underfloor batts
	Fletchers	Pink Batts	R4, 195mm thick, bio soluble ceiling batts
	Enviroflex	R2.0 Cellulose Fibre insulation	Insulation that is blown into the desired space where access for batts is not feasible (i.e. skillion / flat roofs, cathedral ceilings)

Table 5: Home retrofit works and related products (continued)

Home retrofits	Brand	Model	Description
Hot water services	Quantum	Heat pumps (Domestic 150, 200, 270 litre units)	Efficient, quiet, electric
	Rinnai	B16, B20, B26	Efficient, external, gas, continuous flow
Heaters/cooler	Daikin	Various 2.5kW, 3.5kW, 6kW units	Efficient, split system air conditioners
	Braemar	Various including TH420 WF 25 & WF30	Gas ducted heaters Flued gas wall furnace
	Bonair	Pyrox 30 & 40 Mj	Flued gas space heater
	Various	Various	Ceiling or portable pedestal fans
Window furnishings	Various	various	Awnings Curtains Blinds
Wren Industries	Renshade	Framed, or affix to inside of windows using Velcro dots	Perforated aluminium foil to reduce heat transfer through windows/skylights whilst letting light in and retaining view
Electricity standby switch/energy savers	EcoSwitch	EcoSwitch	Easy to reach power switch
Replace existing plasma/ cathode ray TVs	Various	Various	LED TVs
Replace old fridges	Various	Various	Modern fridge with 3.5 or more stars

2.14.2.1 The Home Improvement/Retrofit selection process

Following householder recruitment, home audits and householder surveys were completed. SECCCA received the high level home audit reports and took these into consideration when deciding the works to be proposed to the relevant 60 homeowners. SECCCA looked at the gas and electricity bills for homes to see what the historical energy use profile was and checked, for example, if summer/winter energy use peaks occurred, a high baseline of energy use or frugal energy use for most of the year.

SECCCA proposed recommended retrofit works to homeowners, negotiated the agreed works and when the owner agreed they signed a *Home Improvement/Retrofit Works Agreement* and the works were scheduled and completed.

2.14.3 Behaviour Change/Energy Action Program

2.14.3.1 Background

Developing a behavioural change program and testing its impact and effectiveness to improve energy efficiency with low income householders was a key component of the project.

In SECCCA's 2012 application to the Low Income Energy Efficiency Program (LIEEP), the development of a behavioural change program was proposed with a general format and clear purpose: *A behavioural change program that is effective at assisting the low income households in this demographic improve their energy efficiency – including a range of technological, software and hardware solutions that facilitate behavioural change to improve energy efficiency.* (Application form, December 2012).

By mid-2013, the concept of the behavioural change program had evolved: *Householders will participate in a behavioural change program provided by Energy Saver Direct Care workers that will highlight 'lifestyle' ways of reducing energy consumption. (Evaluation plan, June 2013,* from Sharpley, 2016*).* The framework for the Energy Saver Study was also clearer and around half of the 320 participating householders were designated to take part in the behavioural change program (half of these would also receive retrofits).

During 2014 the behavioural change program began to really take shape. In February 2014 SECCCA staff attended Les Robinson's 2-day 'Enabling Change' workshop, and during that year the ESS staff brainstormed possible approaches, tools and activities that could be used. They also discussed its design with the Project Reference & Advisory Committee, the members of which were highly regarded experts in their field. Although there were different views about the nature of the program, a number of general principles emerged from these discussions. They included:

- Designing the delivery around the householder interests. The program to be framed around the individual. Understand the individual, what they value and their core motivations
- Focusing on outcomes rather than products
- Providing active social learning experiences, grab their attention, make it fun
- Having regular and ongoing contact with the householders, be it face-to-face, telephone or email
- Having a suite of approaches that can be adapted to householder diversity.

By the start of 2015, the behaviour change program had been developed, trialled internally by the ESS staff and documented (*Behavioural Change Program for ESS,* SECCCA 2015). It was badged as the 'Energy Action Program' (hereafter EAP) in order to:

- Focus householders on actions that will help them to improve their lives;
- Avoid the use of the word 'behaviour' when dealing with participants as it could be misinterpreted in a negative way (NB: Three words were used interchangeably in this report to describe householder activities – behaviours, actions and practices).

The Project Delivery Team developed the program after much consultation and discussion, and facilitated the training of the ELOs to deliver it. The ELOs presented the program to householders in the behavioural change study groups (B and C).

The ELOs varied in their previous experience of delivering community education programs. Some were highly experienced while others had little or no experience. This made it difficult to prepare a training program that would cater for their differing needs and is reflected in their mixed views and comments about the training and the resources made available to them.

2.14.3.2 EAP Aims

The aim of the Energy Action Program was to trial and test a package of interventions to see if they could produce permanent change in householder behaviour, resulting in more productive energy use in homes.

The EAP also aims to see if providing targeted energy action support to householders, or providing it to householders in addition to home retrofit works, is the most effective way to support householders to improve the efficiency of their energy use, reduce costs, improve comfort, health and wellbeing.

2.14.3.3 EAP Design

Behaviour change programs can have varied results. Changed behaviours can be temporary or permanent and can result in small or significant reductions in energy use. The EAP has been designed to attempt to deal with common failings of behaviour change programs, such as the target audience not being interested in the program's aims, short term/no behaviour change, small reductions in energy consumption and behaviours being short term and not owned by the program participant.

It was identified early in the design of the EAP that it was very important for the EAP to focus on what each householder values, their current and future priorities, use of time, desires and aspirations. It was decided that rather than make the EAP just about energy efficiency, it was a priority to identify how the EAP could best support householders so that they were more likely to adopt, own and continue to do actions that benefited them in their home i.e. to offer them support to do things that they chose as relatively important or that were linked to the householders priorities and values.

A tool/game titled *'the cake game'* was used at the first EAP visit to each home. The game was used to provide a fun and non-threatening context for ELOs to try to identify householder priorities and values and get to know them. Householders were asked before the visit what sort of cake they liked. The ELO took this type of cake to the house (or 'magic sand' in the shape of a cake if they didn't want cake) and asked the householder what they do each week and how much time they spend doing these things. 'Activity labels' were placed on the cake representing the householders' priorities/current activities and the cake was cut into suitably sized pieces to represent the time spent on each activity as exemplified in Figure 12 below.

Figure 12: The cake game: indicated householders priorities and future priorities/desires

This indicated to ELOs how the householder spends their time and the proportion of their time they spend on each activity/priority. Householders were then asked how they would change things in an ideal world with no limits. Householders either added new activities, or placed a '+' or '-' symbol on existing activities. This gave ELOs an indication of what was important to the householder in the future. Householders' responses to the pre-intervention householder survey were also noted i.e. the actions they already did to use energy efficiently.

The ELO then focussed on suggesting one or two targeted, relevant, new energy efficiency actions to the householder from a 'Top15 actions list' or 'other actions list' that were developed by the project delivery team. Information and support was provided to householders which was related in some way to the householder's preferences where possible, rather than simply providing generic energy efficiency information to improve householder awareness. It was recognised early in the EAP design process that householders are more likely to own and adopt new actions and continue doing the adopted actions if the action may achieve some progress to their priorities/desired outcomes, rather than if they are just told what to do.

Behaviour change in this project's context can also be thought of as supporting householders to operate their home in a way that minimises costs and maximises its performance and comfort. Many people are not aware/shown how to operate a home efficiently. Consequently they do not always achieve the best performance that they could in their home efficiently.

Another important EAP design element is that the recommended actions were only offered by ELOs progressively to householders i.e. the householders were given the opportunity to succeed with 1-2 early efforts and gain confidence/receive positive feedback from ELOs, so that more actions can be added through the EAP, but only when householders were ready.

2.14.3.4 Theory of change

The EAP involved incremental change. The program needed to deliver the following elements to achieve lasting impact and significant energy savings:

- Shift in thinking – motivates the householder by trying to establish a link between personal motivations and energy efficiency in the home
- Personalisation - identifies actions that may achieve improved energy efficiency and progress towards each householders' priorities, values, desires etc

- Support - schedule of up to three visits to support the householder to progressively adopt actions, record progress and sustain the change
- Introduction of measurement of behaviour – create a *Fridge Action Magnet* log sheet, plus encourage the monitoring of energy bills
- Provision of information – provide factsheets, energy videos and targeted presentation of the list of energy saving actions to householders
- Improvements to technology and equipment – offer a thermometer, In-home Display (IHD), control devices for appliances, pedestal fans, easy to access power switches
- Operational adjustments to the way people use their home – provide information to inform householders of opportunities so they can change what they do in their home to improve energy efficiency/save money/improve comfort etc
- Peer to peer information – facilitate group workshops for householders at which they can share their experiences and learning with other householders. This was to help householders adopt new actions and sustain behavioural changes.

2.14.3.5 Summary of Energy Action Program

The **Energy Action Program** has a three step delivery process:

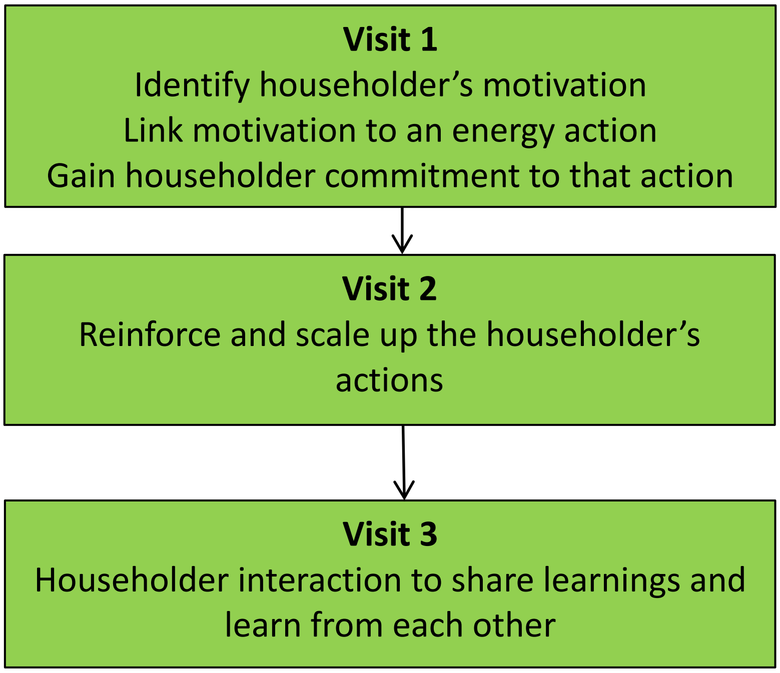


Figure 13: The Energy Action Plan process

Detail of the tasks that Energy Liaison Officers implemented for the EAP are listed in Appendix 8.

Scripts for Visits 1, 2 and 3 are in Appendices 9, 10 and 11. They provide a detailed list of how the project planned to provide each visit to EAP householders.

Other EAP tools were the *Top 15 Action Cards, Other 30 action cards,* and a *Fridge Action Magnet.* These are available in Appendices 12, 13 and 14. The 8 Energy Efficiency information sheets are available by going to www.seccca.org.au

2.14.3.6 In Home Displays

In Home Displays (IHDs) are an electronic device that shows current and historical information about the energy use in the home i.e. when energy was used and how much. IHDs come in a range of shapes, sizes and levels of functionality. The aim was to determine the effectiveness of 30 custom android tablet (deluxe IHD) against 30 'Watt's Clever' off the shelf devices (standard IHD) and in turn, compare the homes with IHDs with houses in the study group who were not issued with IHDs. This was to compare of costs and benefits of the two different IHDs.

The deluxe IHDs were linked to homes that had onsite energy monitoring undertaken using EcoFront energy monitoring equipment. They have specifically designed energy-use monitoring software that is linked to the EcoFront equipment. The deluxe IHDs show the following information for energy use:

- current energy use for gas, electricity and the total energy use

- how much energy has been used today, this month and year
- electricity use by circuit (up to 8 circuits i.e. total energy, hot water service, lights, heater/cooler, others)
- how much extra energy is used when a device is turned on/up.

The deluxe IHDs also provide energy saving tips to help improve the energy efficiency of homes, reduce energy costs and they provide information about the project.

A collaborative research and design process was undertaken for the deluxe IHDs which considered cost, the poor eyesight of some people (particularly the elderly participants) and device readability, useability for physically impaired users, access to the device, its size and operating energy use and cost.

A 10” touch screen android tablet was selected, plus a rigid, plastic, purpose-designed and manufactured tablet stand. The energy monitoring software was loaded to each tablet with a home screen display such as Figure 14. Householders were provided with a *deluxe IHD user manual* and ELOs tried to show each householder how to use the IHD.

Figure 14: Deluxe IHD home page

Source: Energy Monitoring Solutions

The 30 standard IHDs (see Figure 15) were supplied and installed to 30 other EAP homes and householders were shown how to use them and supplied with a manual.

Figure 15: Watts Clever Wireless Energy Monitor – Smart Meter: EW 4500 (standard IHD)

Source: Watts Clever

2.15 Energy use analysis

Several different measures were used to assess the impact of the interventions on households. These measures fall broadly into four main categories: savings in energy consumption, savings in energy bills, savings in greenhouse gas emissions, and increased comfort in households.

House daily energy consumption values were used to calculate for each house an average daily value for each month pre-intervention and an average daily value for each month post-intervention. The average daily value post-intervention was compared against the average daily value pre-intervention for equivalent months. The difference between these two gives the change in consumption for a house for a month. For control houses, daily averages were calculated for months in 2014 and compared against equivalent months in 2015.

Bill savings were calculated by applying a $/kWh and $/MJ rate to daily electricity and gas savings respectively (Table 6).

Table 6: Constants used in calculations. Greenhouse gas emission data obtained from National Greenhouse Accounts 2015 (Department of the Environment).

Constant name	Constant value
Cost of electricity	29 cents per kWh
Cost of gas	1.8 cents per MJ
Electricity greenhouse gas emissions	1.26 kg CO2-equivalent per kWh
Gas greenhouse gas emissions	0.0039 kg CO2-equivalent per MJ

Greenhouse gas emissions savings were calculated by applying a kgCO2-e/kWh and kgCO2-e/MJ rate to electricity and gas savings (Table 6).

Changes in household comfort levels were calculated using monitored thirty minutely indoor temperatures.

The energy data was analysed using a combination of the following tools: R for statistical analysis; Tableau for visualisation of the data; PostgreSQL for aggregation of data; Microsoft Access for aggregation and manipulation of data.

For each dwelling, the electricity and gas usage data was first aggregated (or in the case of distributor billing data, disaggregated) to a daily total, and then to an average daily total for each month so that the comparison pre- and post- intervention could be based on similar weather conditions.

To calculate total energy use, gas use was converted from MJ to kWh (using 1 MJ = 0.278 kWh), and then added to electricity use (in kWh).

For each study group for each month, the changes in electricity, gas, and total energy daily averages for the dwellings in the group were averaged (mean). Each study group's mean was compared against the control group mean using a t-test. Statistical significance and 95% confidence intervals were calculated.

The differences between the study group energy means were tested for statistical significance (at the 0.95 level) using t-tests. Each intervention group was compared against the control group. Intervention groups which showed statistically significant differences in their means to the control group are noted in the *Intervention Impacts* section with an asterisk.

2.16 Additional research

2.16.1 RMIT Health Study

The Health Study, a PhD research project by Nicola Willand, supplemented the Energy Saver Study (ESS). In the context of housing as a determinant of health, the study of the social impacts of residential energy efficiency is gaining interest. Previous research has indicated that residential energy efficiency improvement programs may mitigate greenhouse gas emissions and lead to benefits in terms of physiological, psychological and social health. While improved winter warmth, affordability of fuel and householder satisfaction have been suggested as likely mediating factors, causality remains unclear due to the complex interplay between the technical quality of the building, householder situation and practices, and the delivery of the interventions. Evidence for the Australian context is poor, summer conditions have scarcely been investigated and the householder lived experience of interventions is under-researched.

Using a systems based framework, the purpose of this Health Study was gain to a better understanding of how householder practices and experiences contributed to the impacts of the ESS on the mediating factors along the pathway from improved energy efficiency of the building to health outcomes and on final health outcomes. The objective of the study was to identify and describe householder practices that seemed to explain outcomes in indoor temperatures, energy use, energy costs and householder health.

2.16.1.1 Method

In this mixed-methods quasi-randomised controlled trial, an experimental set-up was combined with an inquiry into the householder experience to inform future energy conservation programs and Ageing in Place policy. The study accompanied 13 control (Group D 'control') and 16 intervention (Group A 'retrofit only') households over the course of one year from September 2014 to September 2015.

The study captured objective indicators, such as indoor temperatures and energy consumption as well as subjective indicators such as comfort, satisfaction with the home, difficulty of paying bills and self-rated health. In addition, four waves of householder interviews sought to provide a better understanding of householder practices. A social practice approach was adopted to provide an understanding of how the material entity of the dwelling, householder capabilities and the meaning of householder routines and preferences shaped changes in the vulnerability, resilience and health outcomes of householders.

The holistic nature of this study required multiple layers of data analysis, synthesis and interpretation. Analysis of quantitative and qualitative data was performed for each wave of data collection. Standardisation of the indoor temperatures, energy consumption and vapour pressure excess against daily mean ambient temperatures were performed to control for the variability in weather conditions and data sets between the baseline and follow-up years. Qualitative data assisted in identifying householder practices, their nature, meaning and developments. Pre- to post-intervention changes in the quantitative indices were calculated, and explanations for the results were sought through the verification of quantitative and qualitative results and inference. Due to data limitations, outcomes for summer conditions were not explored.

2.16.2 Swinburne University investigation of Social Influence

Social influence on participating householders' residential energy practices is being researched by Swinburne University Masters student Lucy Allinson (who was also the Team Leader in this project). The Masters research aims to explore the range of influences impacting the householder's decision to change an action and to sustain a practice.

These influences are framed around Social Practice Theory and categorized into 3 domains:

- Infrastructure and material influence
- Competency, skill, attitudes and beliefs
- Social influence

Particular emphasis will be placed on social influence and the specific influence patterns for successful and failed change in household energy based practices.

The researcher is completing this as a longitudinal, mixed methods study which is still in progress. Stage 1 interviews on social influence patterns on new and failed actions have been completed. The question that was asked of each householder is: "Who would you go to for advice on energy use in your home?" Each householder was then asked to plot their advisors by degree of importance.

Stage 2 interviews on social influence patterns on sustained practices and evaluation of stories of "Most Significance" were completed in April 2016.

The methodology uses data from the Energy Saver Study, with themed interviews and a technique called Most Significant Change.

The Most Significant Change technique is used in complex scenarios to find out what influences are evident in areas of successful change.

The Most Significant Change technique involves collecting participant stories of 'significant change' and these stories are then evaluated by participants groups under key influence domains and overall.

3 Results

3.1 Council Delivery Frameworks

Although the project was instigated by the environment teams, the project's delivery was based within the HACC area. Each council hired an ELO (for the LIEEP project only) into their HACC teams and supported them to recruit, retain and support householders to participate in the project. HACC teams provided ELOs with in-kind supervision, induction, training and support where required throughout the project.

In all of the councils the project improved the relationships between the Environment and HACC teams, their awareness of what each other do and how they do it. Participation in the project improved councils' capacities to deliver energy efficiency services in the future i.e. some of the council staff now have a better knowledge of the role that energy efficiency plays in low income householders lives, the barriers to energy efficiency, the opportunities to improve energy efficiency, and how and who can deliver goods and services to deliver this support.

Three somewhat different models were used to establish and deliver the project across the six councils.

Five councils appointed an ELO and placed them within the councils' HACC team. In the first stage of the project (recruitment of the householders) the ELOs were provided with the HACC database of clients from which they were to randomly select the project participants. There was some variation in the ELOs access to the householder databases and to the level of support given to them by the HACC team to use it. All ELOs were able to identify eligible clients and recruit householders to the project. Recruitment of participants was effective because ELOs were either able to i) be introduced to existing HACC clients by an existing HACC direct care worker and 'trust' was handed to them, or ii) ELOs approached clients as a HACC staff member and inherited/built rapport with clients in good faith as a HACC team member, possible due to the value many clients have for HACC services and staff.

A second model was that one council had outsourced their HACC services. Cardinia is one of only two councils in Victoria that don't have a HACC team. The not-for-profit organisation 'mecwac*are*' is a service provider in its own right. They work for council and hold the clients' personal data. To establish this project there needed to be agreement between the council and mecwac*are*. As a result an ELO was employed by SECCCA but reported to staff at the council and at mecwac*are*. It took some time to establish the project at mecwac*are* because of this government-private partnership. Privacy rules were all important. The difficulty was that the data was held by mecwac*are* and it was to be provided to a non-council outsider (the ELO). To use the database, the ELO relied on two mecwac*are* administration staff to do the search to find suitable clients. Following client identification and recruitment, the project was successfully delivered through this public-private partnership.

The third model was that Mornington Peninsula Shire Council (MPSC) was willing for their HACC Home Maintenance team to provide home retrofits to participating householders and be reimbursed for the labour cost, with SECCCA pre-purchasing the majority of materials. Mornington Peninsula council already offered draught sealing services to its clients prior to the project. SECCCA determined the retrofits that were offered to each LIEEP household and passed lists of works to the MPSC ELO. The ELO gave work requests (that included light globe changing, draught sealing and hot water service insulation) to the Home Maintenance team and they completed the works. This was a very cheap way to deliver a limited range of home retrofits. Other retrofit tasks that MPSC was not trained/certified/willing to do such as installing insulation, draught sealing exhaust fans, electrical and plumbing works and window furnishings was outsourced by SECCCA to private contractors.

It has not been a priority for HACC assessment officers, team leaders, carers or Home Maintenance staff previously, but the HACC staff members are now somewhat more informed about draught sealing goods and services and their benefits to clients. MPSC may continue to offer and deliver this service. It may also enhance awareness amongst its staff and clients of this service and council may consider adding other energy efficiency support services to the range of available home maintenance services following this project e.g. window furnishings and insulating hot water services (pressure relief valves and hot water outlet pipes).

"We had a (home) maintenance team consisting of a leader and 3 officers. In the past they did draught sealing. They attended some (draught sealing) training and it helped them see the big picture and where they fitted in. It was good for them. It validated what they were doing and introduced them to new products. They did lighting upgrades to LEDs, draught sealing and insulating hot water systems (lagging and valve cosy). They were challenged but adjusted to it." They believed the quality of the maintenance team work was better than that provided by external contractors, but they still need to embed it into their existing range of work so it won't add to costs significantly.

Casey council HACC team identified an opportunity to further investigate and trial the provision of energy efficiency support services by HACC to its clients as a result of this project. Casey put a proposal to the Department of Health & Human Services in the 3rd quarter of 2015 (last year of the project) and was successful in receiving funding for a 6 month full time HACC project officer role to investigate and trial community energy efficiency support opportunities and provide a report to council by June 2016. The successful applicant commenced this role in late 2015 and is working in consultation with SECCCA to deliver the additional project.

3.1.1 Feedback from councils

The study was instigated by the environment team in each council but was based within the HACC area. In all of the councils there were sometimes tenuous links between the environment and HACC teams. In the initial stages of the project some of the HACC staff were suspicious and needed to be assured of the value of the study. *'It was difficult early on. The HACC team was told it was happening.'* Despite these initial concerns, everyone who attended six council focus groups agreed that it was worthwhile participating in the study, and, importantly, their involvement was key to the success of the study.

A range of other feedback was received from councils including:

- It was worthwhile participating in the study
- Helps council activate its plan. It was a strategic initiative.

- The learnings are going to be critical. It will provide evidence to our climate change committee.
- The study helped to improve the credibility of the council among the householders who received the retrofitting and behavioural change activities
- Council involvement was important to the success of the study: ‘The barriers would have been huge if it wasn’t for the council.’ ‘Council involvement was vital.’
- The involvement of the council greatly strengthened the legitimacy of the study
- The partnerships between HACC and environment teams improved communication and established links within the council
- It demonstrated ways that the (HACC) maintenance team could be involved in energy conservation (health and wellbeing)
- The study raised awareness and provided information and ideas to both council staff and clients
- As a pilot it was pretty well done. The roll out beyond the project should be far smoother.

Despite its many challenges the study was, overall, successful in the councils’ overall view. They indicated that both council and the householders benefited from the project and had increased knowledge and capacity as a result of participating in the project.

3.1.2 Challenges noted by council staff

A wide range of challenges facing the study were identified. Many were transitional and overcome overtime, while others possibly restricted the outcomes of the study. The most important challenges that needed to be overcome involved the complex nature of the study, the tight and changing timeframe and the workload of the ELOs who were all employed part-time. There was a general recognition, however, that despite these challenges the study was successful.

Specific challenges included:

- Involving householders in the project: ELOs needed to develop trust and overcome householder resistance to participate
- The initial home energy audit results were not always accurate and didn’t always help the retrofitting process
- ELOs were on a steep learning curve and their employment contracts changed over time
- The project’s time schedule was unrealistic/changed/could be revised/improved
- It was a challenge dealing with contractors and tradesmen, especially in vulnerable peoples’ homes. Their work was often invasive of people’s homes and lives

3.2 Pre-intervention data

3.2.1 Householders

The number of people living in a house impacts the amount of energy a house consumes. Likewise, the occupancy pattern of the household also influences energy consumption.

The majority of households in this study were single person households (55%), with a further 39% being a two person household as per Figure 16. Only 6% of households had more than two people and only 2.5% were classified as a family with children.

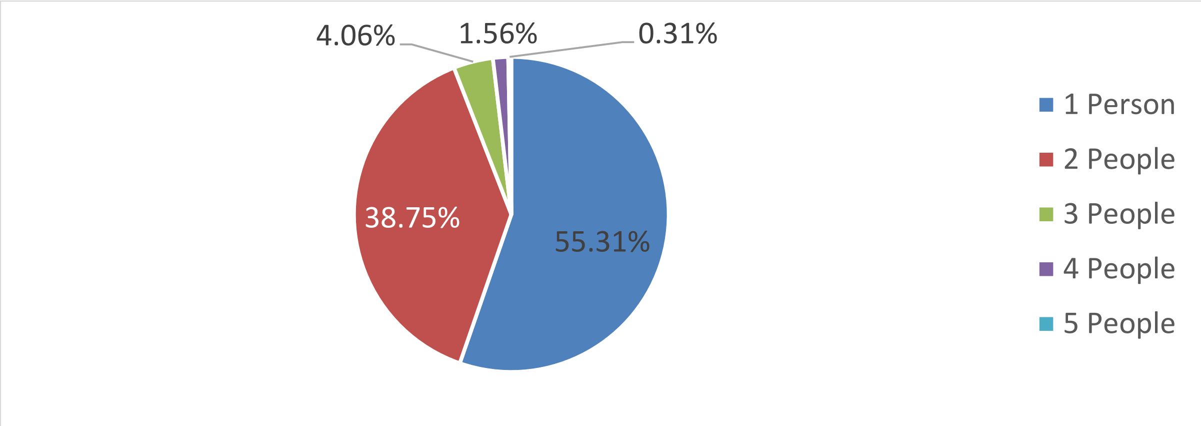


Figure 16: Number of people in a household

The age profile of the participants reveals that the households are predominantly older people with 83% being at least 70 years old (see Figure 17). This is also reflected in the household type where 50% of participants classified themselves as retirees while a further 42% classified themselves as a single or couple and it can be assumed that many in these groups were also retirees (see Figure 18). In addition, 78% of participants were female.

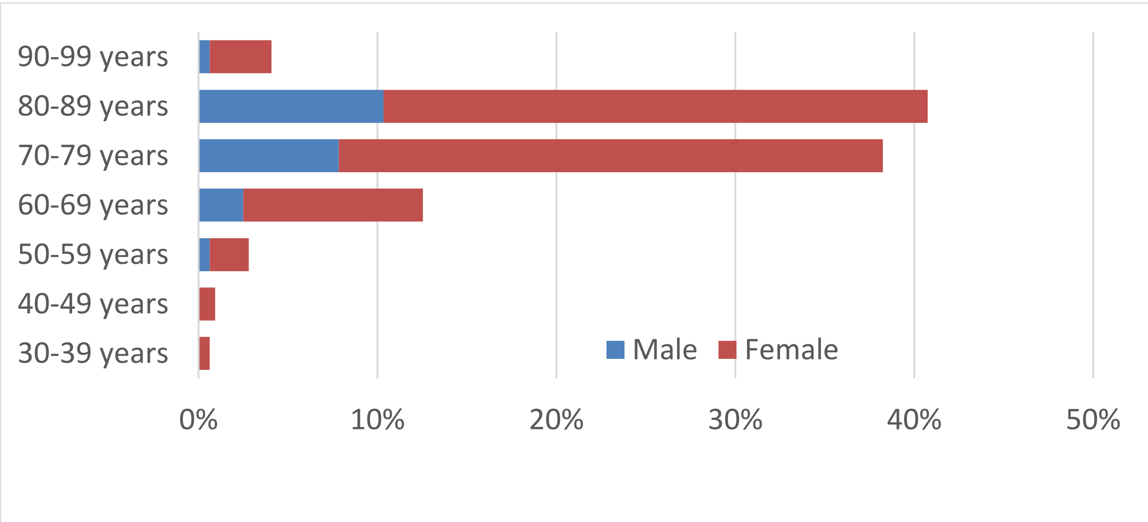


Figure 17: Age and gender of household participants

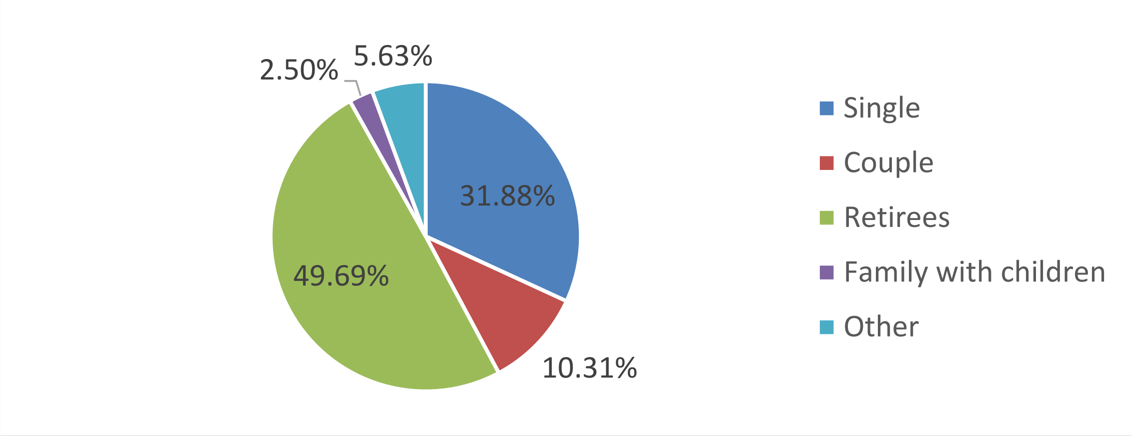


Figure 18: Household type

The occupancy profile of the households also shows that the majority of participants are retired or not working full time (see Figure 19). 84% of houses are occupied all day while only 1.6% are empty during the day. Around 12% of houses are occupied for half the day.

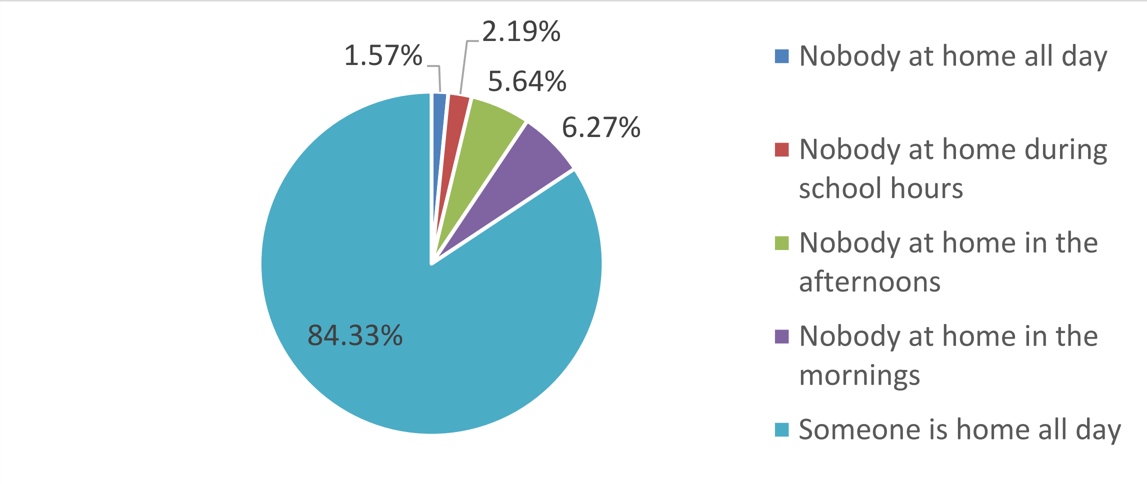


Figure 19: House occupancy

The study was focussed on low income households and for 69% of households their weekly income was less than $600/week as per Figure 20. Low income households are generally considered to earn less than $475/week while the average weekly income for Australian households is $998 (Australian Bureau of Statistics, 2015).

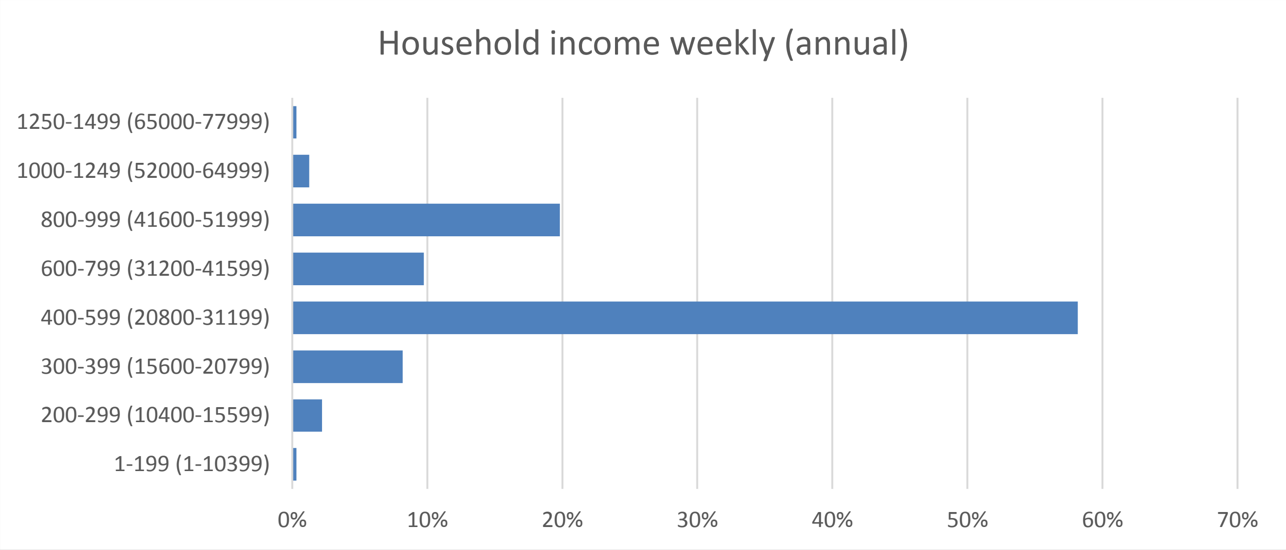


Figure 20: Household income – weekly and annual

Household ownership in councils varied between 80 and 90% of householders and 6.5% were tenants. This was a lower than average number of tenants against the national profile but consistent with this age profile.

Tenant numbers varied considerably across councils i.e. Mornington Peninsula has 6% of participants being tenants, whereas only 2% of participants in Bayside are tenants. Kingston has a large percentage of tenants but withdrew early from the project.

3.2.2 House energy audit data

3.2.2.1 House profile

Almost 80% of the houses in the study were separate houses, with the remaining being semi-detached townhouses (14%) and flats or apartments (6%) as per Figure 21.

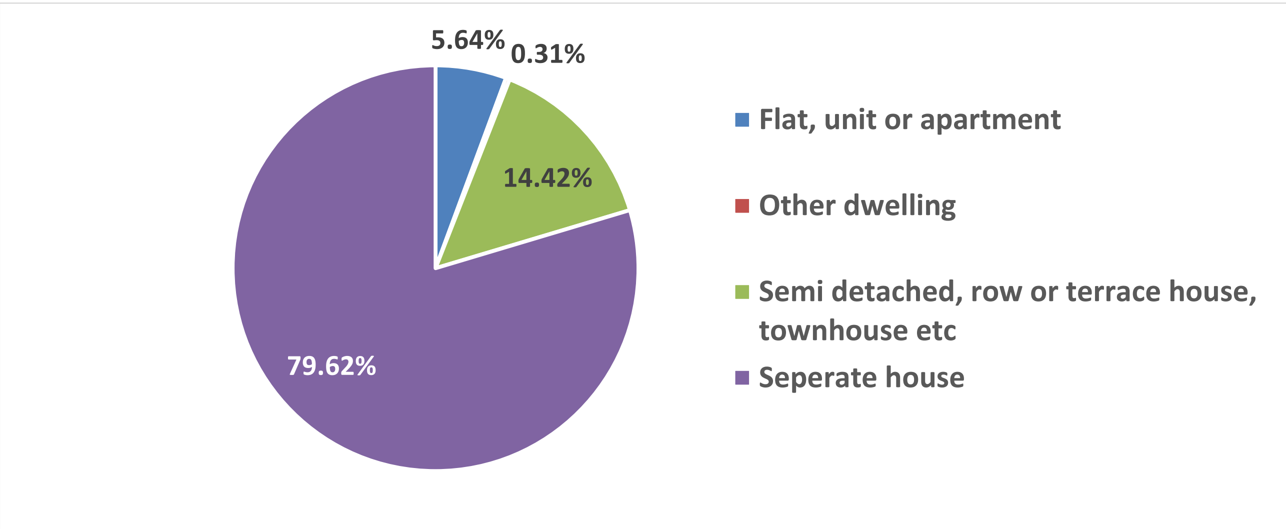


Figure 21: House type

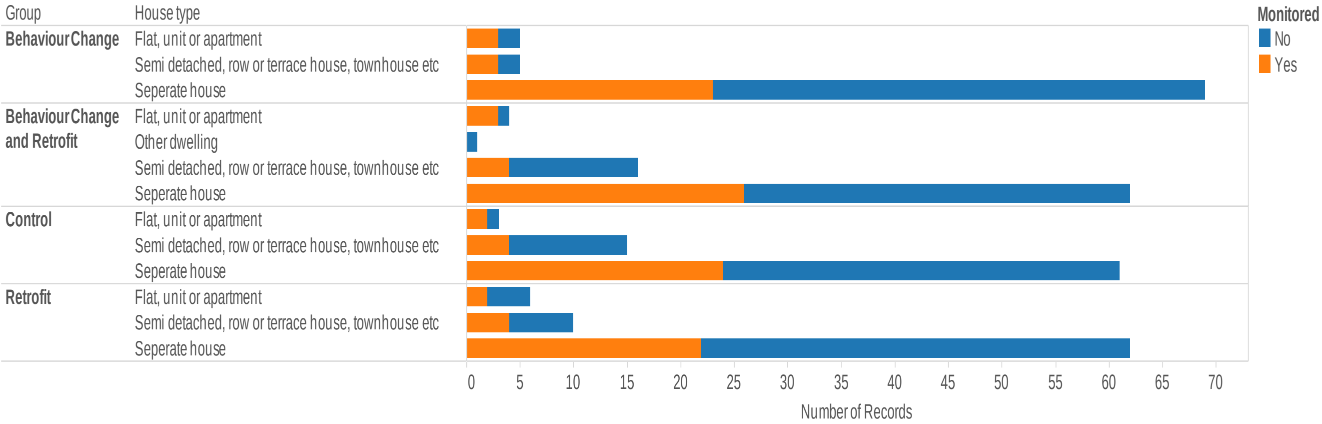


Figure 22: House type by study group

The age of the house can impact significantly on the energy efficiency of the house. Older houses tend to be draughty compared to newer houses and also would not have been subject to any energy efficiency provisions in the National Construction Code. In Victoria, the first requirements to include energy efficiency measures, such as ceiling insulation, were introduced into the building code in 2001. Before then no such requirements existed and consequently many older houses have minimal energy efficiency measures.

The majority of houses in the study are less than 50 years old. There is a fairly even spread of houses from the 1970's through to the current decade with a smaller number of post war houses. Houses that are older than 70 years comprise around 13% (Figure 23).

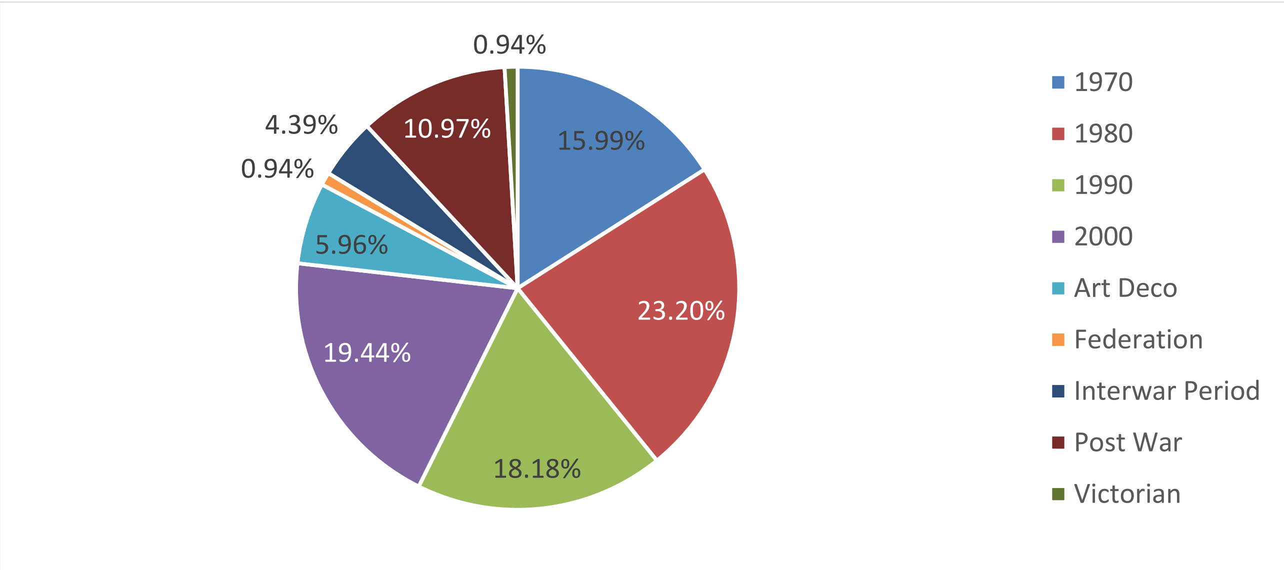


Figure 23: House age

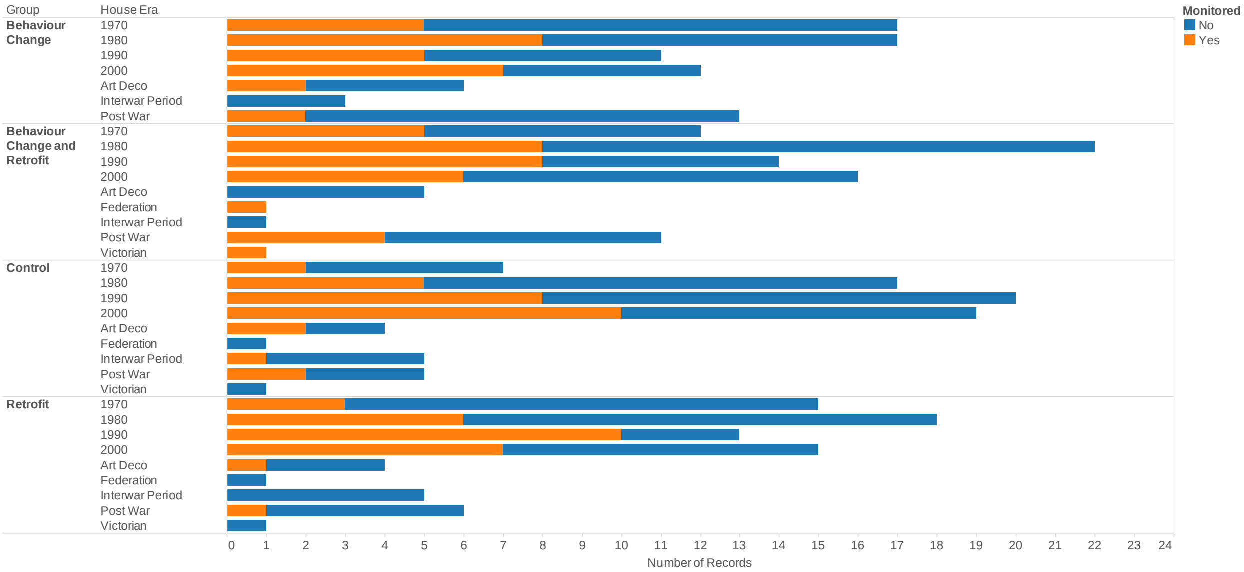


Figure 24: House age by study group

Although specific floor area for each house was not measured, the number of bedrooms was measured and this can be used as a measure for the size of the house. Figure 25 shows the breakdown by number of bedrooms and it is interesting to note that 16% of houses have four or more bedrooms. These would be considered large houses.

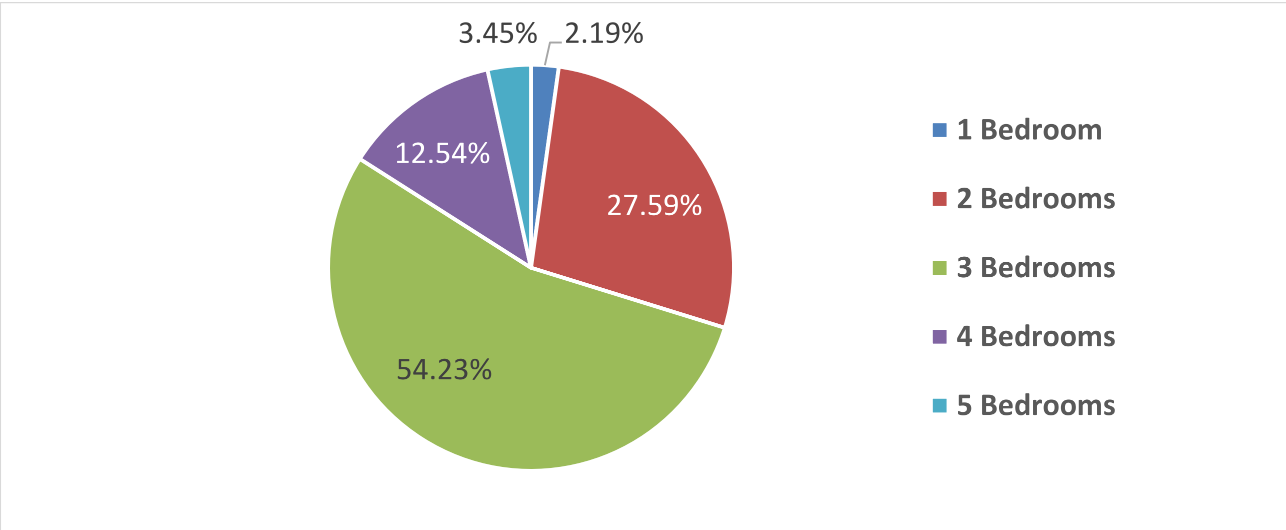


Figure 25: Number of bedrooms

3.2.2.2 House construction

The construction system used for a house can influence its energy efficiency potential and also dictates the types of retrofits that may be possible. For example, a house with a flat roof is more difficult to add insulation to than a house that has access to the roof cavity.

Many of the houses in the study (41%) had a concrete slab on the ground (Figure 26). This type of construction minimises air infiltration through the floor and generally improves the thermal performance of the house. Almost half the houses have raised timber floors (49%), although most have an enclosed sub-floor area that generally helps reduce air infiltration through the floor.

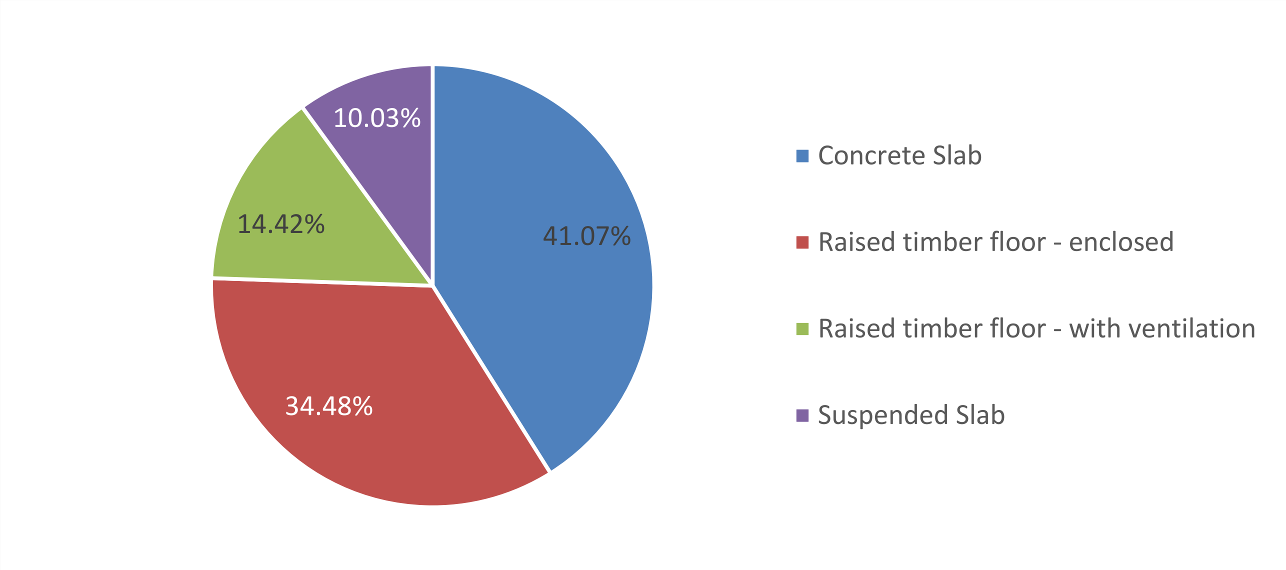


Figure 26: Floor type

The dominant external wall type is brick veneer with 71% of houses using this construction technique (Figure 27). Around 18.5% use a timber frame with an external cladding such as weatherboards or fibro cement.

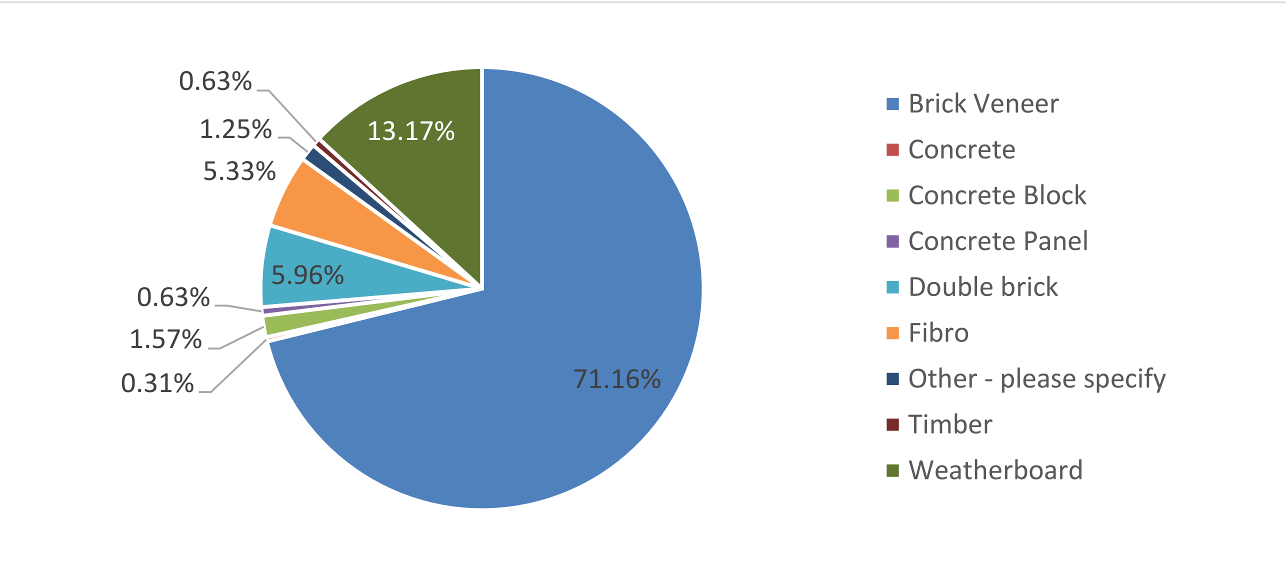


Figure 27: External wall type

Both brick veneer and clad houses have a wall cavity that allows for insulation, however, few house walls were accessible to investigate the existence of wall insulation (Figure 28). For 89% of houses inspected it was not possible to determine the presence of wall insulation. Nevertheless, it can be assumed that the majority of these houses would not have insulation in their wall cavity because until very recently (2006 onwards) the use of wall insulation in house construction was rare in Victoria.

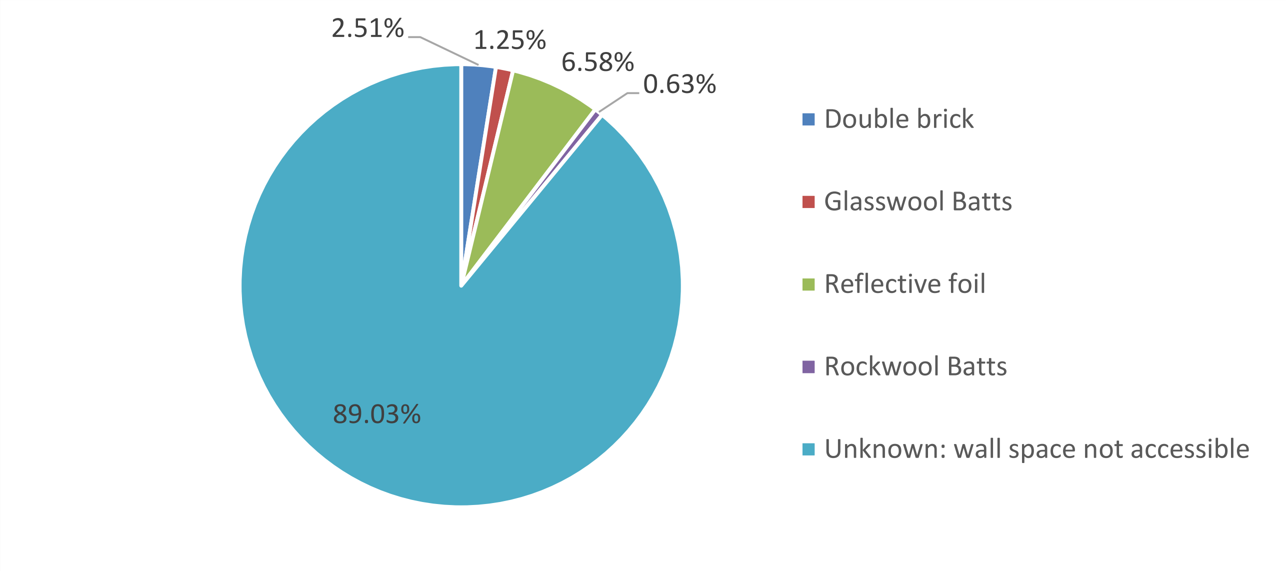


Figure 28: External wall insulation

Traditionally in Victoria tiled pitched roofs are the norm and the majority of houses in the project reflect this with 67% having a tiled roof (see Figure 29). The remaining roofs are nearly all metal clad (31%).

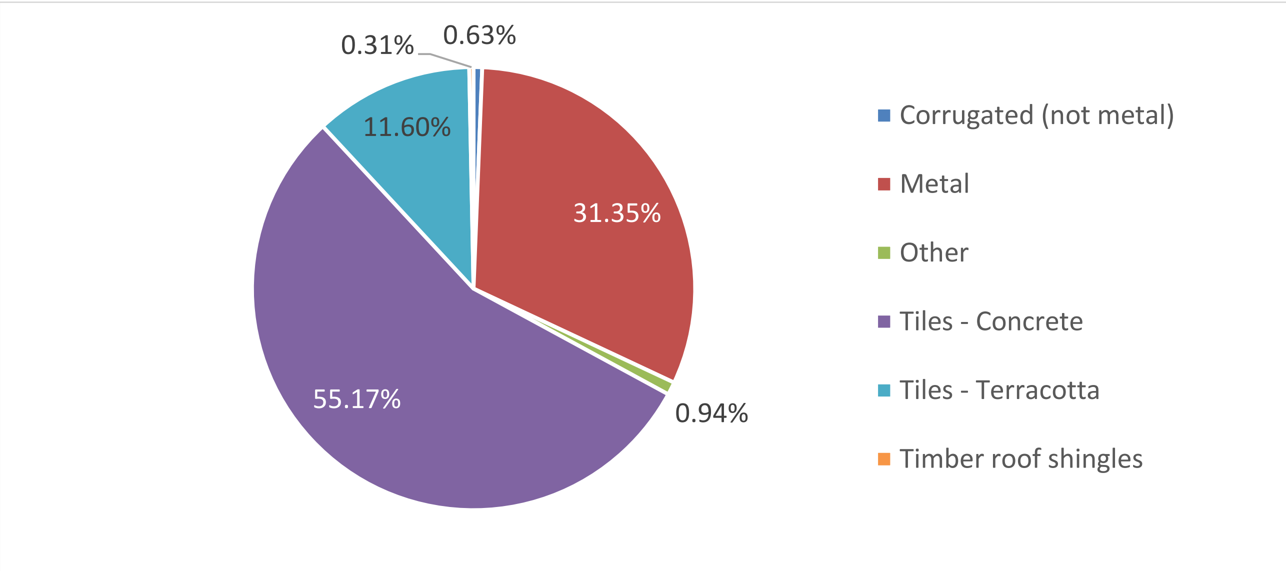


Figure 29: Roof cladding

Pitched roofs usually allow access to the roof space and consequently the house inspectors were able to inspect for the existence of ceiling insulation. Many of the houses in the project were built before ceiling insulation was required. Nevertheless, the addition of ceiling insulation has been encouraged by some government backed programs and consequently the number of houses with ceiling insulation has been increasing. Within this project 3.5% of houses were found to have no ceiling insulation, although for a further 15% of houses it was not possible to inspect the ceiling space. Almost half the houses inspected had some form of batt insulation (49%), while a further 31% had some form of loose fill insulation (Figure 30).

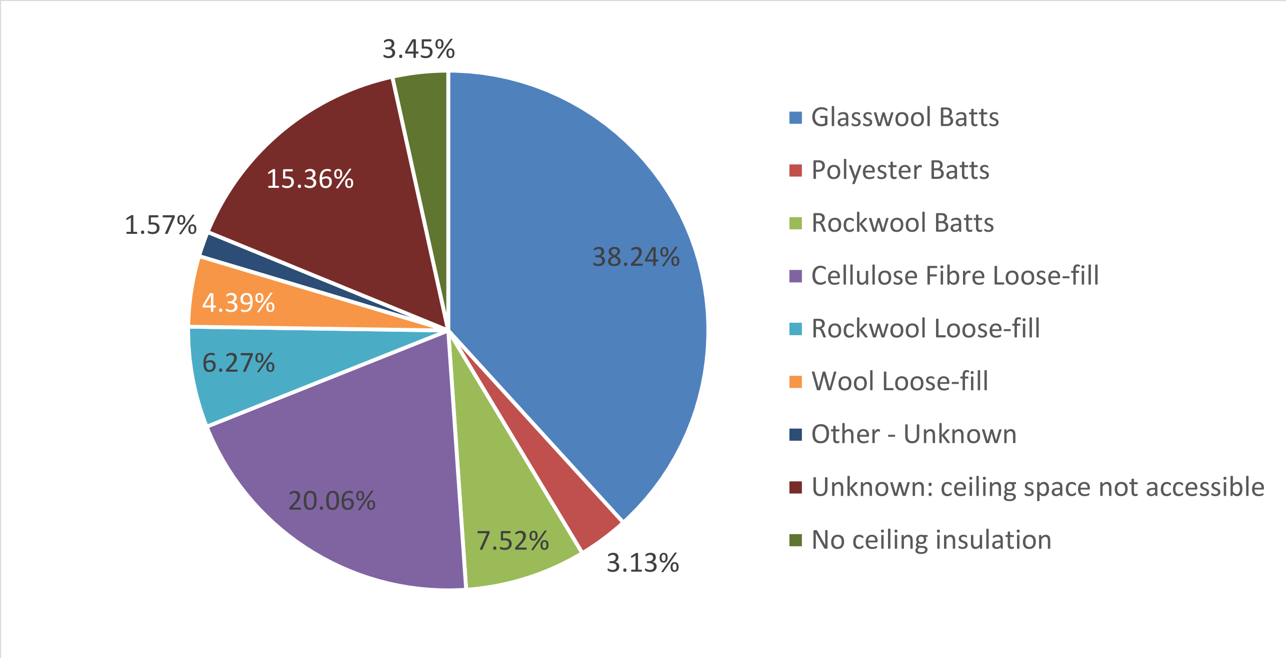


Figure 30: Ceiling insulation

The effectiveness of ceiling insulation is a factor of its thickness and general condition. Over time ceiling insulation compresses which reduces its effectiveness. Compression is particularly a problem with loose-fill insulation, but batts also suffer from compression. Insulation can also get damaged by animals, water infiltration and through the installation of other services that are located in the roof space such as ductwork and electrical cabling.

Overall, only 7% of ceiling insulation inspected was considered to be in good condition (majority of coverage consistent - only minimal gaps), while 67% was deemed to be in average condition (majority coverage consistent - some gaps to ceiling perimeter, around downlights, under heater platforms & tight corners). 26% was regarded as in poor condition (inconsistent insulation coverage - lots of gaps or large gaps, thin, degraded or ripped). Figure 31 shows the assessed condition of the insulation for the general insulation types (loose-fill, batts and other). It is interesting to note that a higher percentage of the batt insulation was considered to be in poor condition than the loose-fill insulation (24% and 18% respectively). However, only 1% of the loose fill insulation was considered in good condition compared to 12% of the batt insulation. From the home audits, 70% of homes had ceiling insulation that was 90mm or less, with only 25% of homes having ceiling insulation greater than 90mm thick.

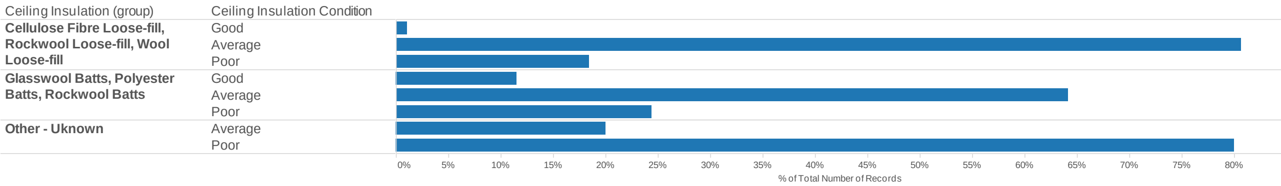


Figure 31: Ceiling insulation condition by insulation type

Windows are an essential part of any house, but they are also one of the major sources for heat loss and heat gain within a house. The type of window frame and the glazing system used can both help in reducing the thermal transfer between inside and out and vice versa.

Timber framed windows usually perform better in this respect than aluminium windows and when combined with double glazing can deliver a high performance window solution. 39% of houses in the project had timber window frames, but only around 1% had double glazing (Figure 32). Double glazing is increasing in popularity in new dwellings, but within existing housing stock it is rare.

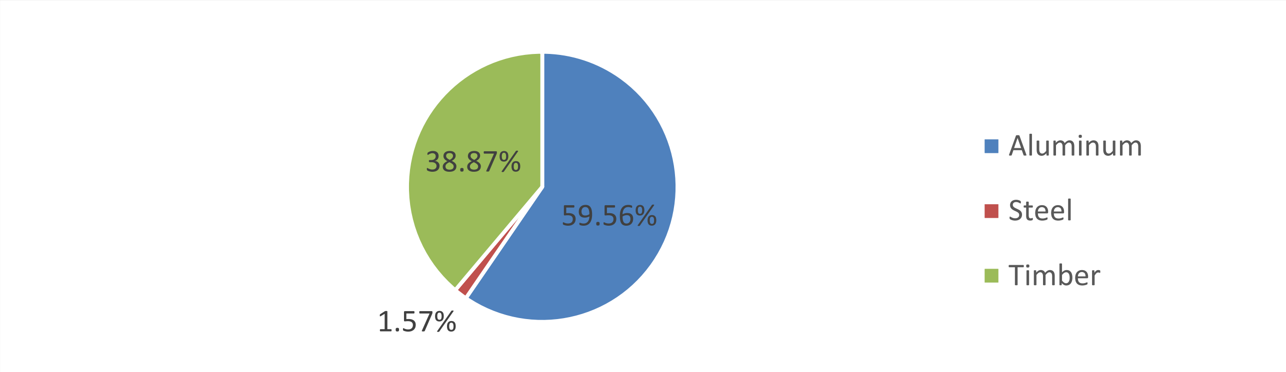


Figure 32: Window frame

3.2.2.3   House systems

Houses have a range of systems that are significant contributors to the overall energy consumption of the house. These include the heating/cooling systems, the hot water system and the lighting system. In addition, many households have installed PV systems which, of course, help reduce the amount of electricity that is taken from the grid.

Heating and cooling is usually the single biggest consumer of energy in Victorian households, with hot water systems being the second highest consumer (Figure 33). The efficiency of the systems that are installed can have a significant impact on the overall energy consumption of a house.

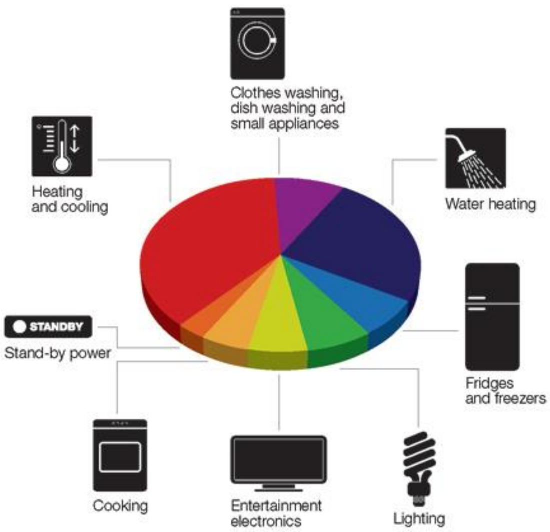


Figure 33: Typical energy consumption profile for Victorian households

In Victoria, a heating system is more common than a cooling system. All houses in the project had some form of heating system and mostly this was a fixed system rather than a portable system. Gas heating dominates with 70% of houses having some form of gas heating (Figure 34). Reverse cycle heat pumps had the next highest uptake being in 20% of houses. Within the gas systems, they are split between ducted (57%) and wall mounted space heaters (40%), while with reverse cycle systems the majority a wall mounted split systems (77%) with the remaining 23% being ducted (Figure 35).

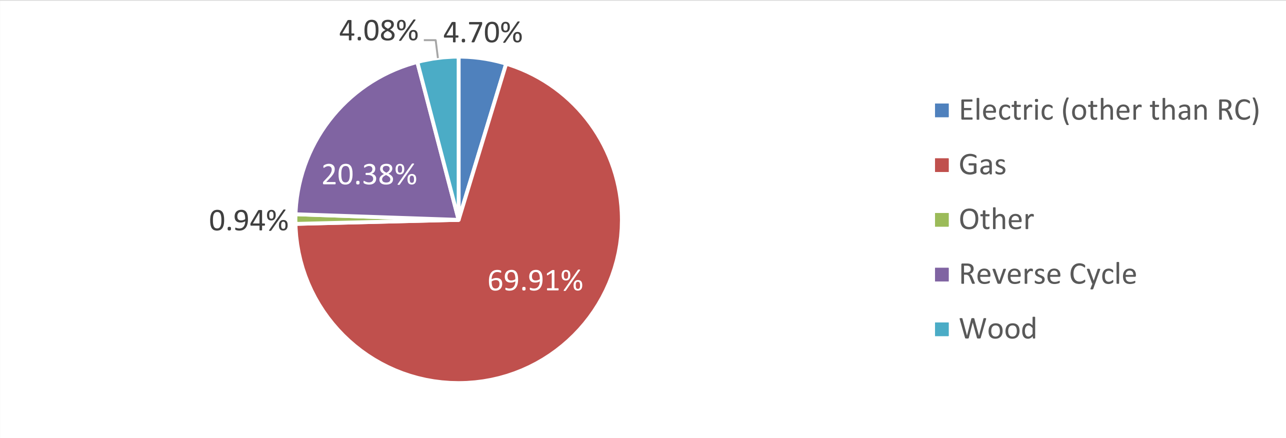


Figure 34: Heating systems

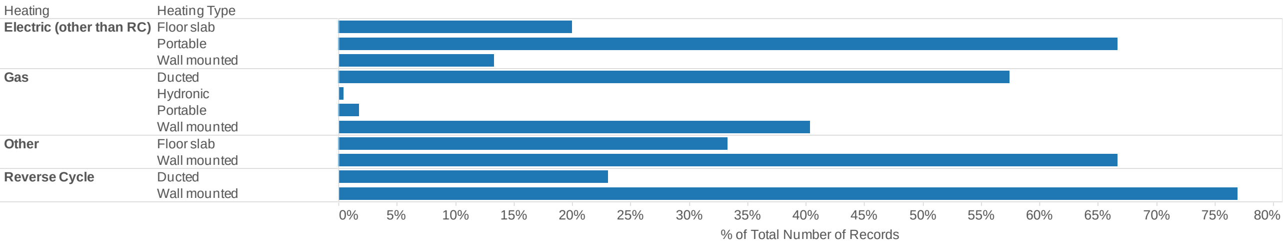


Figure 35: Heating system type

Most of the houses in the study had some form of cooling system with only 6% having no cooling system (Figure 36). The majority of houses used a reverse cycle heat pump (73%) and for 28% this was the same system they used for the house heating. Around 12% had evaporative cooling systems which are relatively low energy systems.

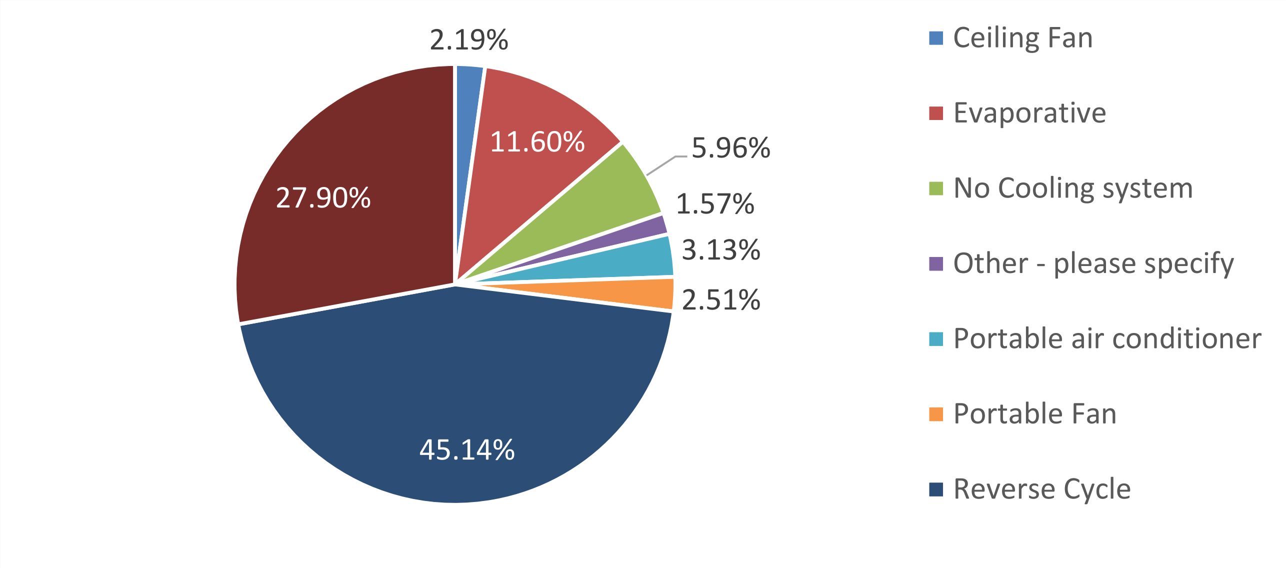


Figure 36: Cooling systems

Gas hot water systems were the dominant type of hot water system used accounting for 70% of all systems. Electric systems made up 24% while a surprisingly low 6% were solar systems (Figure 37).

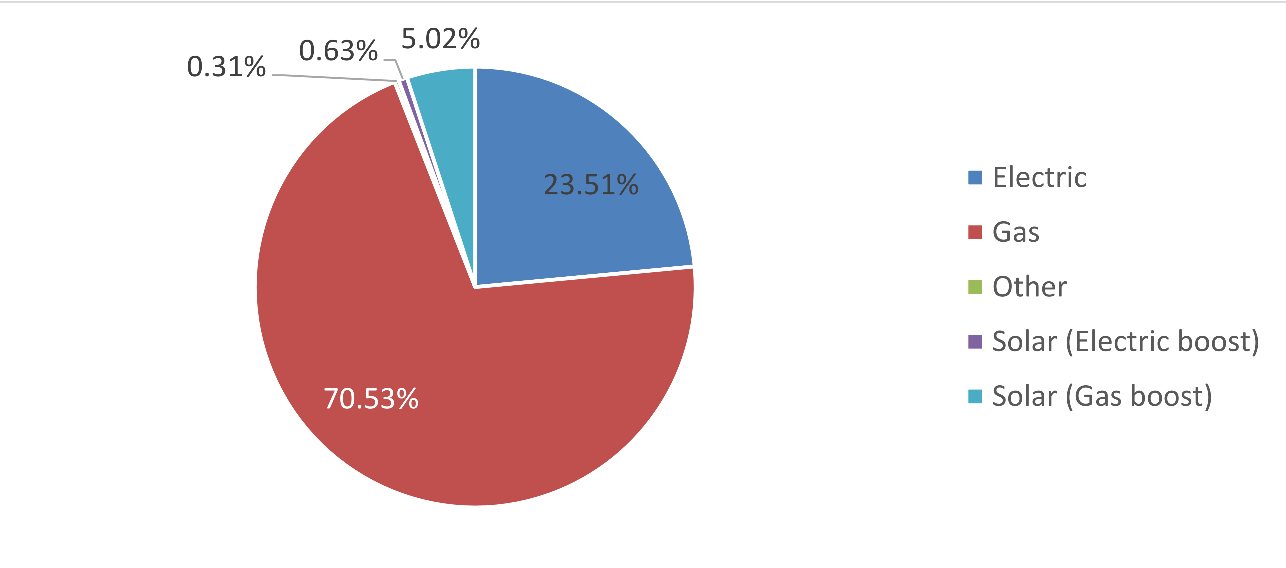


Figure 37: Hot water systems

The majority of hot water systems utilised a storage tank, but 18% of the gas hot water systems were instantaneous, non-storage type systems (Figure 38).

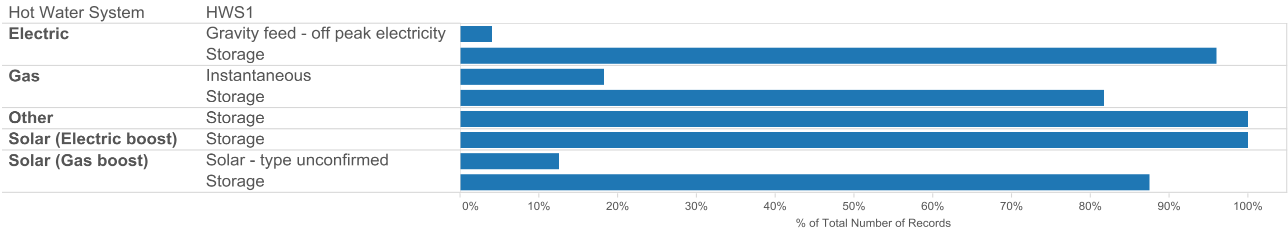


Figure 38: Hot water systems by type

Around 14% of the houses in the study had a solar PV system installed to generate electricity. Around half the PV systems installed were 1.5 kilowatts or smaller, but a surprisingly large number of big PV arrays were also installed. 26% of systems were 3Kw or bigger which for many houses would be large enough to meet the majority of their electricity needs.

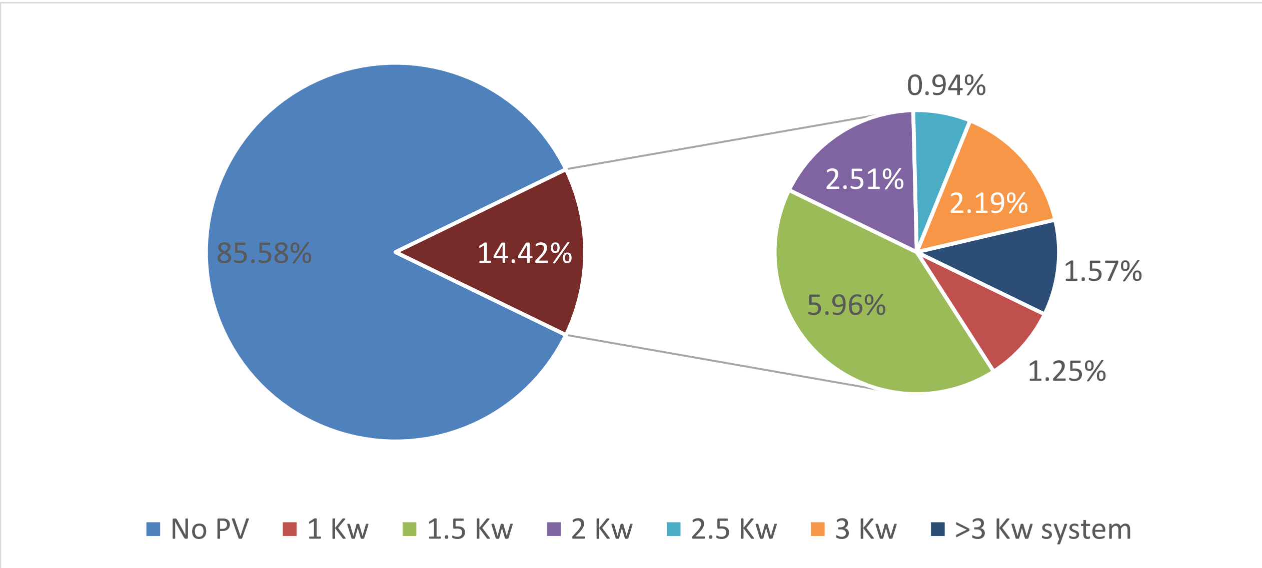


Figure 39: PV systems installed

3.3 Impact on air exchange rate/draughtiness

Draught testing was done at 60 randomly selected homes that were designated to receive retrofit interventions. Prior to interventions, these homes had average air exchange rate of 21.5 exchanges per hour per cubic metre at 50 Pascals of air pressure (ACH $m^3/hr/m^3$@ 50pa) (Figure 40). 34 of these homes were identified as being relatively less suitable/practical to draught seal within the allowable budget and these homes had an average air exchange rate of 20.6 ACH $m^3/hr/m^3$.

The 26 homes that were practical to draught seal within the budget had a pre-intervention average ACH of 22.6 $m^3/hr/m^3$. These 26 homes were draught sealed and then retested for draughtiness and they had an average ACH of 16.2 $m^3/hr/m^3$, a decrease of 28% (Figure 40).

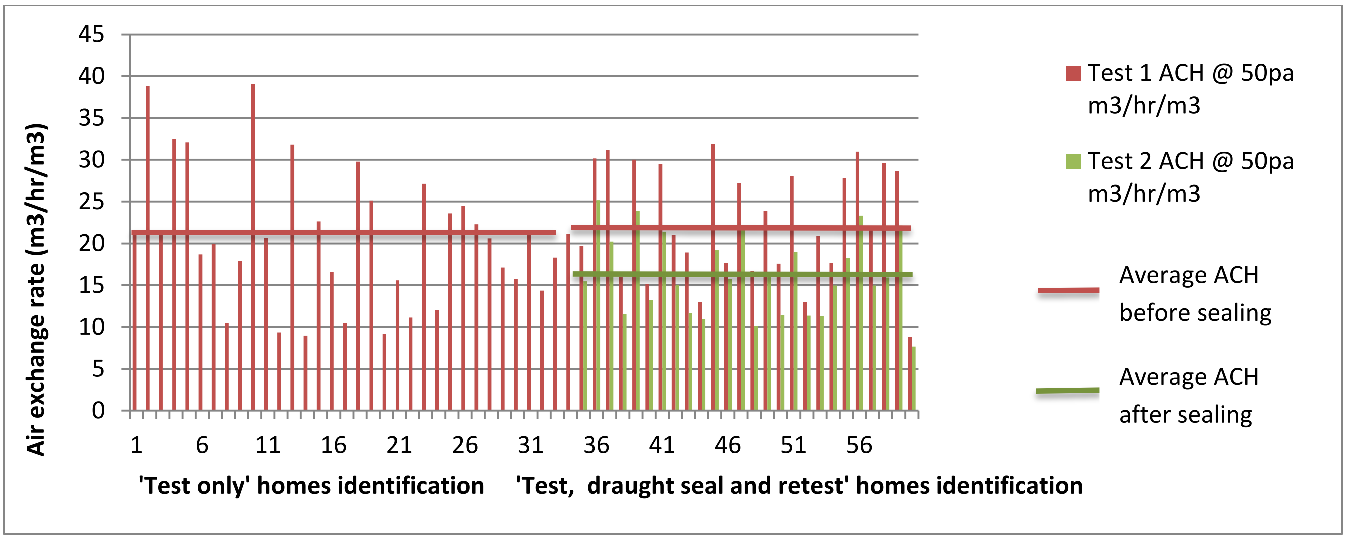


Figure 40: Air exchange rates of 60 homes before draught sealing and at 26 of these homes after draught sealing, noting average air exchange rates/hr are 28% less after draught sealing

3.4 Monitored Energy use

The average total energy use/day was 38.5 kWh/day for the 120 homes with energy monitoring equipment installed (Figure 41) with increases in consumption in the winter periods.

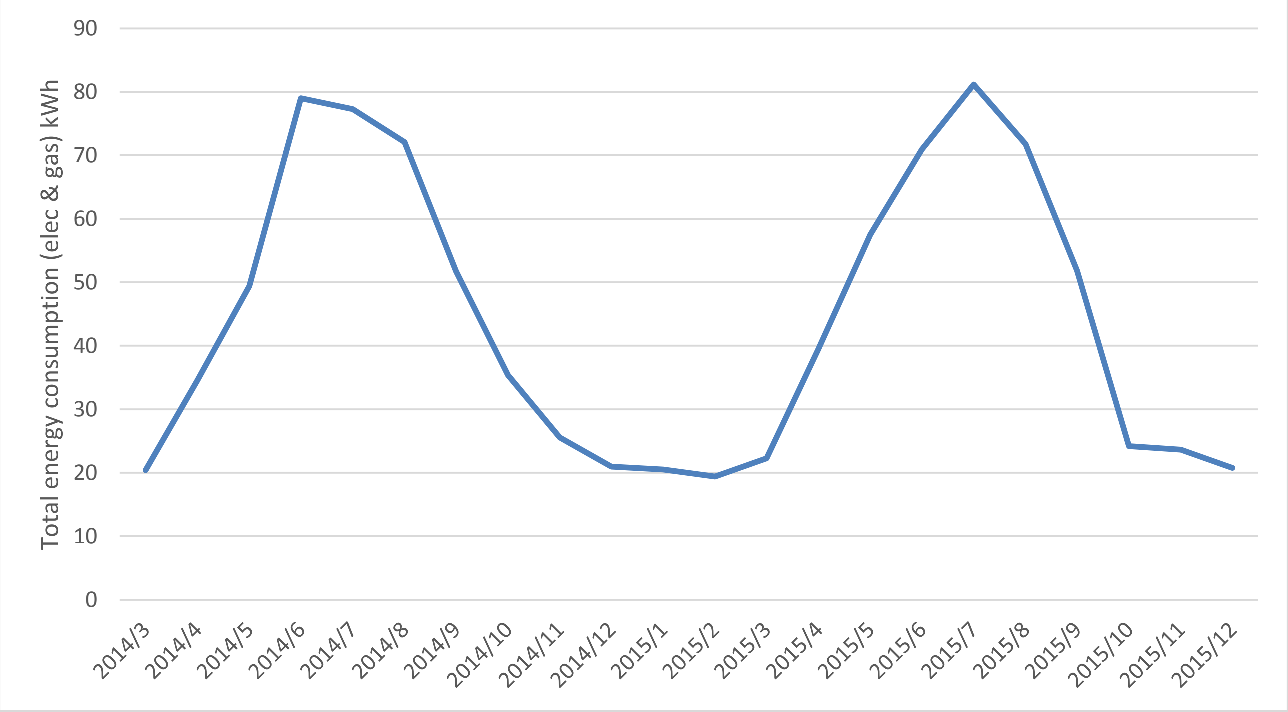


Figure 41: Average daily total energy consumption (electricity and gas) by month and year (kWh) (calculated using monitored data)

Gas consumption dominates the total daily energy profile, especially during the winter months. Over the monitoring period average daily energy consumption was 44.1kWh, but during winter the average daily was 75.4kWh of which gas consumption contributed about 90% of the total. Over the summer months when gas air heating is not being used the average daily energy consumption was only 20.4kWh.

Daily electricity use averages were 11.8 kWh/day and decreased slightly during the study period (Figure 42). Peak use is typically over winter due to heating and a mini-peak in use occurs during January-February each year due to cooling appliances.

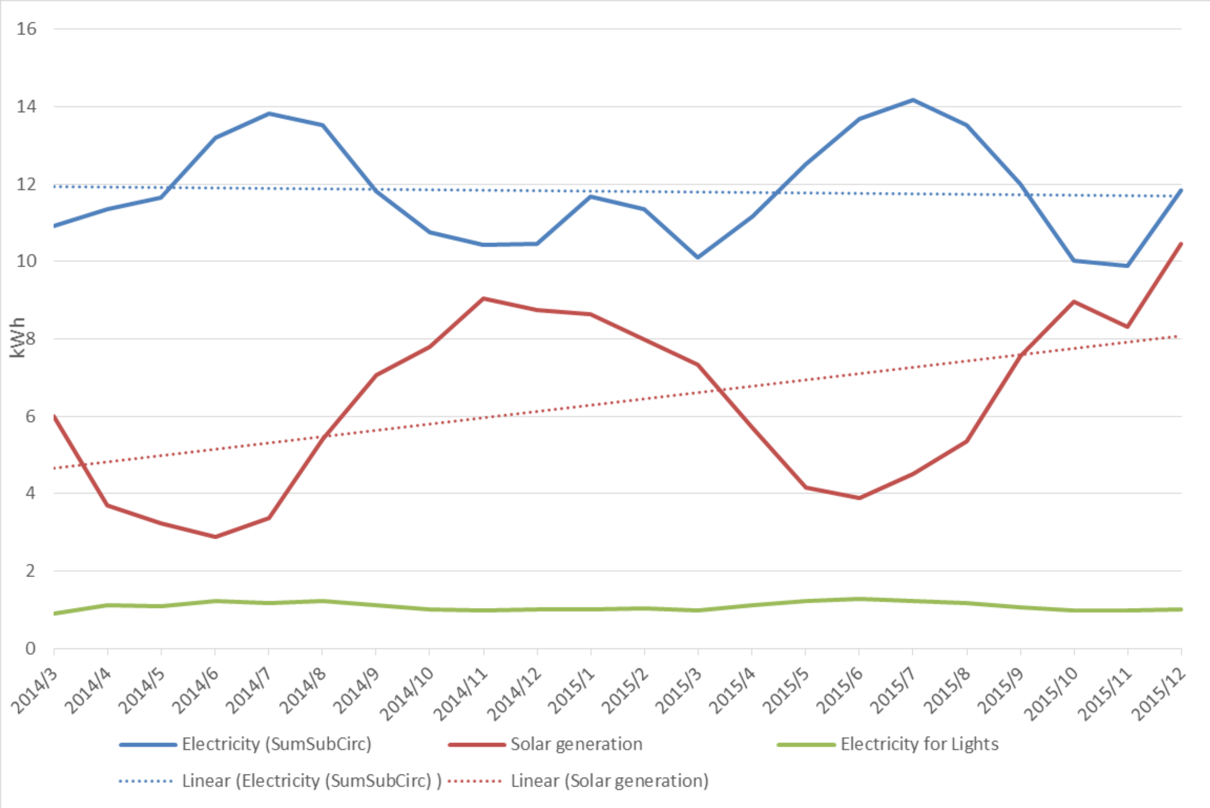


Figure 42: Monitored data average daily electricity consumption and generation by month and year

Gas use averaged at 127.7 MJ/day over the monitoring period, but it was highly variable depending on the time of the year. Over the winter months consumption averaged 243.6 MJ/day, while during the summer months consumption averaged 36.6 MJ/day.

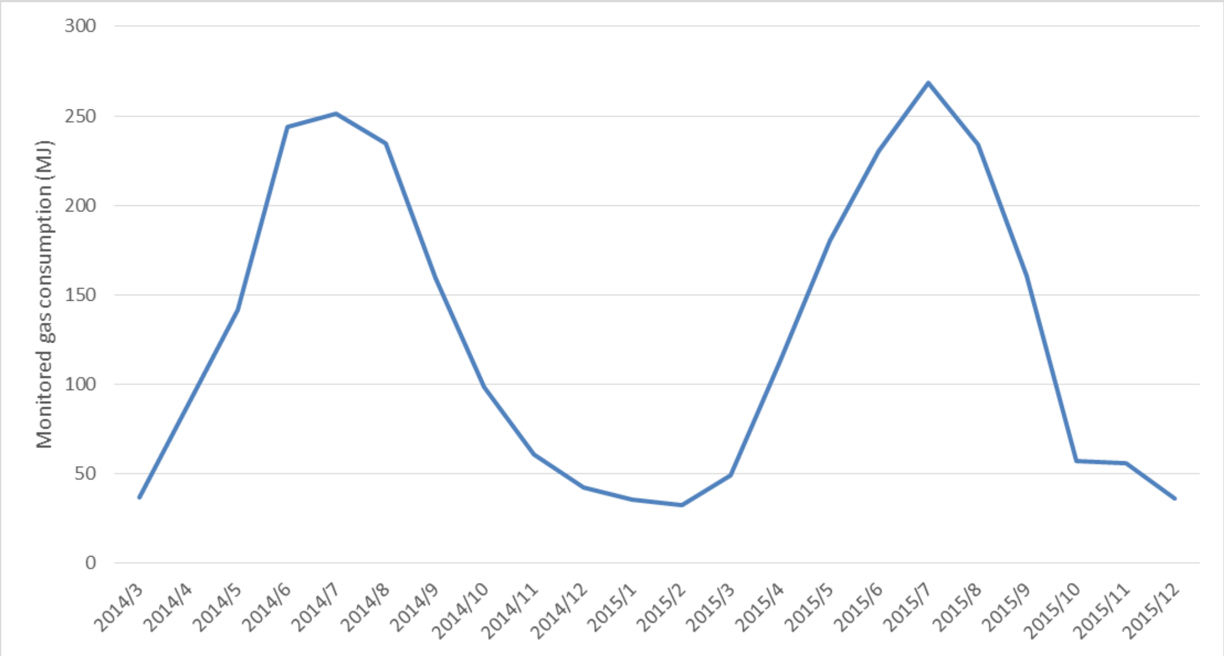


Figure 43: Monitored data average daily gas consumption by month and year (MJ)

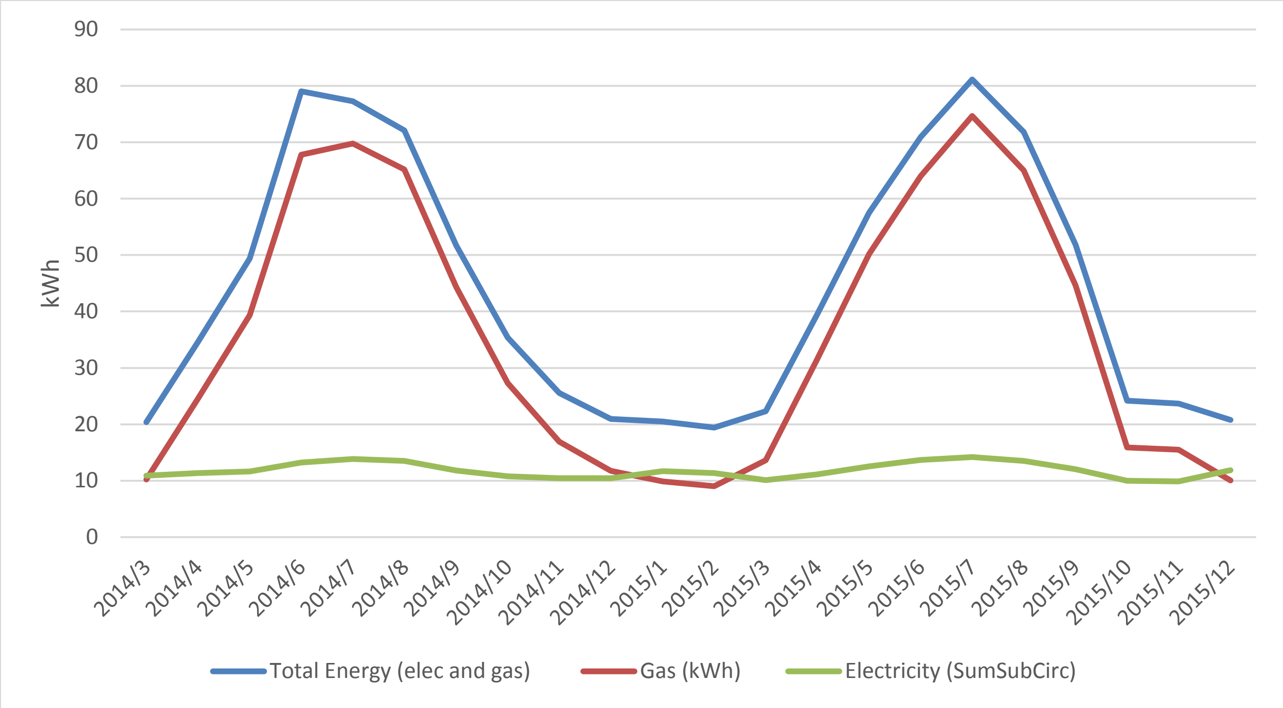


Figure 44: Average daily total energy consumption (electricity and gas) by month and year (kWh) (calculated using monitored data), and compared against electricity and gas consumption

At first glance it may appear that the dominance of gas consumption means that an all-electric house may be cheaper to run and more energy efficient. Certainly in energy terms an all-electric house would consume less kWh/day than a gas and electric house, but in cost this may not be the case. On a kWh basis gas costs 0.5 cents/kWh, whereas electricity costs 29 cents/kWh. In terms of greenhouse gas emissions, electricity in Victoria produces 1.26kg CO_2e/kWh compared to 0.20kg CO_2e/kWh for gas (Department of Environment, 2015).

3.5 Electricity data – smart meter

Electricity smart meters provide half hourly data on consumption from the grid and export to the grid if the house has a PV array. Figure 45 shows the average daily consumption and generation profiles over the years for those houses for which smart meter data was available. For the period it shows that the average daily consumption was 11kWh, but over the years the trend has seen a slight decline in the amount of electricity taken from the grid. In contrast, electricity that has been generated by rooftop solar PV systems and exported to the grid has increased over the period. On average, PV export has been around 3.7kWh/day. Increases in grid electricity are matched by a decrease in the amount of PV electricity that is exported to the grid. The amount that a PV array can generate decreases over the winter months due to a decrease in available sunshine and this decrease is offset by an increase in grid sourced electricity.

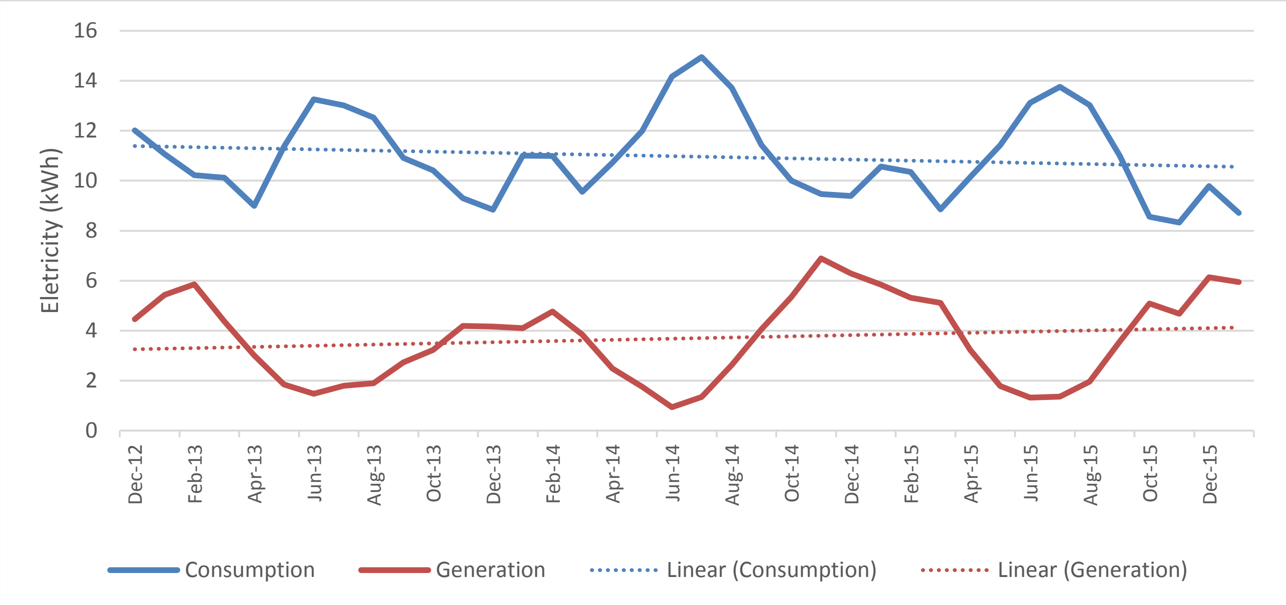


Figure 45: Smart meter average daily electricity consumption and generation by month and year

Figure 46 shows the average daily consumption profile for houses with PV arrays and those without as well as all the houses combined. It shows that generally the houses with a PV array take less electricity from the grid than houses that don't have a PV array and that this gap becomes more obvious in the summer months when the PV arrays are producing close to capacity. The initial higher consumption values being shown for the houses with PV systems is probably due to the PV systems not being installed until later in the data period. It would appear that by December 2013 all houses in the study that were identified as having a PV system actually had the system installed.

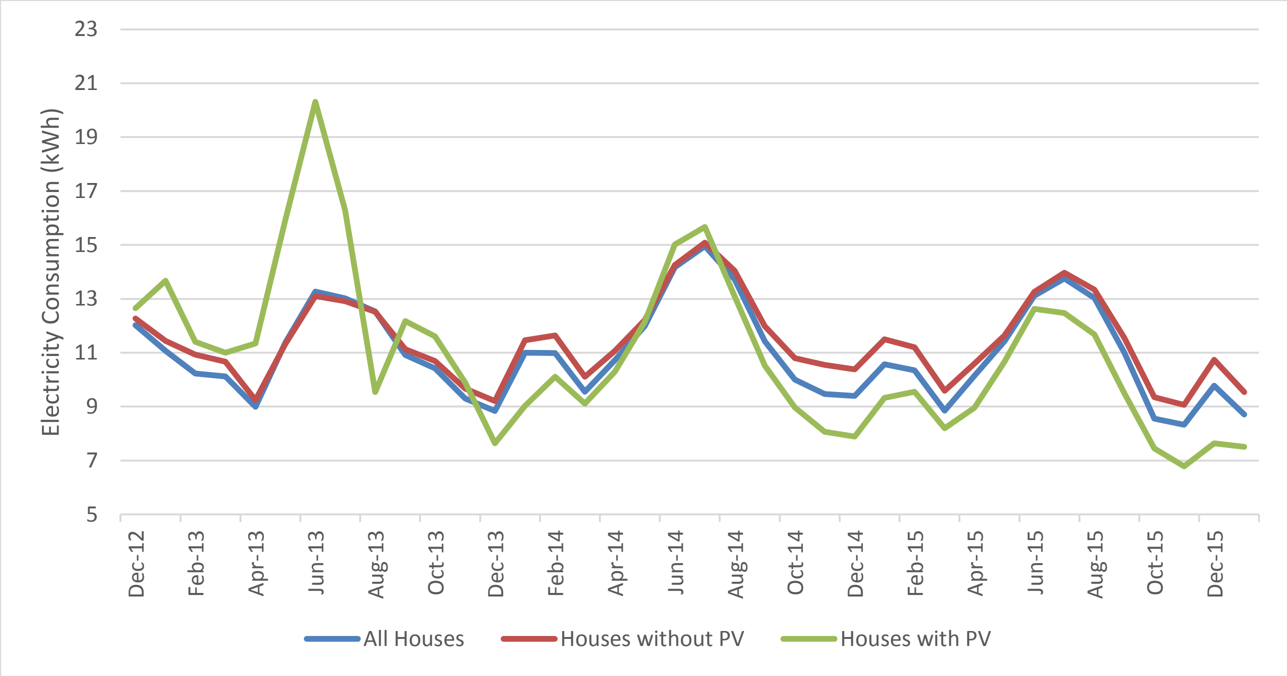


Figure 46: Average daily electricity consumption by PV system

The houses without PV averaged 11.4kWh/day compared to the average for all houses of 11kWh/day. This consumption rate is lower than the average rate of 15.2kWh/day that was reported in the Victorian Utility Consumption Survey (Roy Morgan Research, 2008) and very close to the 11.1kWh/day reported in the Electricity Bills Benchmark report (Acil Allen Consulting, 2015). It is interesting to note too that the Victorian Utility Consumption Survey also reported the average consumption for houses occupied by aged concession card holders which would be very similar in profile to the houses in this study. For these houses the reported consumption rate was 12.8kWh/day.

3.6 Natural gas consumption - billing

Gas consumption data was only available as billing data and consequently it was usually consumption over a period of 3 months. For analysis we determined the number of days in each billing cycle and then divided the total consumption by the number of days to calculate an average daily consumption value. In Victoria, gas consumption is primarily used for hot water heating and air heating in the winter months. Figure 47 shows the average daily natural gas consumption by month. It clearly shows the seasonal nature of gas consumption with the winter daily consumption averaging around 250MJ/day compared with the average summer daily consumption of 40MJ/day.

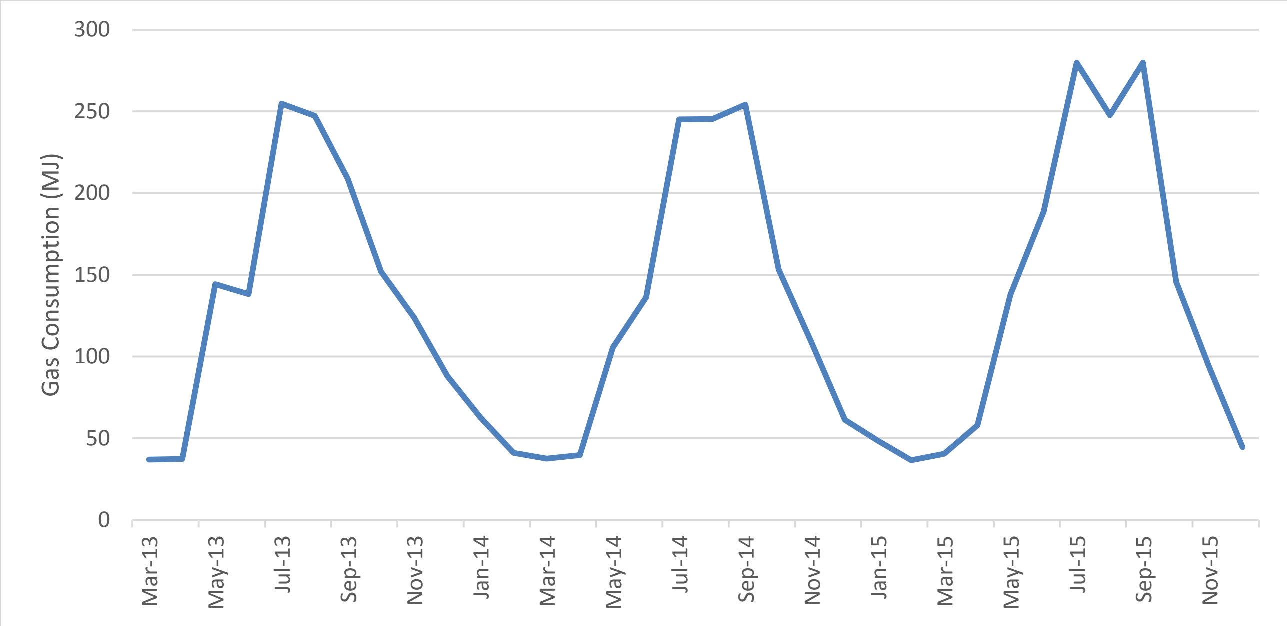


Figure 47: Average daily natural gas consumption by month and year

3.7 Comparison between monitored and distributor data

Average daily electricity and gas use data from monitored and distributor data was very similar as can be seen from Figure 48

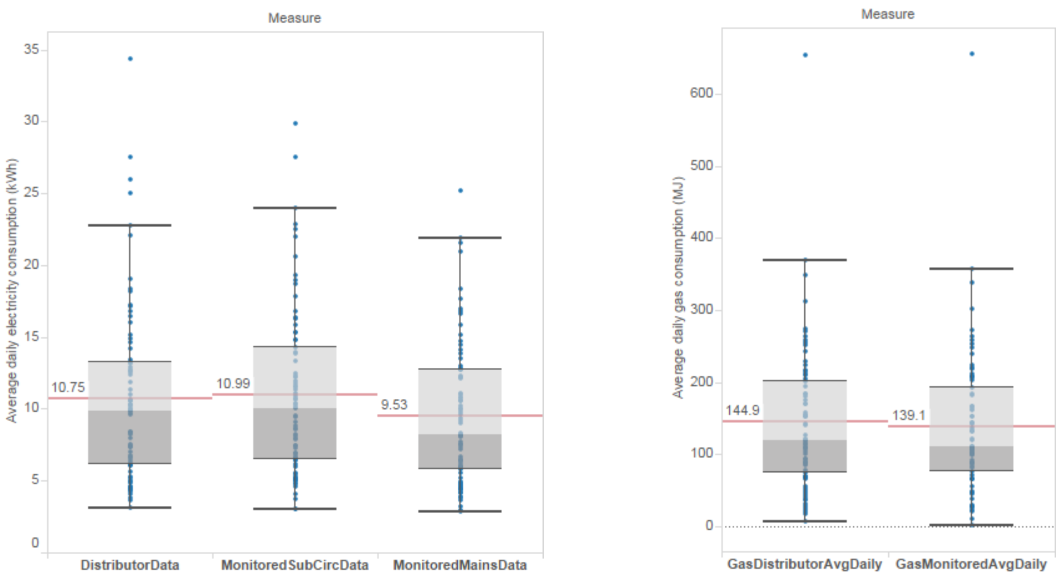


Figure 48: Comparison between monitored and distributor data for average daily electricity and gas use

3.8 Temperature

3.8.1 External temperatures

Figure 49 shows the average, maximum and minimum temperatures for each BoM station for each month from January 2014 to December 2015. It shows that the monthly average and maximum temperatures for each station followed very similar profiles. The highest average monthly temperature of 22°C was recorded at Nilma North in January 2014 while for the entire period the average temperature was 14.7°C. January 2014 also recorded the highest maximum temperature of 43.1°C at Moorabbin Airport. The average maximum temperature for the entire period was 28.2°C.

It is important to note the unusually high temperatures recorded in October 2015. Maximum temperatures for this month ranged from 29.9°C to 34.5°C and the average temperatures ranged from 15.0°C to 17.1°C. Comparison temperatures from October 2014 are around 2°C cooler with average temperatures ranging from 13.6°C to 15.0°C. October 2015 was one of the hottest Octobers on record and the temperature spike is reflected in the energy consumption for this month.

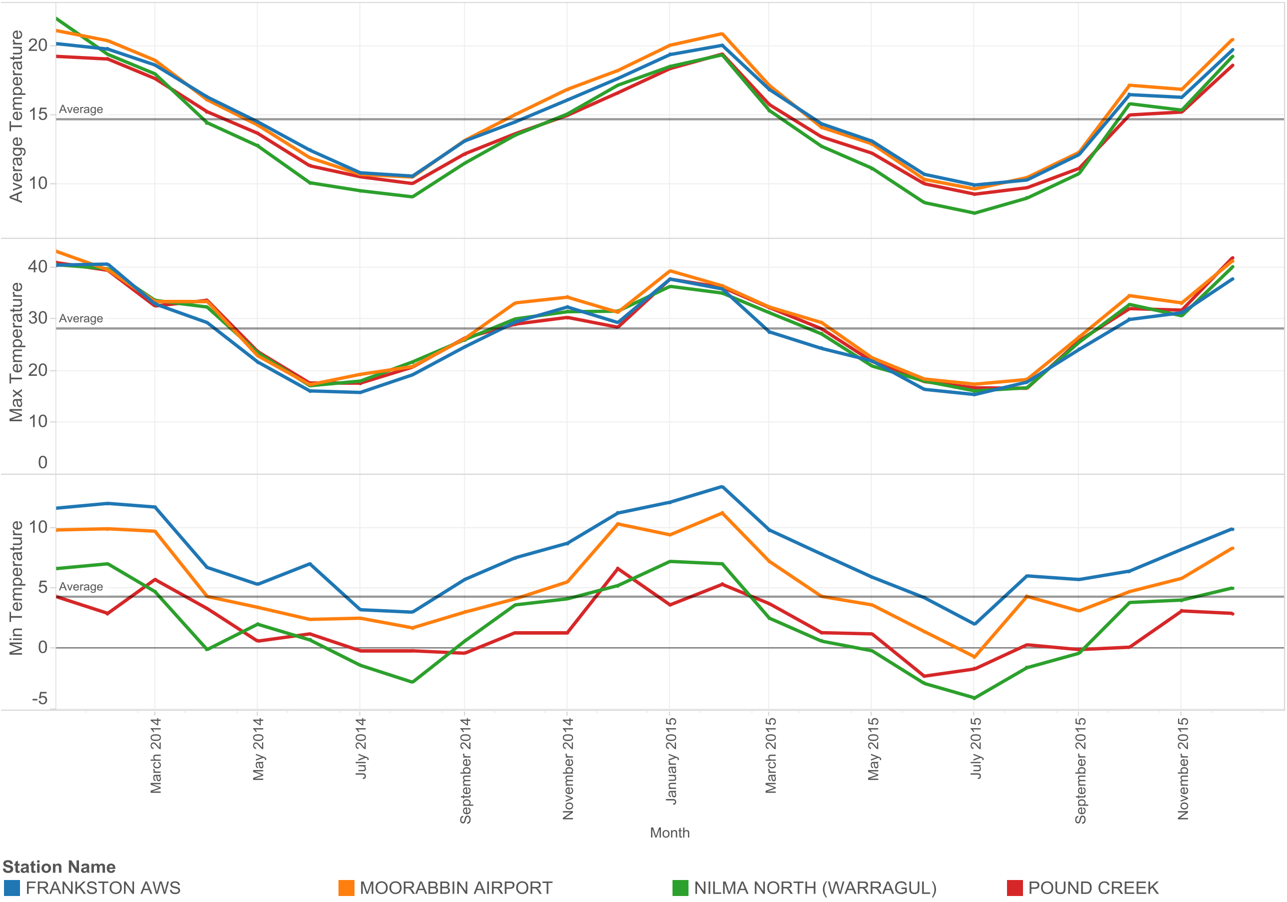


Figure 49: Monthly temperatures (°C) for BoM stations for 2014-2015

3.8.2 Internal temperatures

Figure 50 shows the average, average maximum and average minimum temperatures for all houses by the location of the temperature sensor. Generally bedrooms were slightly cooler than living rooms by up to a degree during the winter months. Over the study period the average internal temperature was 19.7°C for living areas and 19.3°C for bedrooms. The highest monthly average temperature was 23.2°C for February 2015.

Averaging the minimum and maximum temperatures recorded in each house also revealed the extremes experienced for each month. September 2014 to February 2015 saw an extended period of high maximum temperatures being experienced. Over this period each month had a maximum indoor temperature in excess of 30°C. In winter, the average minimums were not as extreme as the summer maximums. The coolest period was August 2014 where an average minimum of 10.1°C was recorded.

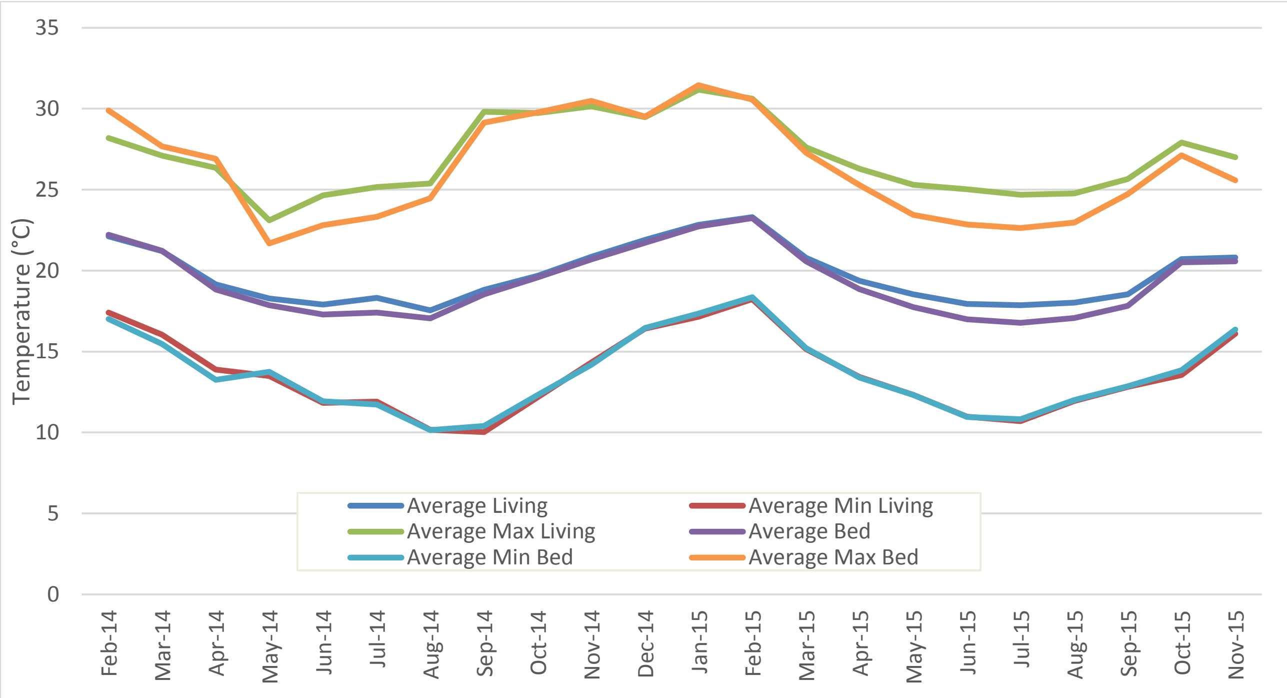


Figure 50: Monthly internal temperatures (°C) by location

3.9 Cost of interventions

Intervention costs varied from house to house (Figure 51), depending on what combination of interventions the house underwent. Retrofit interventions varied from $469 to $4,450 with a mean of $2,348. Behaviour change only interventions varied from $85 to $2,586 with a mean of $711. Retrofit combined with behaviour change interventions cost between $1,086 and $6,840 with a mean of $2,885.

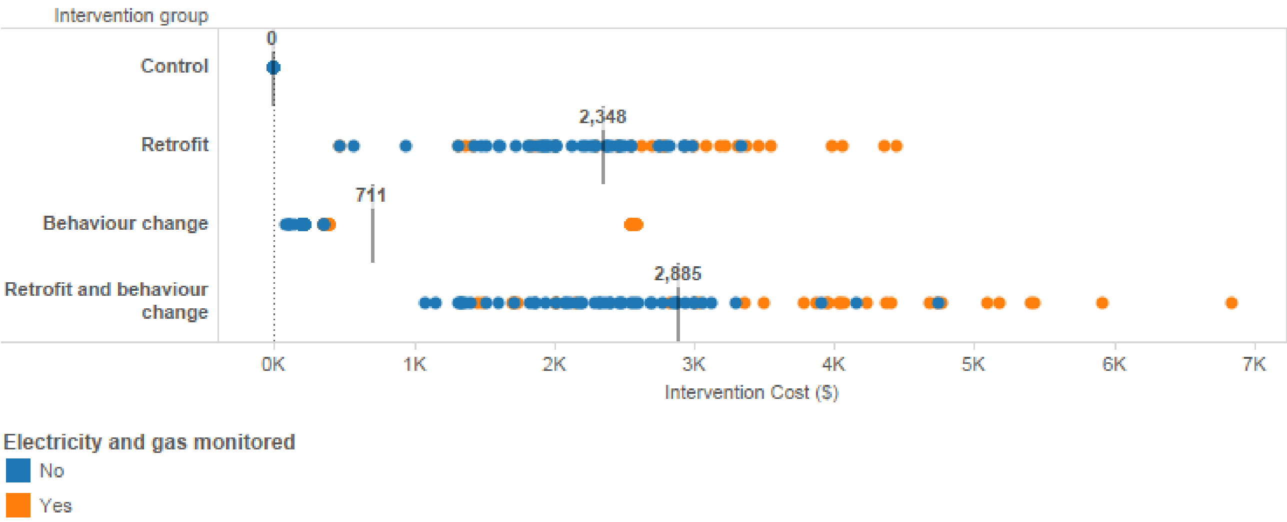


Figure 51: House intervention costs

Figure 52 shows the mean intervention costs for the intervention sub-groups (and separated into monitored or not monitored).

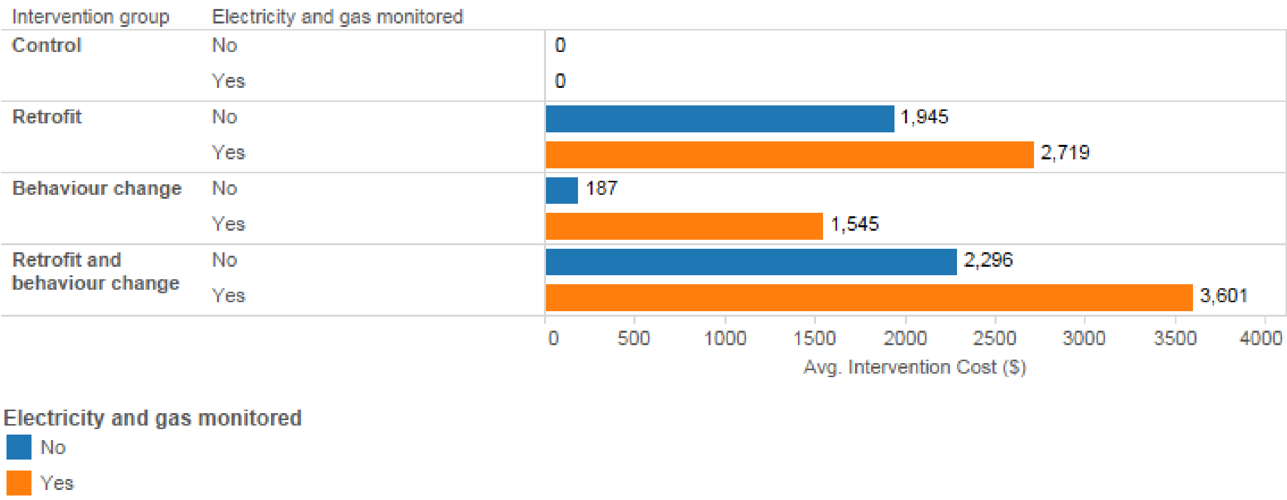


Figure 52: Intervention group average intervention cost

For houses which had LED lighting interventions, the mean cost of this intervention was $308.21 for the retrofit group and $212.18 for the retrofit and behaviour change group.

Table 7: Cost of LED lighting interventions

Study Group	Mean cost of house LED lighting interventions
Retrofit	$308.21
Retrofit and behaviour change	$212.18

Draught sealing at the 26 homes which were blower door/draught tested cost an average of $1673 per home. Some of these homes received draught sealing for as little as $400, whereas other homes received $2400 of draught sealing.

The building envelope retrofits at homes which were star rated and reassessed for their star ratings after retrofits cost an average of $2129 per home. The retrofit costs at these homes ranged from $901 to $3190.

From this data, the cost to increase the star rating of participating homes by 1 star averaged at $2661 per home.

3.9.1 Cost of providing the project at different levels

The costs to provide this project at 4 cost levels are provided in Table 8. Supply and install of home retrofits, plus home audits plus behaviour change support cost over $4000 per participant. Recruitment cost approximately $170 per participant and retention around $30 each. Running the project at an organisational level cost approximately $1.3 million dollars or nearly $4000 per participant over the 3 years and providing this project as a trial cost an additional $2 million, or over $18,000 per participant including in-kind contributions.

Table 8: Cost of providing this project at 4 cost levels, plus the cost:benefit ratios (taking into account 10 years of benefits)

Cost level	Cost level description	Cost ($)	Benefit/10 years ($)	Cost/benefit ratio
1	Direct trial approach i.e. delivery of the trial approach to a participant including: -Retrofit supply & install $2348 -Home audit $979 -Behaviour change & education coaching $711	4038	1642	2.5
2	Delivery of the trial approach to a participant **plus** recruitment and retention @ $198/participant	4236	1642	2.6
3	Delivery of the trial approach to a participant including recruitment and retention **plus** running the organisation to do the actions @ $3930/participant	8166	1642	5.0

4	Delivery of the trial approach to a participant including recruitment and retention and running the organisation **plus** participating in a government funded trial @ $10428 /participant	18594	1642	11.3

These costs are based on the facts/assumptions that:

- Participants all receive home retrofit and behaviour change support
- Benefits per year = $164.25 (derived from largest statistically significant $bill saving resulting from the intervention)
- Energy Liaison Officers cost $32 per hour plus 30% oncost (vehicle, desk, computer, superannuation etc) = $41.60/hour.
- Project management staff including coordinators, team leaders, administration costs = $50-55/hour
- Recruitment of participants takes approximately 1.75 hours each including background checks, applications, eligibility, engagement, visit to home and phone calls
- Retention of participants takes 45 minutes each during the project
- Running the organisation to support and facilitate the project cost $1,001,800 over the 3 years
- The extra costs to provide this program as a trial cost $1,958,600 for the 3 years
- In-kind contributions of $1.5 million were provided to the project

3.10 Retention of householders

This project retained 93% (or 299) of the 320 householders that were recruited to participate in the project at project end.

3.11 Data limitations

Ideally we would have a full year's worth of data pre-intervention and another full year's worth of data post-intervention. There were a number of reasons why this was not possible: the project started later and took longer 4 months longer to recruit householders than was originally planned; following on from this, later timing of interventions than originally planned; withdrawal of some volunteers before the end of the study period; and finally, earlier 'draft report' and final reporting deadlines than were in the project contract.

As the project did not have a full year's worth of data pre- and post-intervention, it was unable to calculate household average daily consumption over the year prior to intervention and then compare it against the household average daily consumption in the year after the intervention. Instead, we have used the available data to calculate average daily consumption for each month prior to intervention and again for each month after intervention. Only months where there was at least twenty days' worth of data were used. Where a house had pre- and post-intervention data for the same month (different year), the difference between the daily averages was calculated.

Although households received multiple interventions over a range of dates, the date of the first intervention was used as the dividing line between the pre-intervention period and the post-intervention period for each household. This was done in order to maximise the amount of data we could use for analysis. This may have resulted in the impact of interventions being greater in the later post-intervention months.

Some households had data covering more months than others. Due to this, the study group averages are weighted towards the houses and months where there was more data (Figure 53). There is no change data for January or February for any households, and there is data for only one household for March. This data limitation means that the impact of interventions on summer energy use is not properly gauged by this study and that the results are weighted to indicate winter outcomes.

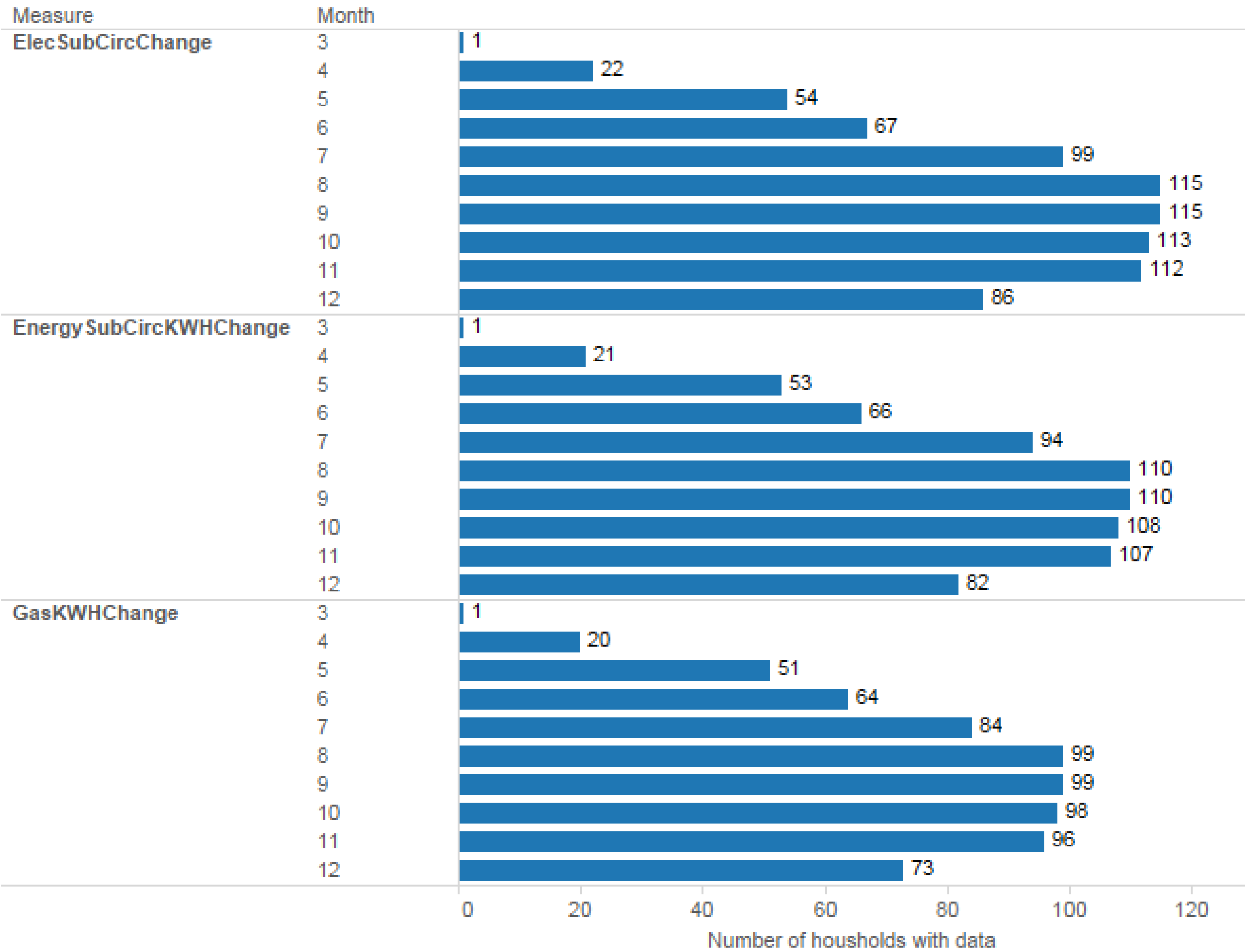


Figure 53: Number of households for which change data was available for each month

3.12 Intervention Impacts

3.12.1 Impact on energy consumption (monitored households)

The mean change in average daily energy consumption varies between study groups. For total energy, the mean change in average daily consumption was +0.05 kWh for houses in the control group, +1.70 kWh for houses which underwent retrofit, -0.95 kWh for houses which underwent behaviour change, and -4.31 kWh for houses which underwent a combination of retrofit and behaviour change. Thus, relative to the control group, retrofit houses had a mean change of +1.65 kWh, behaviour change houses had a mean change of

-1.00 kWh, and retrofit & behaviour change houses had a mean change of -4.36 kWh (Table 9).

Table 9: Intervention group change in average daily energy consumption relative to control group. Values marked with an asterisk (*) were statistically significant at the 0.95 level.

Intervention group	Change in average daily energy consumption relative to control group (kWh)		
	Total energy	Electricity	Gas
Retrofit	1.65	-0.82	2.28
Behaviour change	-1.00	-0.41	-0.91
Retrofit & behaviour change	-4.36*	-0.39	-4.80*

By comparing the changes in average daily energy consumption against the levels of consumption pre-intervention (Table 10) we can see that the retrofit and behaviour change intervention led to a saving of 10.0% in energy consumption, and a saving of 13.1% in gas consumption over the period of the analysis.

Table 10: Household average daily energy consumption pre-intervention and post-intervention (kWh)

Intervention Group	EnergySubCircKWH		ElecSubCirc		GasKWH	
	Pre-intervention	post-intervention	pre-intervention	post-intervention	pre-intervention	post-intervention
control	55.68	55.73	12.65	12.99	47.78	47.70
retrofit	50.43	52.13	12.68	12.19	39.20	41.40
behaviour change	51.62	50.40	10.88	10.80	45.19	43.92
retrofit & behaviour change	43.83	39.52	12.33	12.28	36.59	31.71

3.12.2 Impact on energy bills (monitored households)

The savings (or additional expenditure) on daily energy bills (Figure 55) associated with the change in energy consumption varied from house month to house month. The mean change in total daily energy bills was +3 cents for the control group, +1 cent for the retrofit group, -8 cents for the behaviour change group, and -30 cents for the combined retrofit/behaviour change group. Thus, relative to the control group, the retrofit group had a mean daily change of -2 cents, the behaviour change group had a mean change of -11 cents, and the combined retrofit/behaviour change group had a mean change of -33 cents. Changes in daily energy bills associated with electricity and gas consumption separately are shown in Figure 54, Figure 55 and Table 11. Only the change in gas bills for the combined retrofit/behaviour change group was statistically significant.

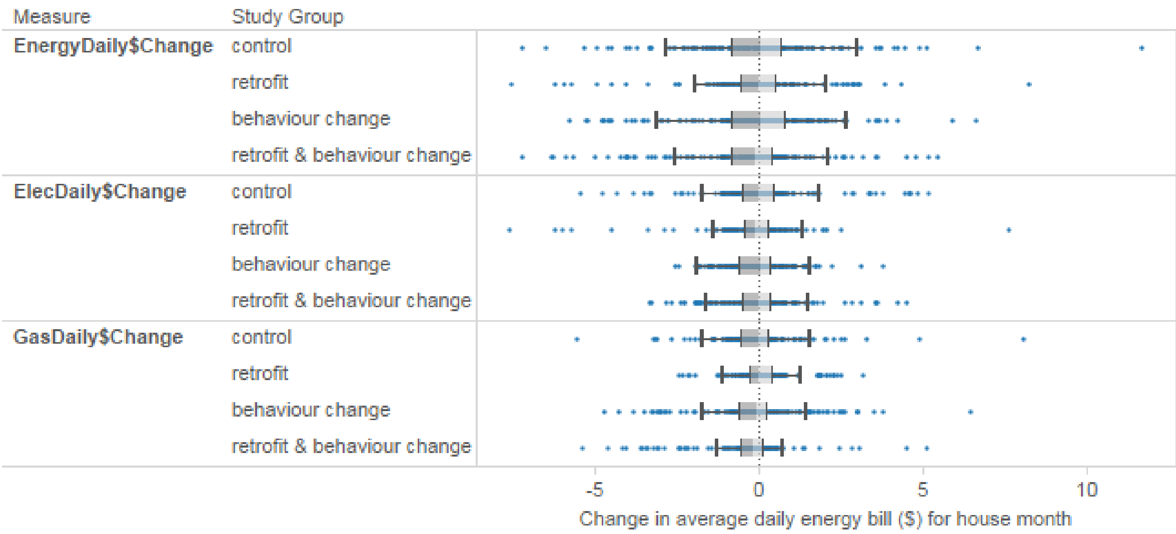


Figure 54: Change in average daily energy bills for house months (using monitored data, and sum of sub circuits for electricity)

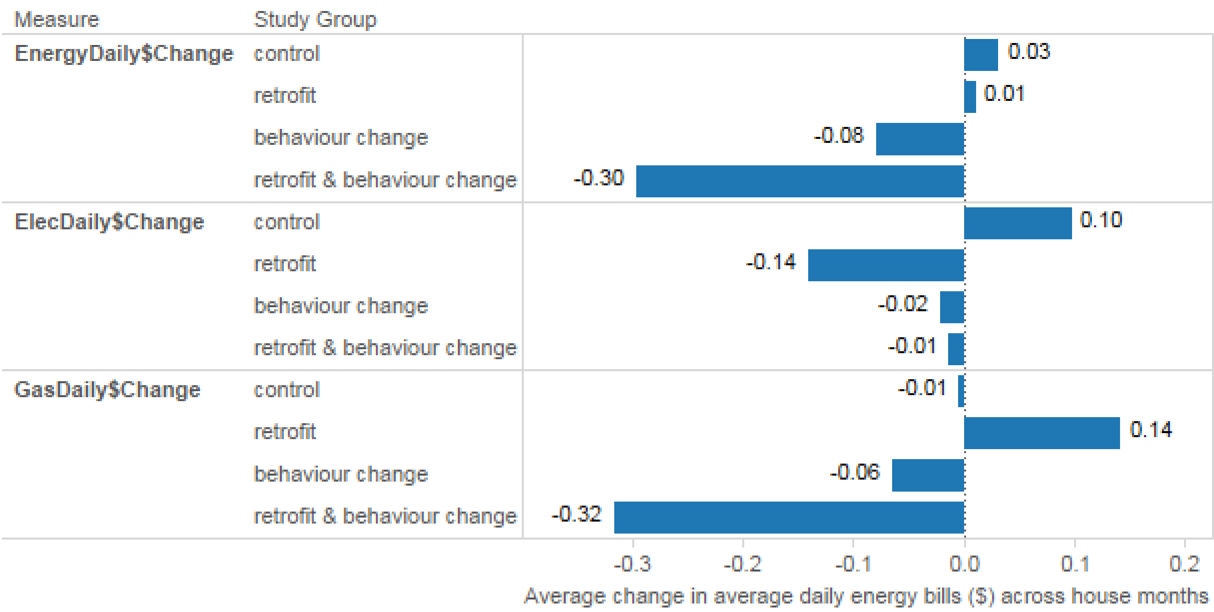


Figure 55: Mean change in average daily energy bills for houses in each study group (using monitored data, and sum of sub circuits for electricity)

Table 11: Intervention group change in average daily energy bills relative to control group

Intervention group	Change in average daily energy bills relative to control group ($)		
	For total energy	For electricity	For gas
Retrofit	-0.02	-0.24	0.15
Behaviour change	-0.11	-0.12	-0.59
Retrofit & behaviour change	-0.33	-0.11	-0.31*

By comparing the changes in average daily energy bills against the costs associated with gas consumption pre-intervention (Table 12) we can see that the retrofit and behaviour change intervention led to a saving of 13.1% in costs for gas consumption.

Table 12: Household average daily spend on energy consumption pre-intervention and post-intervention ($)

Intervention Group	EnergySubCirc$		ElecSubCirc$		Gas$	
	Pre-intervention	post-intervention	pre-intervention	post-intervention	pre-intervention	post-intervention
control	6.38	6.41	3.67	3.77	3.09	3.09
retrofit	6.04	6.05	3.68	3.54	2.54	2.68
behaviour change	5.80	5.70	3.15	3.13	2.93	2.84
retrofit & behaviour change	5.57	5.27	3.58	3.56	2.37	2.05

3.12.3 Impact on Greenhouse gas emissions (monitored households)

Table 13 show the changes in average daily greenhouse gas emissions for houses in each study group. Only the change in greenhouse gas emissions due to gas consumption for the combined retrofit/behaviour change group was statistically significant, with a mean daily savings of 0.95 kg CO2-e, when compared against the control group.

Table 13: Intervention group change in average daily GHG emissions relative to control group

Intervention group	Change in average daily GHG emissions relative to control group (kgCO_2-e)		
	For total energy	For electricity	For gas
Retrofit	-0.27	-1.03	0.46
Behaviour change	-0.42	-0.51	-0.18
Retrofit & behaviour change	-1.09	-0.48	-0.95*

By comparing the changes in average daily GHG emissions against the GHG emissions associated with gas consumption pre-intervention (Table 14) we can see that the retrofit and behaviour change intervention led to a saving of 13.0% in GHG emissions for gas consumption.

Table 14: Household average daily GHG emissions for energy consumption pre-intervention and post-intervention (kg CO_2-e)

Intervention Group	EnergySubCircKgCO_2		ElecSubCircKgCO_2		GasKgCO_2	
	Pre-intervention	post-intervention	pre-intervention	post-intervention	pre-intervention	post-intervention
control	24.16	24.31	15.94	16.37	9.53	9.51
retrofit	23.12	22.99	15.97	15.36	7.82	8.25
behaviour change	21.86	21.51	13.71	13.61	9.01	8.76
retrofit & behaviour change	21.59	20.65	15.54	15.48	7.30	6.32

3.12.4 Impacts on householder comfort (monitored households)

The change in indoor temperature in winter months was statistically significant for both the combined retrofit/behaviour change group (+1.61 °C) and the retrofit only group (+1.9 °C), when compared against the control group.

Figure 56 andTable 15 show the changes in household comfort as measured by average daily temperature in living rooms during the winter months. The change in temperature was statistically significant for both the combined retrofit/behaviour change group (+1.61 °C) and the retrofit only group (+1.9 °C), when compared against the control group.

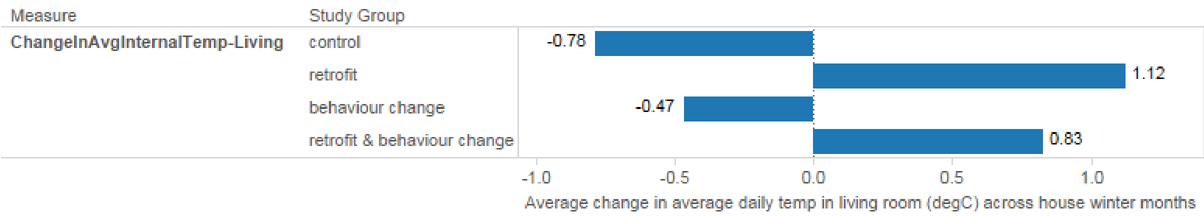


Figure 56: Mean change in average daily temperature in living room for houses in each study group during winter months (using monitored data, and sum of sub circuits for electricity)

Table 15: Intervention group change in average daily temperature in living room during winter months relative to control group

Intervention group	Change in average daily temperature in living room during winter months relative to control group (°C)
Retrofit	+1.9*
Behaviour change	+0.31
Retrofit & behaviour change	+1.61*

Table 16: Household average daily temperature in living room during winter months pre-intervention and post-intervention

Intervention Group	AverageTemp-Living for winter months (°C)	
	Pre-intervention	Post-intervention
control	17.47	16.68
retrofit	17.43	18.55
behaviour change	18.32	17.85
retrofit & behaviour change	17.54	18.37

By comparing the changes in temperature against the average daily temperature in the living room during winter months pre-intervention (Table 16) we can see that the retrofit only intervention led to a 10.9% increase in average daily temperature, and the retrofit and behaviour change intervention led to an increase of 9.2%.

3.12.5 Impact of LED lighting intervention (monitored households)

The electricity monitoring equipment in the houses measured consumption at the circuit level. This allowed examination separately the part of the electricity consumption that was used for lighting and enabled investigation into the impact of LED lighting retrofit interventions. The following analysis uses all monitored houses from the control and behaviour change groups, but only those monitored houses in the retrofit and combined retrofit/behaviour change groups that received LED lighting retrofit interventions.

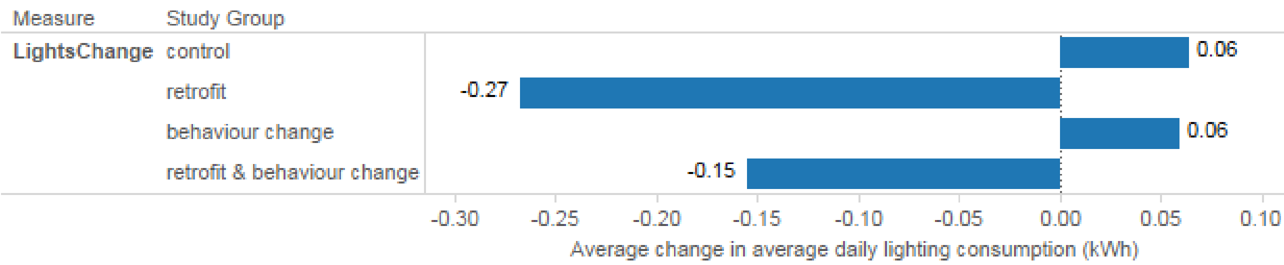


Figure 57: Mean change in average daily consumption of electricity for lighting for houses in each study group (using sum of monitored light circuits)

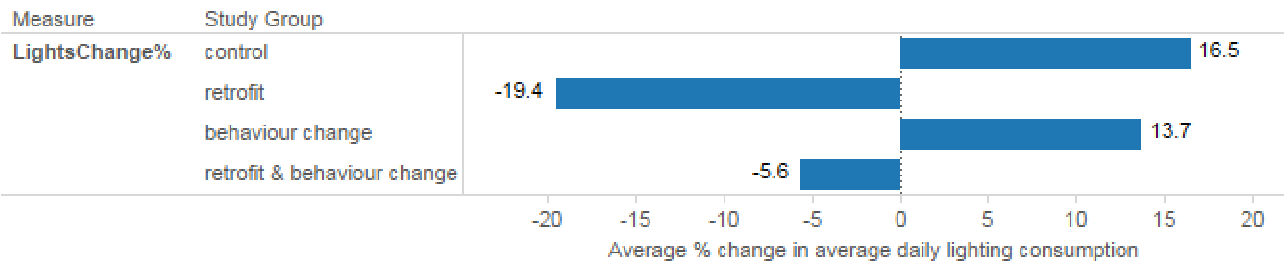


Figure 58: Mean percentage change in average daily consumption of electricity for lighting for houses in each study group (using sum of monitored light circuits)

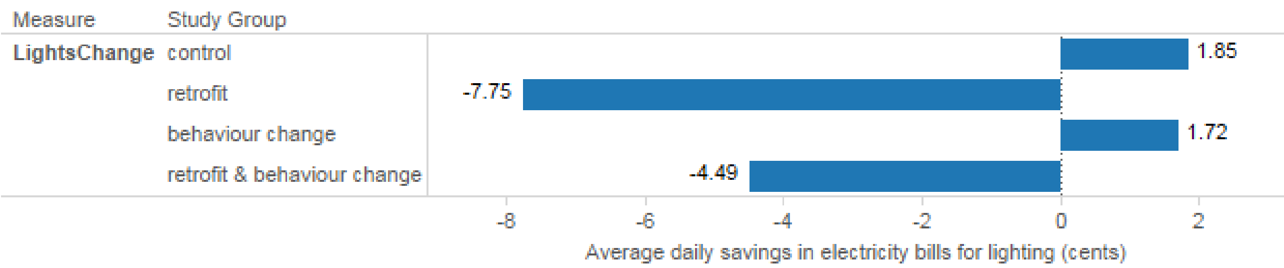


Figure 59: Mean change in average daily electricity bills for electricity consumed for lighting for houses in each study group

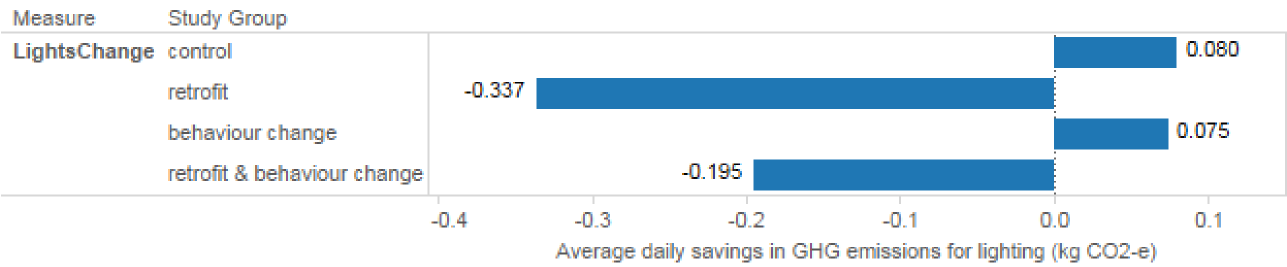


Figure 60: Mean change in average daily greenhouse gas emissions for electricity consumed for lighting for houses in each study group

Table 17: Intervention group changes in average daily electricity consumption, daily bills, and GHG emissions associated with lighting, relative to the control group

Intervention group	For lighting component of electricity consumption, relative to control group			
	Change in average daily electricity consumption (kWh)	Change in average daily electricity consumption (%)	Change in average daily electricity bills (cents)	Change in average daily GHG emissions (kg CO_2-e)
Retrofit	-0.33*	-35.9*	-9.5*	-0.42*
Behaviour change	0	-2.7	-0.1	-0.01
Retrofit & behaviour change	-0.21*	-22.1*	-6.3*	-0.28*

Households which underwent retrofit only interventions and which received LED lighting interventions made a mean saving in their average daily electricity consumption for lighting of 0.33 kWh, a mean percentage saving in their daily electricity consumption for lighting of 35.9%, a mean saving in their average daily electricity bills for lighting of 9.5 cents ($34.60/yr), and a mean saving in their average daily GHG emissions for lighting of 0.42 kg CO_2-e.

3.12.6 Impact on energy consumption (distributor data)

Relative to the control group retrofit houses had a mean change in their daily total energy consumption of -3.78* kWh, behaviour change houses had a mean change of -2.69 kWh, and retrofit & behaviour change houses had a mean change of -4.80* kWh. Looking at electricity only, relative to the control group, retrofit houses had a mean change of -1.05 kWh, behaviour change houses had a mean change of -0.77 kWh, and retrofit & behaviour change houses had a mean change of -0.15 kWh. Looking at gas only, relative to the control group, retrofit houses had a mean change of -2.54 kWh, behaviour change houses had a mean change of -3.25 kWh, and retrofit & behaviour change houses had a mean change of -7.01* kWh.

When tested for statistical significance (at the 0.95 level) using t-tests, the retrofit and behavioiur change group showed a change in total energy consumption which was statistically significant, and also in gas consumption. The retrofit group showed a change in total energy consumption which was statistically significant, but the change in gas consumption was not. None of the intervention groups showed a statistically significant change in electricity consumption by itself.

By comparing the changes in average daily energy consumption against the levels of consumption pre-intervention (Table 19) we can see that the retrofit and behaviour change intervention led to a saving of 11.4% in energy consumption, and a saving of 18.5% in gas consumption over the period of the analysis. The retrofit only intervention led to a saving of 7.1% in energy consumption.

Table 18: Intervention group change in average daily energy consumption relative to control group – using distributor data

Intervention group	Change in average daily energy consumption relative to control group [with 95%CI if difference is statistically significant] (kWh)		
	Total energy	**Electricity**	**Gas**
Retrofit	-3.78* [-7.24, -0.32]	-1.05	-2.54
Behaviour change	-2.69	-0.77	-3.25
Retrofit & behaviour change	-4.80* [-8.07, -1.53]	-0.15	-7.01* [-10.91, -3.11]

Table 19: Household average daily energy consumption pre-intervention and post-intervention (kWh) – using distributor data

Intervention Group	Energy		Electricity		Gas	
	Pre-intervention	**post-intervention**	**pre-intervention**	**post-intervention**	**pre-intervention**	**post-intervention**
control	50.38	54.08	12.61	11.48	44.37	53.05
retrofit	53.51	59.37	11.95	9.76	42.48	51.81
behaviour change	50.49	56.12	12.32	10.41	44.25	56.00
retrofit & behaviour change	42.02	42.90	10.48	9.20	37.81	42.66

3.12.7 Impact on energy bills (distributor data)

Relative to the control group, retrofit houses had a mean change in their daily total energy bills of -86.6 cents, behaviour change houses had a mean change of -36.7 cents, and retrofit & behaviour change houses had a mean change of -31.1 cents. Looking at electricity only, relative to the control group, retrofit houses had a mean change of -30.6 cents, behaviour change houses had a mean change of -22.3 cents, and retrofit & behaviour change houses had a mean change of -4.4 cents. Looking at gas only, relative to the control group, retrofit houses had a mean change of -16.5 cents, behaviour change houses had a mean change of -21.1 cents, and retrofit & behaviour change houses had a mean change of -45.4 cents.

When tested for statistical significance (at the 0.95 level) using t-tests, the retrofit only group showed a change in total energy bills which was statistically significant. The retrofit and behaviour change group showed a change in gas bills which was statistically significant.

Retrofit intervention led to a saving of 14.1% in costs for energy consumption. The retrofit and behaviour change intervention led to a saving of 18.6% in costs for gas consumption.

Table 20: Intervention group change in average daily energy bills relative to control group – using distributor data

Intervention group	Change in average daily energy bills relative to control group [with 95%CI if difference is statistically significant] ($)		
	Total energy	Electricity	Gas
Retrofit	-0.866* [-1.545,-0.187]	-0.306	-0.165
Behaviour change	-0.367	-0.223	-0.211
Retrofit & behaviour change	-0.311	-0.044	-0.454* [-0.706,-0.201]

Table 21: Household average daily energy bills pre-intervention and post-intervention ($) – using distributor data

Intervention Group	Energy		Electricity		Gas	
	Pre-intervention	post-intervention	pre-intervention	post-intervention	pre-intervention	post-intervention
control	6.068	6.047	3.657	3.329	2.873	3.435
retrofit	6.143	5.861	3.465	2.831	2.750	3.355
behaviour change	6.185	6.160	3.572	3.020	2.865	3.626
retrofit & behaviour change	5.089	4.904	3.040	2.668	2.448	2.762

Households which underwent a combination of retrofit and behaviour change interventions made a mean saving in their daily gas bill of $0.45 ($164/yr), or 18.6%.

Households which underwent retrofit only interventions made a mean saving in their daily total energy bill of $0.87 ($318/yr), or 14.1%.

3.12.8 Impact on greenhouse gas emissions (distributor data)

The change in in average daily greenhouse gas emissions due to gas consumption was statistically significant for the combined retrofit/behaviour change group, with a mean daily savings of 1.39 kg CO_2-e, when compared against the control group. The change in average daily greenhouse gas emissions due to total energy consumption was statistically significant for the retrofit only group, with a mean daily saving of 3.84 kg CO_2-e, when compared against the control group. No other results for changes in greenhouse gas emissions were statistically significant.

Table 22: Intervention group change in average daily GHG emissions relative to control group – using distributor data

Intervention group	Change in average daily GHG emissions relative to control group (kgCO2-e)		
	For total energy	For electricity	For gas
Retrofit	-3.84* [-6.73,-0.95]	-1.33	-0.51
Behaviour change	-1.60	-0.97	-0.65
Retrofit & behaviour change	-1.11	-0.19	-1.39* [-2.17,-0.62]

By comparing the changes in average daily GHG emissions against the GHG emissions associated with gas consumption pre-intervention (Table 23) we can see that the retrofit and behaviour change intervention led to a saving of 18.5% in GHG emissions for gas consumption, and the retrofit only intervention led to a saving of 16.5% in GHG emissions for total energy consumption.

Table 23: Household average daily GHG emissions for energy consumption pre-intervention and post-intervention (kg CO_2-e) – using distributor data

Intervention Group	EnergyDistKgCO2		ElecDistKgCO2		GasDistKgCO2	
	Pre-intervention	post-intervention	pre-intervention	post-intervention	pre-intervention	post-intervention
control	23.24	22.75	15.89	14.46	8.83	10.56
retrofit	23.27	21.32	15.06	12.30	8.45	10.31
behaviour change	23.79	23.07	15.52	13.12	8.80	11.14
retrofit & behaviour change	19.52	18.55	13.21	11.59	7.52	8.49

Households which underwent a combination of retrofit and behaviour change interventions made a mean saving in their greenhouse gas emissions due to gas consumption of 1.4 kg CO2-e, or 18.5%.

Households which underwent retrofit only interventions made a mean saving in their greenhouse gas emissions due to total energy consumption of 3.84 kg CO_2-e, or 16.5%.

3.12.9 Impact on householder comfort (for all houses with temperature data)

The change in average daily temperature in living rooms during the winter months was statistically significant for the retrofit only group (+0.96 °C), when compared against the control group.

There was insufficient summer data to be able to determine whether the interventions had an impact on indoor temperatures over the summer months.

Table 24: Intervention group change in average daily temperature in living room during winter months relative to control group – for all houses with temperature data

Intervention group	Change in average daily temperature in living room during winter months relative to control group (°C)
Retrofit	+0.96* [0.23,1.68]
Behaviour change	-0.02
Retrofit & behaviour change	+0.66

The retrofit only intervention led to a 5.1% increase in average daily temperature.

Table 25: Household average daily temperature in living room during winter months pre-intervention and post-intervention (for all houses with temperature data)

Intervention Group	AverageTemp-Living for winter months (°C)	
	Pre-intervention	Post-intervention
control	18.27	17.87
retrofit	18.69	19.24
behaviour change	19.26	18.84
retrofit & behaviour change	18.71	18.97

Feedback from householders after receiving insulation included:

"I had my doors sealed and insulation placed in the roof. Now it stays warmer when days are cooler and it warms up quicker and holds the heat."

Are you comfortable with the retrofit proposals that we offered to you?

"Oh yes very comfortable the minute that the draught excluders were put on I noticed oh there is something different here and you wouldn't think that a small thing like a draught excluder around a door or window could make such a difference. I felt it immediately and similarly with the new insulation it was just like a warm blanket had descended over the house, I was thrilled."

"It is not a young house … is pretty draughty ……. I did not realise it - I did not have enough insulation in the house and I now I don't have to get the heater on till later in the evening about 9pm and I am still comfortable and I used to put it on a 5.30pm. It felt like Christmas!"

3.12.10 Impact of IHD interventions on energy use

The allocation of households to IHDs was not a randomised procedure, so statistical analysis is not possible. The following analysis gives an account of the energy use of the different groups of households, but makes no statistically relevant claims.

3.12.10.1 Energy use results from the monitored data

Of the 28 households in the behaviour change group, 13 had the IHD Standard and 15 had the IHD Deluxe. Of the 32 households in the retrofit and behaviour change group, 11 had the IHD Standard, 15 had the IHD Deluxe, and 6 had no IHD.

Within the retrofit and behaviour change group, households which had an IHD installed (whether Standard or Deluxe) saved less energy than the households that did not have an IHD installed (Figure 61). Households with the Standard IHD installed saved more gas and more total energy than did the households with the Deluxe IHD installed, but used more electricity.

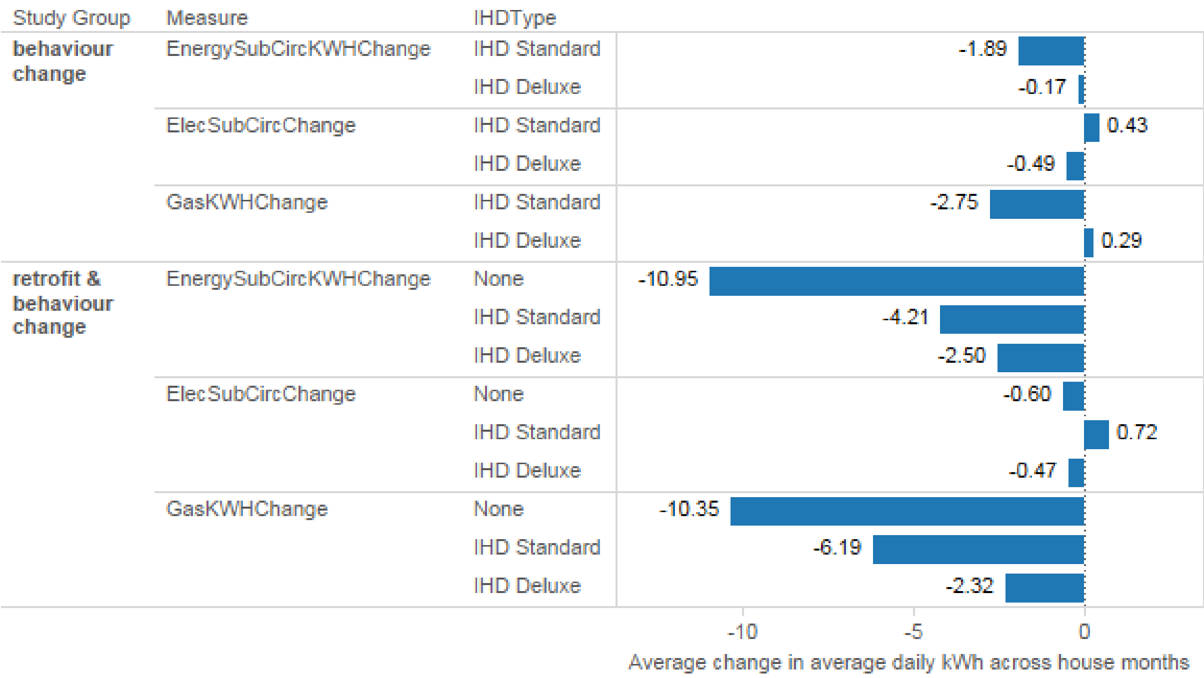


Figure 61: Change in average daily energy consumption for households with different IHD interventions (monitored data)

Within the retrofit group, households with the Standard IHD installed saved more gas and more total energy than did the households with the Deluxe IHD installed, but used more electricity.

3.12.10.2 Energy use results from the distributor data

Within the retrofit and behaviour change group, households which had an IHD installed (whether Standard or Deluxe) saved more on their gas, but less on their electricity and overall energy than the households that did not have an IHD installed (Figure 62).

Within the behaviour change group, households which had an IHD installed (whether Standard or Deluxe) saved more on their gas and overall energy, but less on their electricity than the households that did not have an IHD installed (Figure 62).

Within the retrofit and behaviour change group, households which had a Standard IHD installed made greater savings in their gas and overall energy use, but less savings in their electricity use than the households that had a Deluxe IHD (Figure 63). Households with the Deluxe IHD installed saved less electricity and gas, but more overall energy than did the households with no IHD installed.

Within the behaviour change group, households with the Standard IHD installed saved more electricity, gas and total energy than did the households with the Deluxe IHD installed (Figure 63).

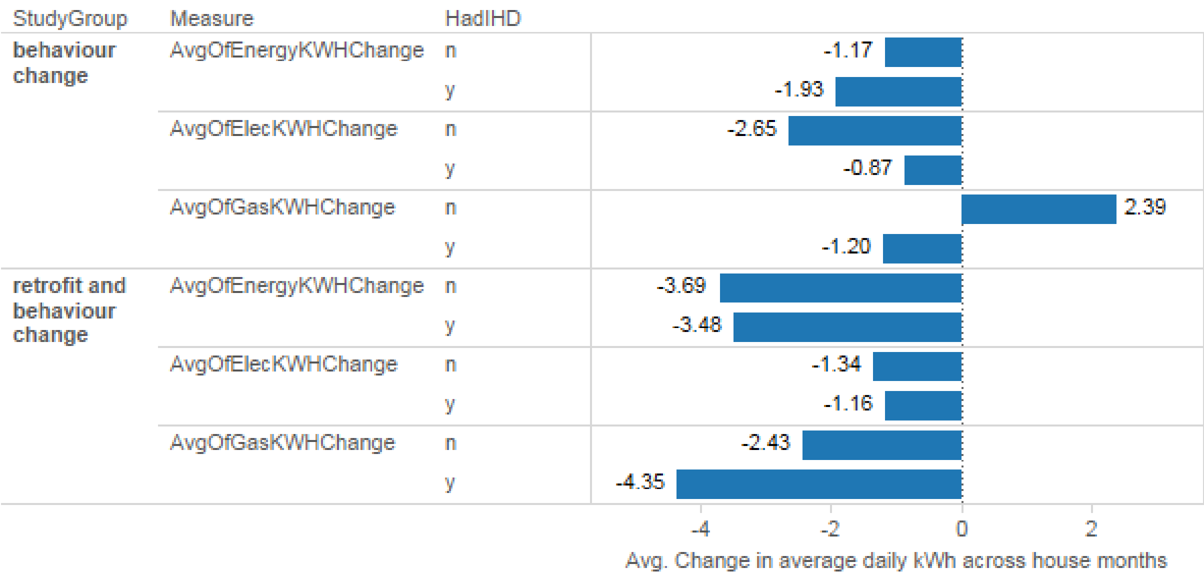


Figure 62: Change in average daily energy consumption for households with and without IHD interventions (distributor data)

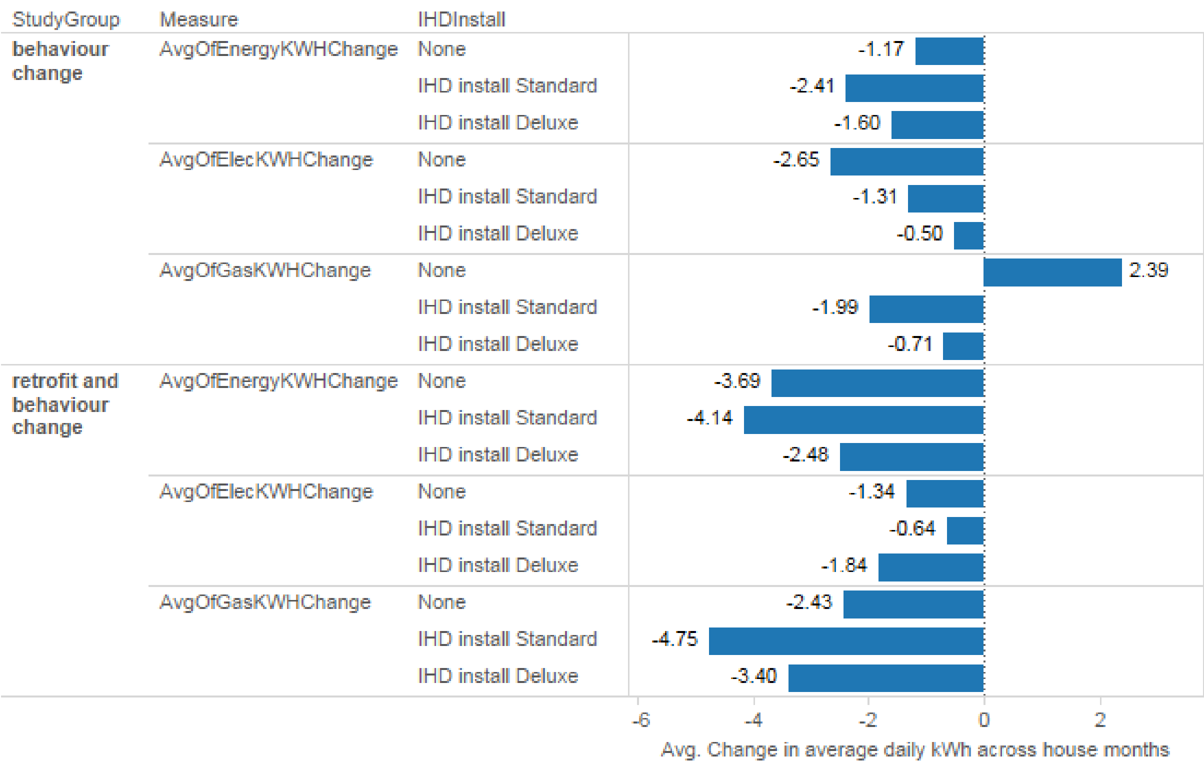


Figure 63: Change in average daily energy consumption for households with different IHD interventions (distributor data)

3.12.11 Householder views on retrofits

Over 90 percent of householders in the retrofit groups believed that the home improvements completed for them met their expectations (Table 26). When asked to rate the impact on the comfort of their home, the highest rated improvements were shade, heaters and coolers, insulation and draught sealing (Table 27).

Table 26: Householders' responses to the question, 'Did these home improvements meet your expectation?'

	Yes (%)	Yes (No.)	No (%)	No (No.)	Unsure (%)	Unsure (No.)
A. Retrofit group	95.71	67	0.00		0.04	3
C. Retrofit/Behavioural change group	94.03	63	0.01	1	0.04	3

Table 27: Householders' responses to the question, 'More specifically, rate the impact of the following home improvements on the comfort of your home'

Improvements	Num.	Useless	Not Useful	No change	Useful	Very Useful	% Useful or Very Useful
Insulation	126	0	0	18	38	70	85.7
Draught Sealing	103	2	3	15	38	45	80.6
Shade	8	0	0	0	3	5	100.0
Lighting	62	1	1	13	24	23	75.8
Heaters and Coolers	13	0	0	0	3	10	100.0
Appliances (Incl. TV)	7	0	0	2	2	3	71.4
Hot water service replacement	7	0	0	2	3	2	71.4
Other - please describe	31	0	0	13	7	11	58.1

Householders that received home improvement retrofit works have indicated that an increase in comfort levels have been achieved due to the works compared to the homes that did not receive retrofit works (effect size 0.2-0.35).

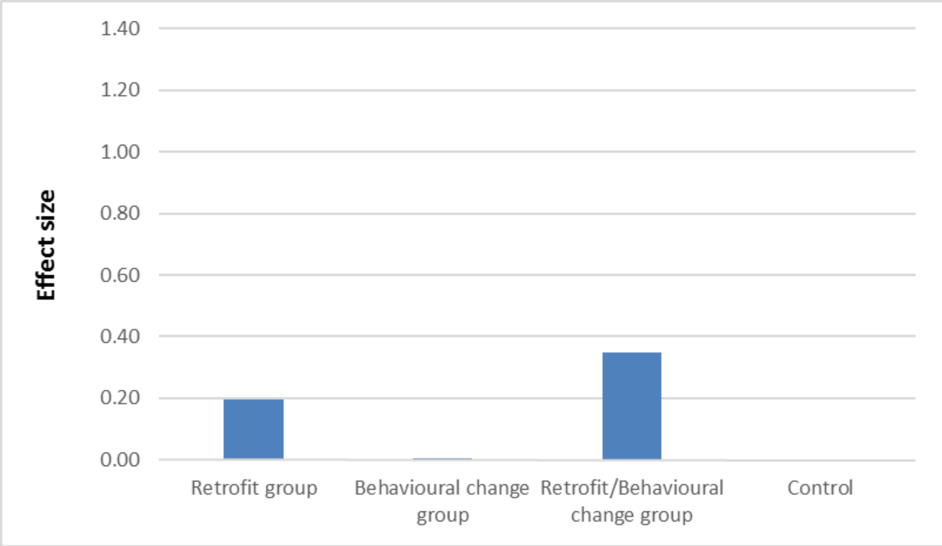


Figure 64: Effect size of Householders' responses to the question, 'How comfortable is your home? (heating/cooling/lighting etc.)' on the pre and post surveys using Control group as the base

3.12.12 Impact on NatHERS Star Rating

Sixty of the 120 monitored houses underwent a thermal efficiency star rating assessment pre-intervention. Their star rating varied from 0 stars to 5.5 stars with a mean of 2.7 stars (Figure 65).

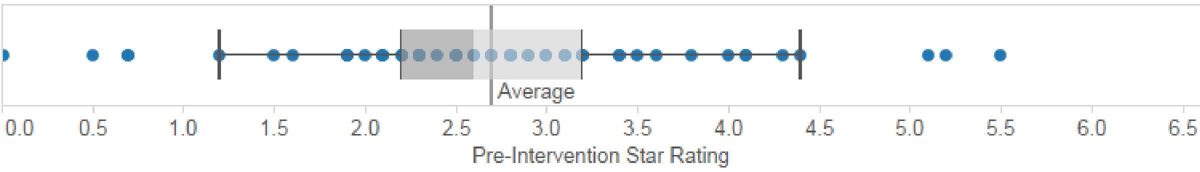
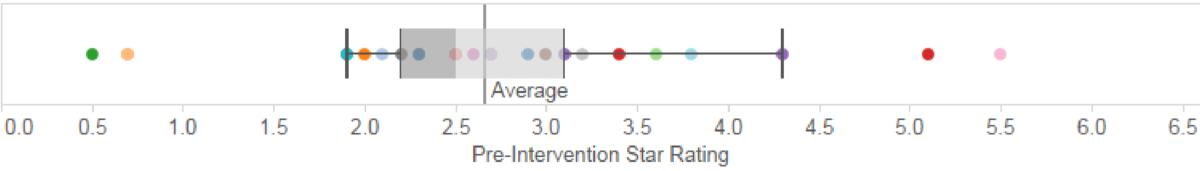


Figure 65: Star rating of 60 houses pre-intervention

Of these 60 houses, the 29 houses which had retrofit interventions also underwent a post-intervention thermal efficiency star rating assessment. Pre-intervention their star ratings varied from 0.5 stars to 5.5 stars with a mean of 2.7 stars; after the retrofit interventions their star ratings varied from 0.7 stars to 6.2 stars with a mean of 3.4 stars (Figure 66).



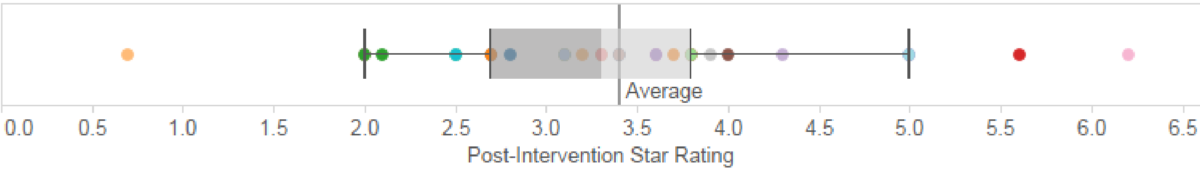


Figure 66: Star rating of 29 houses which had retrofit interventions pre-intervention and then post-intervention

Table 28: Star ratings before and after retrofit interventions on 59 randomly selected homes, change in star ratings and retrofit costs

		Retrofit type				
Home identifier	**Pre-Intervention Star Rating**	**Draught sealing (various)**	**Ceiling insulation**	**Post-Intervention Star Rating**	**Increase in Star Rating following retrofit**	**Cost of retrofit interventions ($)**
1	2.8					2100
2	2.3	yes	yes	2.8	0.5	1864
3	1.9					
4	2.9					
5	3.2					
6	2.1	yes	yes	3.1	1	1820
7	2	yes	yes	2.7	0.7	2469
8	1.2					
9	0.7	yes		0.7	0	2852
10	0.5	yes	yes	2	1.5	2305
11	3.6					
12	3.4		yes	3.8	0.4	1830
13	2.5		yes	3.3	0.8	2545
14	3.5					
15	4.1					
16	2.8					
17	2.2					
18	3.1	yes	yes	3.6	0.5	1821
19	2.7	yes	yes	4.3	1.6	2695
20	3	yes	yes	4	1	1998
21	2.2					
22	2.5	yes	yes	3.4	0.9	2780
23	2.6	yes	yes	3.6	1	1655

24	2.8					
25	4					
26	5.5		yes	6.2	0.7	1488
27	2.2	yes	yes	2.7	0.5	2318
28	3.2	yes	yes	3.9	0.7	2794
29	2.4					
30	1.6					
31	4.1					
32	2.7	yes	yes	3.1	0.4	2187
33	2.3	yes	yes	3.3	1	2556
34	2.3					
35	1.9	yes	yes	2.5	0.6	1501
36	3.8	yes	yes	5	1.2	2934
37	2.9	yes	yes	3.4	0.5	1317
38	2.7	yes	yes	3.3	0.6	2846
39	2.3					
40	2.1					
41	3.4					
42	2.8					
43	2.6					
44	2.3		yes	3.7	1.4	1915
45	4.4					
46	3					
47	3.2					
48	3.1					
49	2.5					
50	2.5	yes	yes	3.2	0.7	2289
51	1.9		yes	2.1	0.2	1808
52	1.5					
53	5.2					
54	2.3	yes	yes	2.5	0.2	3190
55	2.1					
56	2.3					
57	5.1	yes	yes	5.6	0.5	1301
58	0.7		yes	2	1.3	1339
59	4.3	yes	yes	5	0.7	917
					Average retrofit cost	$2,129

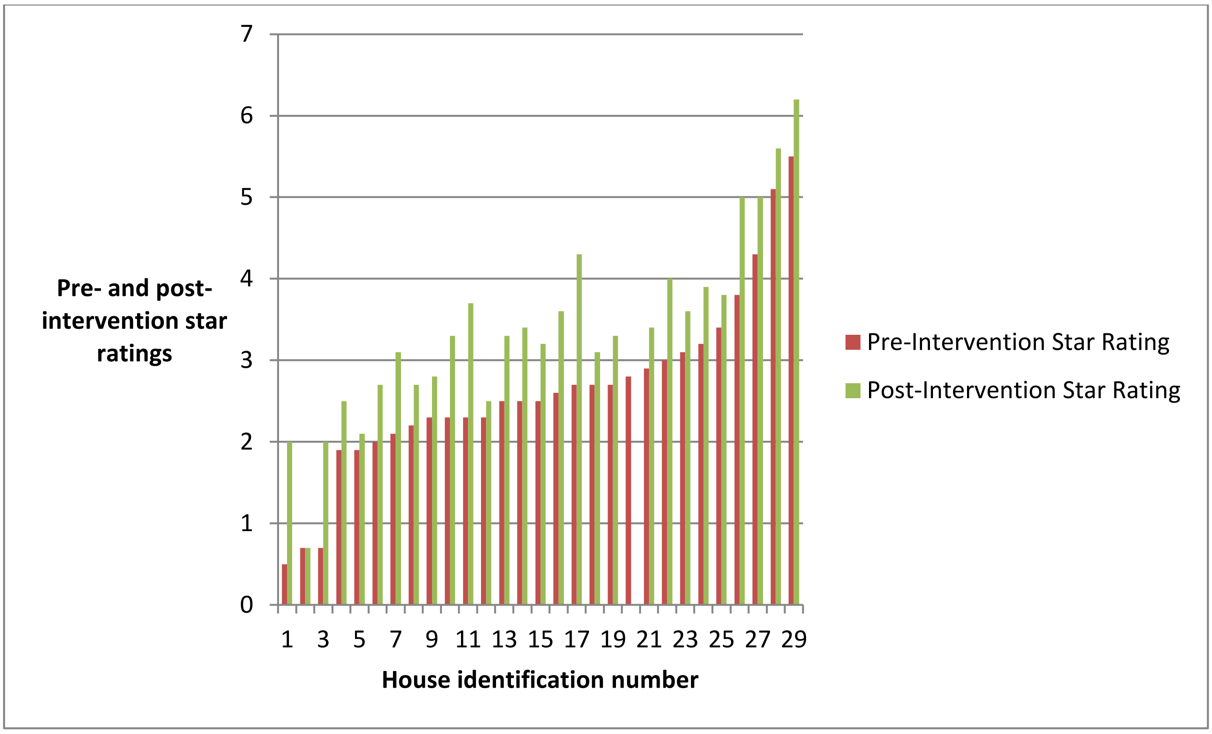


Figure 67: Star ratings for 29 test homes before and after building envelope retrofit works

3.12.13 Impact of Behaviour Change intervention

3.12.13.1 Impact of Energy Action Plan

3.12.13.1.1 Number of energy efficiency actions by householders

Most householders adopted new energy efficiency actions as a result of the EAP. This was demonstrated in the results to questions answered by both the ELOs and householders below.

Table 29: ELO responses to the questions, 'How many householders adopted new behaviours as a result of participating in this program?' and 'How many householders reinforced existing behaviours as a result of participating in this program?'

ELO response to questions regarding householder behaviours	None	A few	Some	Most	All	Average (/5)
Adopted new behaviours	0	1	3	2	0	3.2
Reinforced existing behaviours	0	0	0	5	1	4.2

Most householders (>80 percent) indicated they adopted at least one new action and over half reported they adopted two or more actions

Table 30: Householders', who participated in the EAP, responses to the question, 'How many new energy saving actions did you adopt?'

Householders response to "How many new energy saving practices did you adopt?"	Number (n=129)	Percentage
We didn't adopt any new practices	25	19.4
We adopted one new practice	35	27.1
We adopted two new practices	39	30.2
We adopted three new practices	14	10.9
We adopted four or more new practices	16	12.4
One or more new practices	104	80.6

Table 30: Householders', who participated in the EAP, responses to the question, 'How many new energy saving actions did you adopt?'

Householders response to "How many new energy saving practices did you adopt?"	Number (n=129)	Percentage
We didn't adopt any new practices	25	19.4
We adopted one new practice	35	27.1
We adopted two new practices	39	30.2
We adopted three new practices	14	10.9
We adopted four or more new practices	16	12.4
One or more new practices	104	80.6

Growth in the number of energy efficiency actions by householders in the behaviour change study groups was achieved, but not by householders in the other 2 study groups. The effect size was determined to be medium (effect size greater or equal to 0.4).

The number of the actions undertaken by householders to save energy was tracked during the project and the average number of actions has grown from 16.2 to 19.2 in this time. That is, householders, on average, had adopted three new actions. Importantly, there was a 10 percent increase in the number of householders who reported they incorporated 20 actions or more in their daily lives and a 14 percent decline in those reporting less than 10 actions. (Table 31, Figure 68).

Table 31: The average number of actions taken by householders who participated in the EAP prior and post interventions, and percentages by category (n=129)

		Pre-survey		Post-survey
Average number of actions		16.2		19.2
Correlation		0.7770		
Category	**Range of actions**	**Pre-survey (%)**	**Post-survey (%)**	**% Change**
Low	0-10	24.0	10.1	-14.0
Medium	11-20	49.6	53.5	3.9
High	21-30	26.4	36.4	10.1

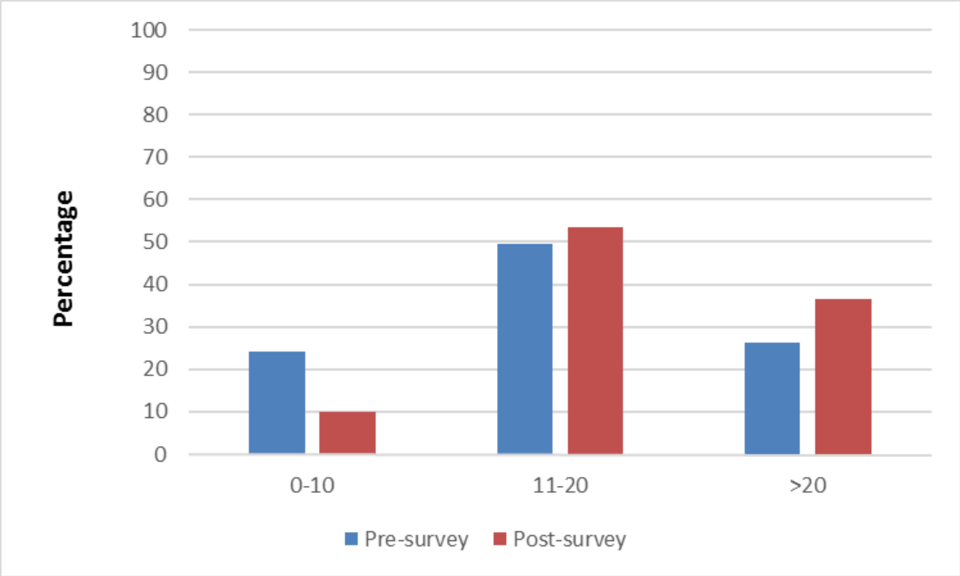


Figure 68: The percentage of householders in the three 'action' level categories (low number of actions, medium & high), pre-survey and post-survey (n=129)

The majority of new actions that the householders adopted were indoor temperature management (28%), buying more efficient appliances (17%) and water use (16%).

Table 32: Householders' responses to the question, 'What were they?'

	A. Retrofit group	B. Behavioural change group	C. Retrofit/ Behavioural change group	D. Control	%
Indoor temperature management (use of thermometer, heater type [fixed/portable], time of heater/cooler use, wearing suitable clothes, windows/doors open/closed, shade, use of blankets etc)	14	27	32	4	28.3
Draught sealing (seal doors, wall vents, holes in walls, fixed louver windows etc)	7	2	7	0	5.9
Water (only boil what you will use, clothes wash full load/in cold, short showers, cold rinse dishes)	4	22	15	2	15.8
Fridges (1 only, no hot food, defrosting, seal)	0	14	8	0	8.1
Lighting (when on/off, zone/pedestal lights)	5	12	15	3	12.9
Appliances (buying more efficient, switches off, standby)	5	22	16	2	16.5
Improving energy bills and retailers	0	3	6	0	3.3
Clothes drying on wash line	0	0	0	1	0.4
Other - Please specify	4	11	17	4	13.2

3.12.13.1.2 Householder feedback about the EAP

Householders indicated a high degree of satisfaction with the Energy Action Program (EAP). The majority of householders (79%) gave high ratings (4 or 5 out of 5). Of the 129 respondents, only a very few gave low ratings (less than 3) (Table 33).

Table 33: Householders' responses to the question, 'How would you rate the experiences you had with the energy action program?'

Householders' responses to 'How would you rate the experiences with the EAP?'	**Rating 1**	**2**	**3**	**4**	**5**	**mean**	**(%) High rating 4 or 5**
Householders who participated in the EAP (n=129)	3	0	24	45	57	4.19	79.1

Most householders (74.4 percent) indicated an improved understanding of saving energy compared to a minority of the control group (17.8 percent) (Table 34).

Table 34: Householders' responses to the question, 'On a scale from 1-5 how would you rate your improved understanding of saving energy?', EAP participants and control

	Rating 1	**2**	**3**	**4**	**5**	**mean**	**(%) Improved (3, 4 or 5)**
Householders who participated in the EAP (n=129)	22	11	40	23	33	3.26	74.4
Control (n = 73)	48	12	10	2	1	1.59	17.8

3.12.13.2 Impacts of In-Home Displays

3.12.13.2.1 Use of deluxe IHDs

For the 30 "deluxe' In-Home Displays, Table 35 and Figure 69 indicate the average use of each page of the energy use software by each householder during the 7 months of March – October 2015.

Table 35: Average number of times each page of the deluxe IHD was visited by householders in a 7 month period

Page visited on IHD	Home	Energy Usage	Tips Page	More Information
Average number of times each page was visited by householder	133	17	5	6

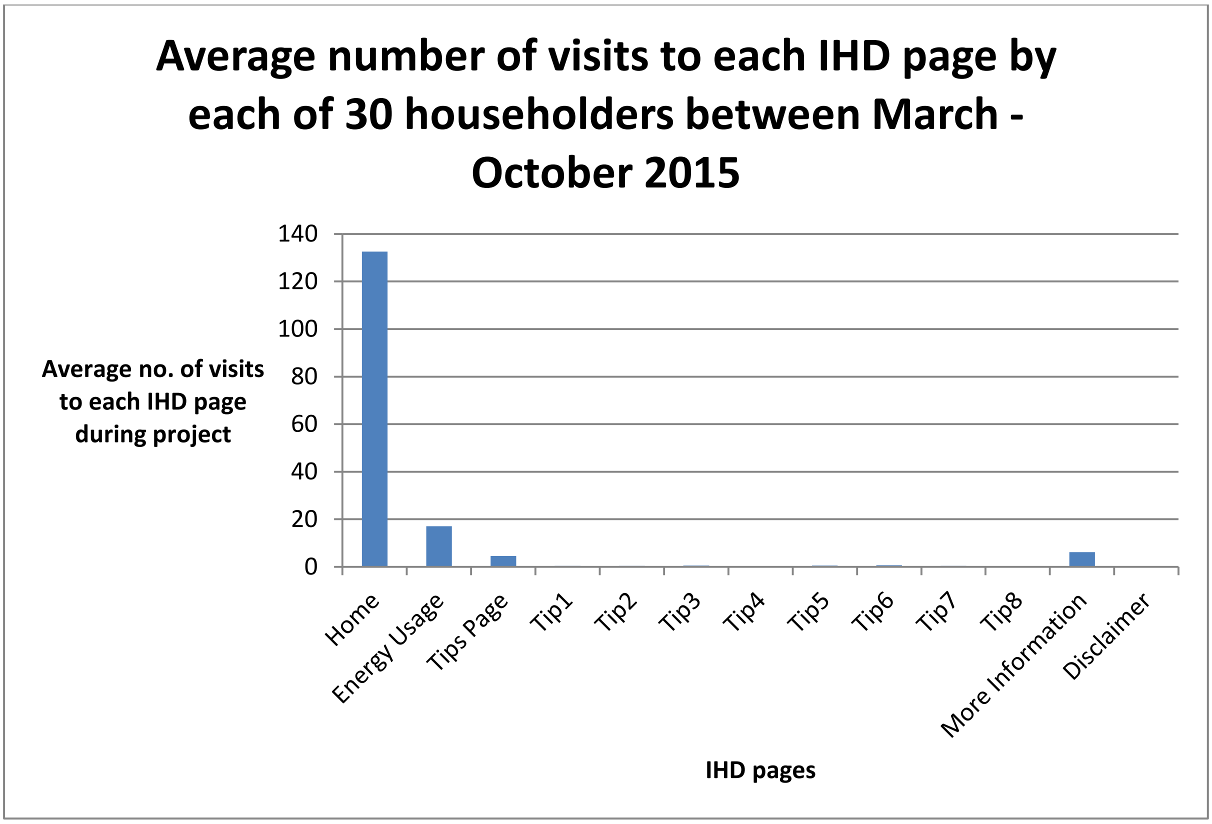


Figure 69: average number of times each page of the deluxe IHD was visited in 7 months

It is important to note that the IHD software defaulted to the home page when it wasn't used for 30 minutes, which made the number of visits to the home page artificially high.

The 'Energy Usage' page was visited approximately twice per month per user over the 7 months.

3.12.13.2.2 Householder feedback about IHDs

The results from the householder IHD survey suggests that the IHDs appealed to only a minority of participating householders. In most cases, two people in the household used the device (Table 36).

Table 36: The number of people in the household who used the IHD

Number of people	Deluxe	Watt's Clever
1	2	4
2	18	15
3	3	1
4	0	0
5	0	1

Twice as many householders who used the deluxe IHD indicated they were regularly or sometimes using it when compared to the Watt's Clever device (NB: the difference was not statistically significant) (Table 37).

Table 37: Householders' response to the questions, 'How often have you been using it? Are you still using it?'

	Deluxe (No.)	Watt's Clever (No.)
Regularly	6	4
Sometimes	4	1
A few times but not any more	8	11
Never	1	4
Other (see below)	4	1

10 of the 23 householders (44 percent) who were given the deluxe device indicated that they were regular or sometime users of the device, compared to five who had the Watt's Clever device (24 percent).

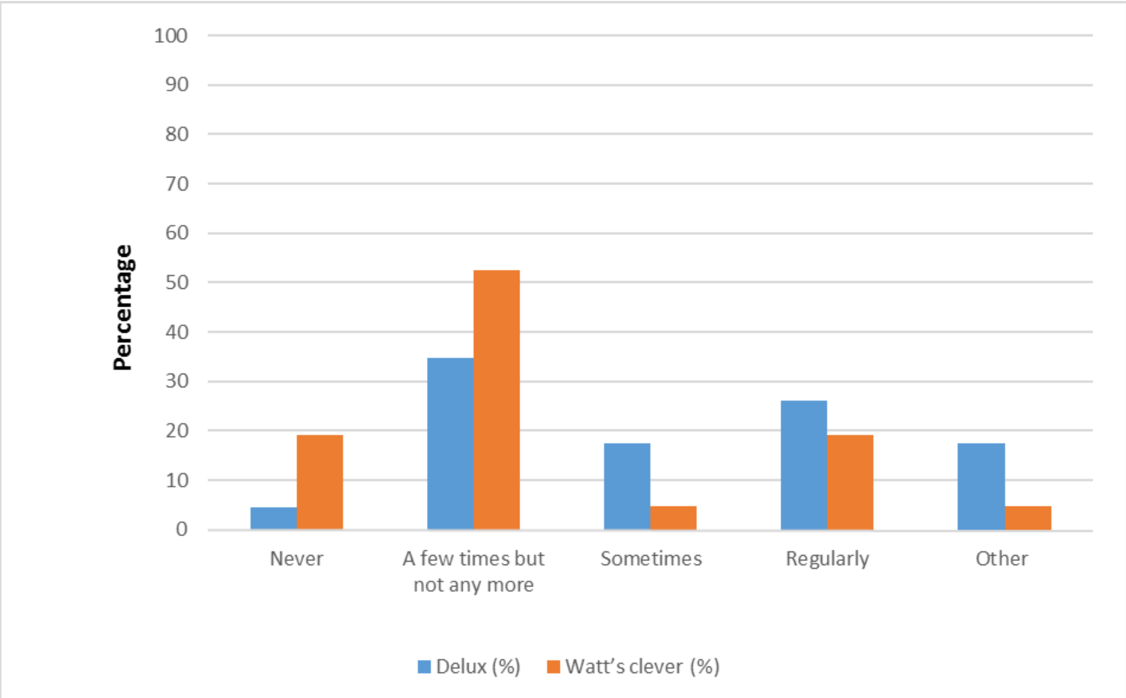


Figure 70: Householders' response to the questions, 'How often have you been using it? Are you still using it?', as percentages

These fifteen householders did so predominantly to observe their overall energy consumption and to find out how much power an appliance uses. Seven householders with the deluxe IHD (30 percent) and three with the Watt's Clever IHD (14 percent) believed it had influenced how they used their appliances and lighting around their house.

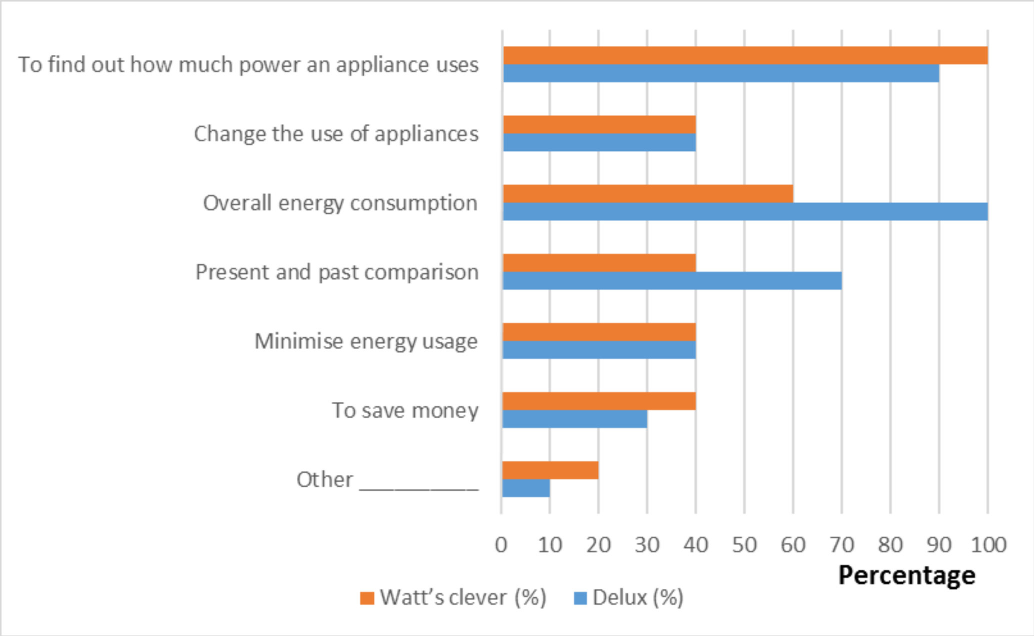


Figure 71: Householders' response to the questions, 'If regularly or sometimes, in what ways did you use it?', as percentages

Table 38: Householders' response to the question's, 'If regularly or sometimes, has it influenced how you use your appliances and lighting around the house?'

	Deluxe (No.)	Deluxe (%)	Watt's Clever (No.)	Watt's Clever (%)
Yes	7	30.4	3	14.3
No	3	13.0	2	9.5
Didn't use the device regularly or sometimes	13	56.5	16	76.2

For those that answered 'yes' to the question 'If regularly or sometimes, has it influenced how you use your appliances and lighting around the house?' the influences mentioned included 'more observant', 'conscious of power use' (bought a smaller kettle and only fills it with the required amount of water),' conscious of heating' (reduced heating at night), 'I was able to see how much my appliances were using when on and on standby' (air conditioner was using 100 watts on standby), 'made us more aware of timing and costs'.

When asked "how easy was it to use" the householders with the deluxe IHD were split between those who see the devices being difficult to use and those who see the device as easy to use. The data was bimodal, with 35 percent indicating it difficult or very difficult to use at one end of the scale and 48 percent finding it easy or very easy to use at the other end. The data for the Watt's Clever device, however, shows no such division with most householders (76%) reporting it as ok or easy to use.

Table 39: Householders' response to the question, 'How easy was it to use?'

	Deluxe (No.)	Deluxe (%)	Watt's Clever (No.)	Watt's Clever (%)
Very difficult	3	13.0	1	4.8
Difficult	5	21.7	3	14.3
OK	4	17.4	9	42.9
Easy	9	39.1	7	33.3
Very easy	2	8.7	1	4.8

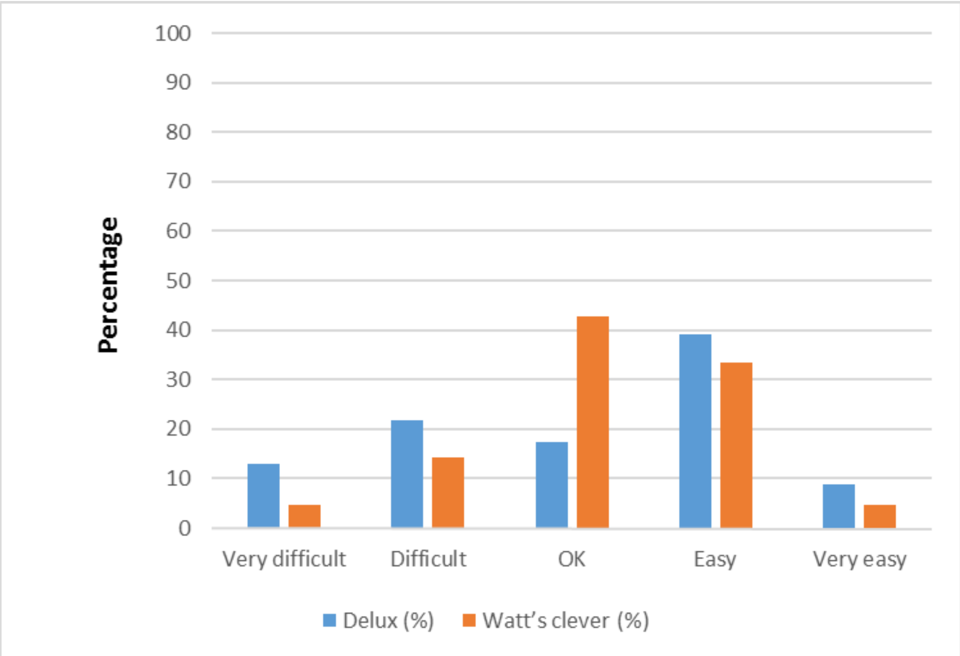


Figure 72: Householders' response to the question, 'How easy was it to use?', as percentages

Table 40: Householders' response to the questions, 'Why was it easy to use?'

	Deluxe (No.)	Deluxe (%)	Watt's Clever (No.)	Watt's Clever (%)
Couldn't work it out	2	8.7	2	9.5
Not good with technology	7	30.4	2	9.5
Too complicated	0	0.0	1	4.8
Difficult to read	2	8.7	6	28.6
Not interested	3	13.0	3	14.3
Tablet connection issues	11	47.8	3	14.3
Couldn't understand the data presented	1	4.3	3	14.3
Showed the information I wanted	6	26.1	5	23.8
Good presentation of data	10	43.5	3	14.3
Other (see below)	8	34.8	8	38.1

deluxe - other	Watt's Clever - other
• easy to navigate • health issues so difficult to concentrate for any length of time • Poor eyesight and difficulty with hands made it hard to use • it was easy to use • good display of the time in the location I had it. • good to learn that aircon was using power on standby	• showed when electricity use spiked • too ill to worry about it. Always shows high usage as oxygen machine on. • didn't give useful information. E.g. where energy used

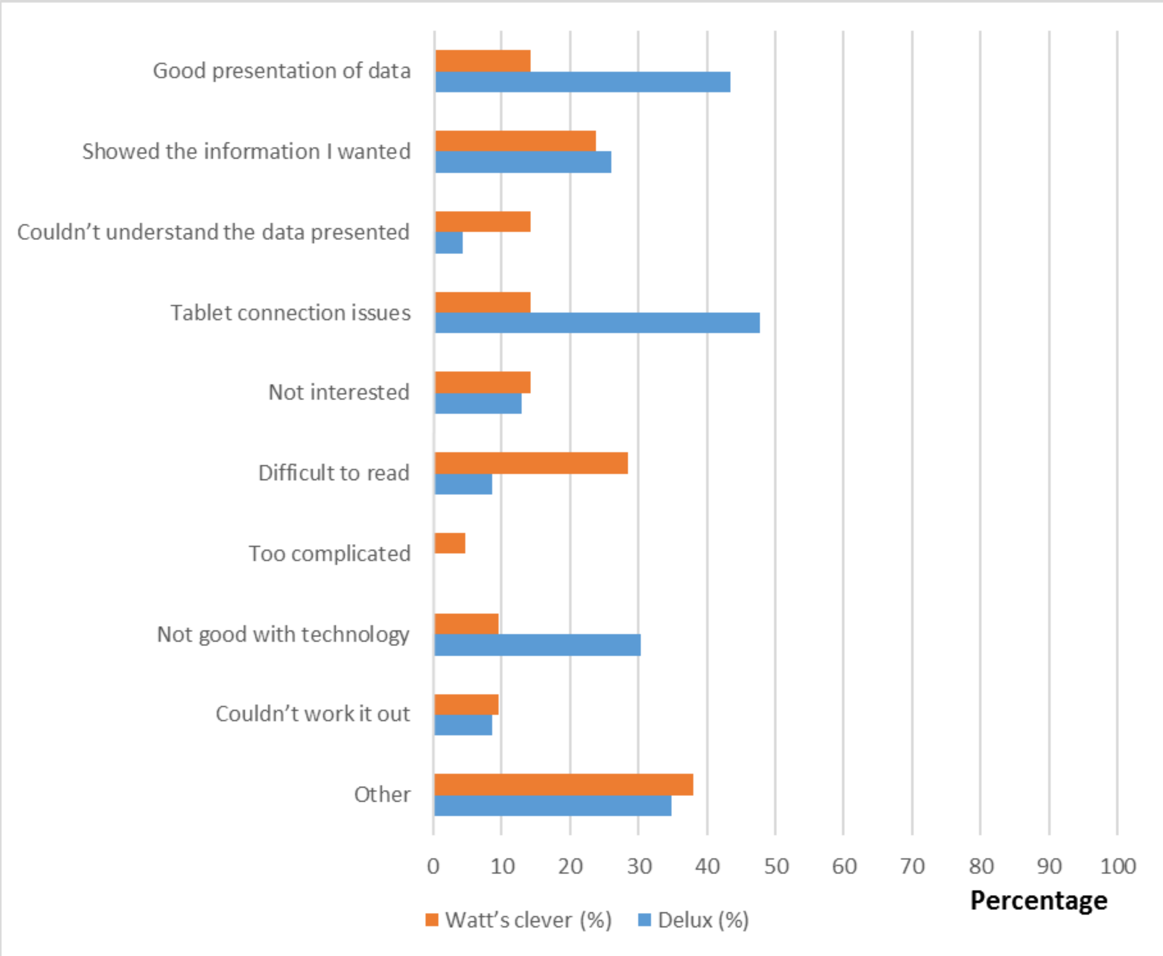


Figure 73: Householders' response to the questions, 'Why was it easy to use?', as percentages

The split among the deluxe IHD users suggests computer skills may be playing an important role in deciding how well it is used. On the other hand, a large number of Watt's Clever uses found it ok or easy to use but it was not appealing enough for most to use it on an occasional or regular basis. Some caution should be taken when considering these findings as the number of householders participating was small.

3.13 Intervention cost effectiveness

3.13.1 Monitored data

Using the mean intervention impacts (which were statistically significant) together with the cost of the interventions, the cost effectiveness of the interventions was calculated (Table 41). For example, it costs a household undergoing a combination of retrofit and behaviour change interventions $2.26 to save 1 kWh of total energy (electricity and gas) per year; it costs a household undergoing retrofit interventions only $1,431 to make their house 1°C warmer in winter, compared to retrofit and behaviour change combination interventions which cost $2237 per °C.

Table 41: Cost effectiveness of interventions which had a statistically significant impact – using monitored data

Intervention	Impact measure	Cost effectiveness
Retrofit and behaviour change	Total energy consumption (measured as sum of monitored sub circuits and gas)	$2.26 per kWh saved per year
Retrofit and behaviour change	Gas consumption	$2.06 per kWh saved per year
Retrofit and behaviour change	Total energy consumption (measured as sum of monitored mains circuits and gas)	$2.12 per kWh saved per year
Retrofit and behaviour change	Gas bills	$31.83 per $ saved in annual gas bill
Retrofit and behaviour change	GHG emissions from gas consumption	$10.39 per kgCO2-e saved over a year
Retrofit and behaviour change	Temperature in living room in winter	$2237 per °C warmer in winter
Retrofit	Temperature in living room in winter	$1431 per °C warmer in winter
Retrofit (including LED lighting)	Electricity consumed for lighting	$2.56 per kWh saved per year
Retrofit and behaviour change (including LED lighting)	Electricity consumed for lighting	$2.77 per kWh saved per year
Retrofit (including LED lighting)	Electricity bills - for lighting	$8.89 per $ saved in annual electricity bill
Retrofit and behaviour change (including LED lighting)	Electricity bills - for lighting	$9.23 per $ saved in annual electricity bill
Retrofit (including LED lighting)	GHG emissions - for lighting	$2.01 per kgCO2-e saved over a year
Retrofit and behaviour change (including LED lighting)	GHG emissions - for lighting	$2.08 per kgCO2-e saved over a year

3.13.2 Distributor data

Using the mean intervention impacts (which were statistically significant) together with the cost of the interventions, the cost effectiveness of the interventions was calculated (Table 42). For example, it costs a household undergoing a combination of retrofit and behaviour change interventions $1.65 to save 1 kWh of total energy (electricity and gas) per year; It costs a household undergoing retrofit interventions only $2,451 to make their house 1°C warmer in winter.

Table 42: Cost effectiveness of interventions which had statistically significant impact – using distributor data

Intervention	Impact measure	Cost effectiveness
Retrofit and behaviour change	Total energy consumption (using distributor data)	$1.65 per kWh saved per year
Retrofit and behaviour change	Gas consumption (using distributor data)	$1.13 per kWh saved per year
Retrofit	Total energy consumption (using distributor data)	$1.70 per kWh saved per year
Retrofit and behaviour change	Gas bills	$17.42 per $ saved in annual gas bill
Retrofit	Energy bills	$7.43 per $ saved in annual gas bill
Retrofit and behaviour change	GHG emissions from gas consumption	$5.67 per kgCO2-e saved over a year
Retrofit	GHG emissions from total energy consumption	$1.68 per kgCO2-e saved over a year
Retrofit	Temperature in living room in winter	$2451 per °C warmer in winter

3.14 Intervention cost- benefit analysis

3.14.1 Monitored data

Using the mean financial benefits (which were statistically significant) for 10 years together with the mean cost of the interventions, the cost –benefit ratios of the interventions were calculated.

Table 43: Cost - benefit ratios of interventions which had a statistically significant benefit – using monitored data based on 10 years of benefits

Intervention	Impact measure	Cost –benefit ratio
Retrofit	Lower electricity costs for lighting	6.77
Retrofit and behaviour change	Lower cost gas bills	2.54

3.14.2 Distributor data

Using the mean financial benefits (which were statistically significant) for 10 years together with the mean cost of the interventions, the cost –benefit ratios of the interventions were calculated.

Table 44: Cost - benefit ratios of interventions which had a statistically significant benefit - using distributor data based on 10 years of benefits

Intervention	Impact measure	Cost –benefit ratio
Retrofit	Lower cost total energy bills	0.74
Retrofit and behaviour change	Lower cost gas bills	1.75

3.15 Data uploaded to LIEEP portal

A lot of the data collected by this project will be used in analysis by the DIIS (along with data from 19 other LIEEP grant recipient projects). For this purpose, data was mapped into LIEEP schema format and uploaded to the LIEEP portal (Table 45). Energy and temperature data, which did not have a format specified for it, has also been uploaded to the LIEEP portal (Table 46).

Table 45: Data uploaded to LIEEP portal in LIEEP schema format

LIEEP Schema table name	Description	SECCCA file uploaded	Number of records
AAS_EE_SURVEY	Attitudes To Energy Efficiency Survey	AAS_EE_SURVEY.csv	313
DWELLING	Dwelling Details	DWELLING.csv	320
ENERGY_AUDIT	Energy Audit	ENERGY_AUDIT.csv	319
FUNDING_AGREEMENT_SURVEY	Funding Agreement Survey	FUNDING_AGREEMENT_SURVEY.csv FUNDING_AGREEMENT_SURVEY_post intervention.csv	319 276
GRANT_RECIPIENT_STAFF	Grant Recipient Staff	GRANT_RECIPIENT_STAFF.csv	17
GRANT_RECIPIENT	Grant Recipient Details	GRANT_RECIPIENT.csv	1
IHD	In-home Display	IHD.csv	60
INFORMATION	Information Session	INFORMATION.csv	361
INSULATION	Insulation Details	INSULATION.csv	1595
LIGHTING	Lighting	LIGHTING.csv	320
PARTICIPANT	Participant Details	PARTICIPANT.csv	320
PV_DETAILS	Photovoltaic Details	PV_DETAILS.csv	46
PROGRAM_BARRIER	Program Barrier	PROGRAM_BARRIER.csv	7
PROGRAM	Program Details	PROGRAM.csv	1
RETROFIT	Retrofit record	RETROFIT.csv	623
SPACE_COOLING	Space cooling	SPACE_COOLING.csv	320
SPACE_HEATING	Space heating	SPACE_HEATING.csv	320
TREATMENT	Treatment condition	TREATMENT.csv	4
WATER_HEATING	Water heating	WATER_HEATING.csv	320

Table 46: Data uploaded to LIEEP portal - not in LIEEP schema format

File name	Description	Number of records
DwellingDistributorElecBilling.csv	Electricity data from distributor - billing (accumulated) format	1,228
DwellingDistributorElecSmartMeter.csv	Electricity data from distributor - thirty minutely format	12,074,230
DwellingDistributorGasBilling.csv	Gas consumption data from distributor - billing (accumulated) format	3,365
DwellingInternalTemperatures.csv	Temperature sensor data – thirty minutely	3,664,415
DwellingMonitoredElecSolarGen30Min.csv	Electricity generation data from Ecofront monitors – thirty minutely	588,735
DwellingMonitoredElecSumMains30Min.csv	Electricity consumption data from Ecofront monitors – thirty minutely – sum of mains circuits	3,315,106
DwellingMonitoredElecSumSubCirc30Min.csv	Electricity consumption data from Ecofront monitors – thirty minutely – sum of sub-circuits circuits	3,316,132
DwellingMonitoredGas30Min.csv	Gas consumption data from Ecofront monitors – thirty minutely	2,853,434

3.16 Additional studies

3.16.1 RMIT Health Study

The study identified and described individual and socially shared householder practices, quantified outcomes in indoor temperatures, energy use, energy costs and householder health, and explained how householder practices influenced these outcomes. Five main themes of householder practices were identified i.e. the intersecting practices of:

- keeping warm
- affording energy
- maintaining air quality

were bundled up in the practices of:

- living at home
- staying healthy.

Protective responses of householders to perceived problems, i.e. coping and adaptation practices, were explored. In addition, the effect of the participation in the research project on householders was examined.

The retrofit intervention trial consisted of 29 homes. While survey and energy monitoring data was available for most homes, due to equipment failure or unverifiable installation dates, the number of matched data sets for measured indoor temperatures was reduced. Although due to the small sample size the results of the statistical tests were rarely significant, the analyses referred to below indicated trends that provided the basis for explanations of outcomes that had been influenced by householder practices.

Living at home

Householders shaped their homes in response to perceived shortcomings in the thermal performance of the building envelope and of the heating systems within the limits of their financial and physical means. Moving into the home had been a common trigger for building improvements. Summer heat was considered a bigger problem than the winter cold, as householders felt they had more coping strategies available to keep warm in winter. The improvement in the perceived comfort from the baseline to the follow-up winter was more pronounced in the intervention than in the control group. Many householders attributed the gain in comfort to the retrofit measures, which had made the homes *cosier* and *warmer*, and was felt to have reduced draughts, accelerated the speed of heating up the house and facilitated the conservation of warmth. Where a new reverse cycle air conditioner was installed, more benefits were attributed to the new heating device than to the top-up insulation and draught proofing.

Interventions led to an increase in the householders' overall satisfaction with the home. This shift may have reflected the householders' overall satisfaction with the retrofits and their perception of better conforming to social norms of house quality.

Keeping warm

With regards to the practices of keeping warm, the research found a clear improvement in the intervention group: the classification 'heating without achieving warmth' had been eliminated and the practices shifted towards more carefree heating.

Daily mean living and bedroom temperatures in the intervention homes increased more than in the control homes. The differences were more pronounced during daytime and in the late evening in the living rooms and during the night and daytime in the bedrooms, however, these differences were not statistically significant. Of particular note, contextual changes, such as in household composition and physiological capabilities, seem to have induced stronger changes in warmth than the material improvements made to the building fabric.

In most households, heating was seen as a reaction to cold rather than as a preventative measure. Many householders persisted in heating only to *take out the chill* and let themselves be guided by subjective comfort levels, the fear of unaffordable energy bills and the perceived norm of intermittent heating. Voluntary under-heating, which was explained by thermal history, by regarding frugality as a virtue or by health beliefs, was found in three homes.

Under-heating of living and bedrooms remained a common problem in both groups. The scope of the retrofits was not sufficient to raise temperatures to adequate levels in most homes. Householders protected themselves from cold exposure through coping and adaptation measures, some presenting health risks in their own right. Nonetheless, benefits from the retrofits in the intervention homes were observed in the reduced prevalence of households reporting to have felt cold and in the reduced number of coping strategies being employed to keep warm.

Affording energy

Subjective fuel poverty was more pronounced in summer than winter, with twice as many householders reporting that they could not cool their homes adequately than reporting to not being able to heat their home adequately. The retrofit measures of the Energy Saver Study eased subjective fuel poverty due to financial constraints in winter

The study also found that changes in energy bill payments were able to ease the perceived burden of energy costs irrespective of the intervention. Although the majority of householders received governmental energy concessions, awareness of these concessions was poor and some householders were missing out on the medical cooling concession. By contrast, householders were acutely aware of the energy providers' pay on time discounts. Direct debt and pre-payment seemed to ease financial and emotional stress and a switch in energy providers afforded better discounts. However, several householders remained overcharged as they did not engage in the energy market. Nonetheless, some householders continued to cope with high bills by trading fresh food or social activities for warmth.

The analysis of the time-stamped gas and electricity data for both winter periods revealed statistically significant benefits in electricity consumption and, hence, costs, in the intervention group. Changes in gas costs, absolute changes in electricity costs, total energy costs or greenhouse gas emissions, however, were not statistically different between the two groups. The analysis also failed to find statistically significant benefits of the intervention on heating energy. Health and age-related increases in cold sensitivity resulted in longer heating periods and higher energy bills. In two cases, the death of spouses resulted in pronounced drops in heating. A quantitative juxtaposition of simulated and actual changes in heating energy in 10 homes suggested that to achieve benefits in energy conservation, retrofit interventions should have aimed at a designed reduction of the heating load of at least 22 percent. Due to the small sample size, this finding was not statistically significant and should be considered as an indication rather than as a guideline.

Maintaining good indoor air quality

Indoor air quality is moderated by involuntary air exchange and ventilation rates. Retrofits may have unintended consequences for indoor air quality by increasing the indoor moisture content. Although the air tightness of all homes at the baseline was considered poor, improving to a fair rating in the intervention homes, this study found a low prevalence of draught awareness and an apparent disregard of draughts. Keeping windows permanently open was practiced by about half of the participating householders, in order to accommodate the dog, due to health beliefs or due to having grown with ‘sleep-outs’. The practice of keeping the bedroom window slightly ajar inhibited the gain in daily mean temperature in the intervention homes.

The retrofit measures had been effective i.e. inhibited involuntary air exchange and thus heat loss, in the living rooms during the nights. No evidence for statistically significant effects during other times of the day was found, possibly due to more random moisture generation and householder ventilation practices. For the bedrooms, retrofit measures had had no effect on overall ventilation rates. Permanently vented bedrooms led to lower vapour pressure levels in both control and intervention groups.

Staying healthy

In most households, warmth was regarded as being important for comfort i.e. an aspect of psychological rather than physiological health. Warmth in the bedroom was seldom considered as a protective measure. Accessibility and safety concerns featured strongly in the description of health issues at home. The outcomes in health from the health symptoms and stress surveys did not show a clear improvement in health for the intervention group. The results of the Quality of Life survey (SF-36v20) scores showed more improvements in the intervention than in the control group, but the differences between the groups were not statistically significant.

Incidental health gains with immediate effect were the removal of polluting gas heaters and other safety measures as a result of the pre-study audits. Other incidental benefits that were directly attributed to the study were the receipt of the Medical Cooling Concession in one household and the empowerment of householders towards energy providers and tradespersons.

Summary

In summary, the study has provided social context to the retrofits of homes with poor thermal quality and subjective fuel poverty of 29 HACC recipients in Victoria and has explained the effects of the Energy Saver Study retrofits on indoor temperatures, affordability of energy, householder health and satisfaction. The knowledge of the householder experience extended the framework of the pathways from housing quality to health outcomes beyond the material qualities of the dwelling to contextual factors. Amongst others, these were the physiological capabilities of the householder, the modes of energy bill payment and the social construction of the adequacy of indoor temperatures. In addition, the study has identified coping and adaptation practices that may be able to build resilience. The detailed exploration of the influences of householder practices on the mediating factors of indoor temperature and affordability of fuel as well as the identification of moderating coping and adaptation practices has helped to better understand the effects of residential energy efficiency interventions on health. However, more research is needed on other contextual and confounding factors that may increase vulnerability or enhance resilience.

3.16.2 Swinburne research: Who influences the householders most?

Data analysis suggests that social influence is key. The number and category of people that householders refer to is detailed below.

The relationships of most importance to the householders (when they are seeking advice on energy in the home) are partners. Children are the next most important influence, followed by ELOs (from this LIEEP project) and then friends.

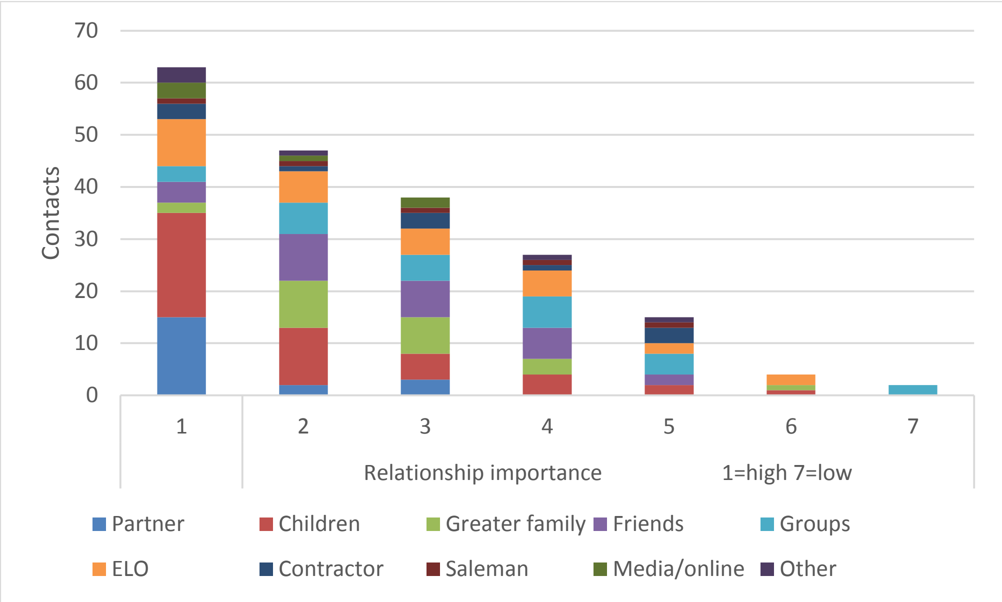


Figure 74: Relationships of most importance to the householder when seeking advice on energy in the home

In terms of who householders actually consult for advice on energy in the home, children are consulted most, followed by members of groups (that householders are themselves members of), then ELOs. Greater family are the next consulted, followed by partners and then friends.

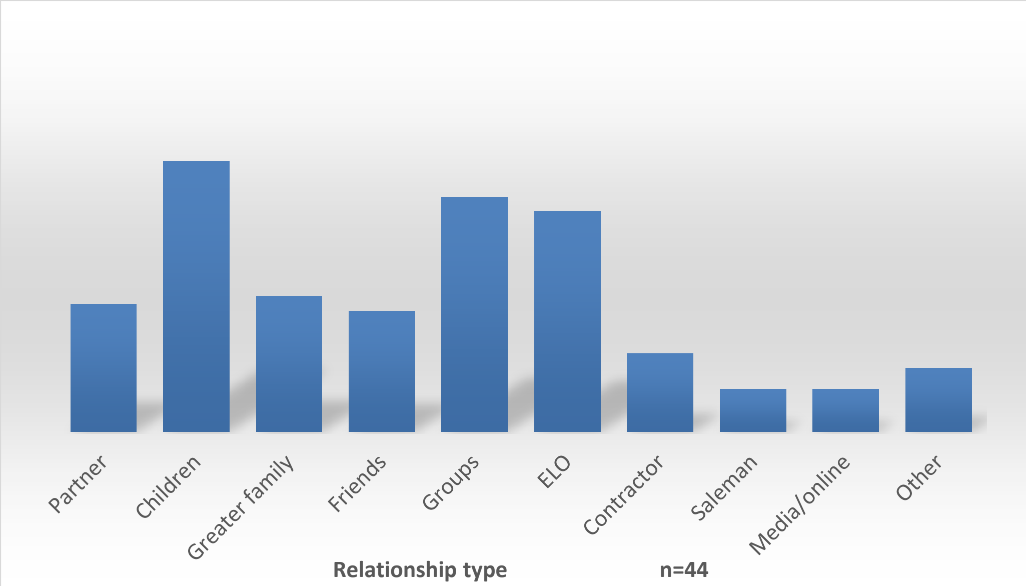


Figure 75: Who householders consult for advice on energy in the home

The overall story of Most Significant Change was selected by householders for reasons of high applicability, low challenge and recommendation. The energy action in the chosen story was to manage the use of standby power.

Additional findings of interest include:

- Competing practices and the impact of hygiene, entertainment, caring, comfort and financial management practices on positive outcomes
- The negotiation between couples and families and the challenge of managing differing physiological states under one roof
- The role of one-off actions versus repeated actions in the transition to habit.
- The significance of ventilation and health to this profile of householders
- The impact of housing suitability and life-stage transitioning on change
- The impact of new learning on effective and sustained change
- Getting household energy based actions into everyday conversations
- The role of community leadership in motivating social influence

This research will be completed by January 2017.

4 Discussion

4.1 Council delivery frameworks

Council HACC teams provide a highly effective context to identify, recruit, retain and support low income householders to improve their energy efficiency. They provide good access to client data which can lead to targeted and successful recruitment. The council HACC service environment provides an effective context and tools to retain clients in such a program i.e. a good environment in which to provide communications, visits and support.

If extra resources are provided to Council HACC teams to provide energy efficiency support to low income householders in the future as part of the services offered by HACC teams, they are an existing, trusted organisation that could provide valuable energy efficiency information and advice to low income homes and support/facilitate home retrofit improvement works in them.

Local goods and service providers can be engaged by councils via their purchasing system to provide home retrofit support to householders (this project used local suppliers in approximately 60% of cases e.g. tradespeople, appliances). This was effective in terms of minimising contractor travel times and costs, getting fast service and local access to goods.

Companies with regional/state/national distribution/scale can be contracted by councils at very competitive rates to provide other larger scale (in number) supply of goods and services across the entire project area e.g. in this project over 140 insulation installs, 40+ LED light upgrades, 100+ draught sealing, 10 hot water services, 12 heaters/coolers. This procurement can be replicated in the future by local governments/regional/state based organisations at the relevant scale. Note that providers of basic draught sealing services at affordable/desirable prices are relatively lacking in the private sector marketplace, primarily constrained by travel distances and related costs.

Councils also provided a great environment to host group community support sessions i.e. centralised locations in each council, free/affordable venues, relatively cheap community bus transport options and a non-commercial context for discussion.

4.1.1 HACC teams

The majority of participating councils' HACC teams are already at full capacity in terms of delivering their existing services to clients i.e. home care meals, health, property maintenance etc. From 1 July 2016, the Australian Government will assume full funding, policy and operational responsibility for HACC services for older people in Victoria to form part of the Commonwealth Home Support Program (CHSP), with Victoria continuing to fund HACC services for people aged under 65 years (under 50 years for Aboriginal and Torres Strait Islander people) (DSS 2016).

To facilitate addition of the provision of energy efficiency services by HACC providers to low income earners will require additional/modified resourcing from government i.e. strong organisational leadership to drive the organisational change, staff training and support, communication material, human resource management and additional resourcing.

To ensure that energy efficiency support services are added to future HACC services and available to the low income community, future HACC service providers will need to be identified. They may from be local government, private or community not-for-profit sectors. Their willingness and capability to provide energy efficiency support services to low income clients will need to be identified and assessed. If their willingness and capability is low, training will need to be made available to increase their capability and willingness to provide energy efficiency support services to clients. This proposed energy efficiency training could be added to the existing DHHS (Vic) training that is offered to HACC staff for free.

The HACC teams indicated they have limited capacity to add energy efficiency support to their existing HACC services, even though energy efficiency services fit very well with the aims of HACC i.e. supporting vulnerable persons to age in place, maintain independence, safety, health, comfort, wellbeing etc. It has become clear that some HACC staff's willingness and/or capacity to provide different (energy efficiency) services is limited/non-existent.

4.1.2 Council processes to determine who is eligible for community support

The project identified that some of this 'low income' HACC client population has the financial capacity to improve elements of their home and make it more energy efficient, comfortable and healthier. The project discovered that anyone with a concession/health benefit/pension card is eligible to receive home and community care. They can be asset rich and may have ready access to cash, but due to the fact they have a low declarable annual income, they are eligible to receive services.

Some participating 'low income' householders, especially once they had a greater awareness of residential energy efficiency and how they can reduce their energy costs (with awareness provided to them by the project), were very forthcoming to spend their own money on energy efficiency upgrades, when the project was only contributing $450 towards works costing them $1000-5000 (ranging from new heaters, blinds, ceiling fans to fridges, TVs and hot water services). This was unexpected and happened late in the project. In late 2015 SECCCA discovered many clients had arranged and had completed many energy efficiency improvements in their homes during the project in the 2nd half of 2015 at their own cost, based on their increased awareness of energy efficiency (assumed as a result of the project).

A recommendation from the project is that, as part of the assessment of clients' eligibility to receive support services from a project like this in the future, both the client's income and the value of their assets and investments are taken into account. This will be critical to ensure that the most vulnerable and those with the lowest incomes and capacity to improve their wellbeing are supported by future programs as a first priority. Those with available funds may just need energy efficiency advice and direction from an existing trusted organisation to trigger them to take actions to improve their energy efficiency.

4.1.3 Benefits of delivering energy efficiency support services through local government

The benefits of delivering energy efficiency support services to low income householders through local government HACC teams include:

- Local governments exist almost everywhere across Australia, so a replicable delivery model is likely to be able to reach the vast majority of the most vulnerable people

- HACC teams have good access to client data so that the most vulnerable people can easily be identified, targeted and be offered/receive services
- Local government coordinated HACC services are generally well respected so their householder recruitment can be effective and efficient and the advice they provide is likely to be trusted and acted upon
- Energy efficiency support services provide progress to existing HACC objectives i.e. support people to age in place, maintain/improve safety in the home (safe indoor temperatures during heatwaves and cold weather), reduce/minimise living costs, improve comfort, reduce cold-related pain/inflammation/stiffness, can lead to more visits from family/friends etc after the home and living conditions are improved, thereby minimising social isolation
- Local governments have a high 'duty of care' to their HACC clients and as such, usually make every effort to ensure these vulnerable clients are supported and protected as much as possible. As a result local government is an excellent organisation/pathway for delivery of energy efficiency support services to low income householders

4.2 Householders

4.2.1 Recruitment

Recruitment via local government HACC service was successful and could be replicated and scaled up for future delivery if local governments were provided with extra resources to do this. The HACC teams provide great access to client data and contact details (within the framework of the Privacy Act) and are a trusted existing organisation to support their low income clients.

The recruitment process that worked was to identify likely eligible householders from the HACC client database, assess them for suitability to participate in the project using the client database and consultation with their existing HACC assessor and carers, send them a personally addressed concise letter describing the project plus a branded flyer, provide a follow up phone call and request a visit to their home. At the home visit the project was described, a brochure and *frequently asked question* sheet was provided plus an *expression of interest* form to be completed and returned. If they were still eligible an A*greement to Participate* form had to be returned and then they were recruited.

4.2.2 Aged, health issues, female and single, with the capacity to learn

The householders had a wide range of circumstances that affected their ability to increase their energy efficiency i.e. they were predominantly aged and had either a chronic or acute health condition with limited capacity to improve their energy efficiency, most but were single females, some were physically and cognitively very able and had a high capacity to plan, organise and arrange their life. When some were presented with information and possible new actions they reported a general increase in awareness and interest in residential energy efficiency. Those with the capacity to learn and adapt will require less support in any future program than householders with high care needs.

A key issue is that each low income household and its occupants need to be assessed for their income, mental and physical health and their capability to manage their lives, lean new things and change behaviours. Each home needs to be audited in relation to energy efficiency i.e. design, nature and condition of the building envelope and its appliances. Then an Energy Action Plan can be created by an ELO in collaboration with the householder(s).

If an energy efficiency apprentice (relatively low salary cost) accompanies the Energy Liaison Officer, the apprentice can provide some low cost energy efficiency support during the first visit i.e. replace incandescent light globes with LED globes, draught seal external doors, wall vents, gaps between building materials and better insulate the hot water service with insulation for the pressure relief valve and lagging of hot outlet pipes.

For householders with a moderate-high capacity to arrange things themselves, they can be given or pointed to resources, equipment, devices, financing options and rebates by the ELO, that they can then learn about and arrange implementation of energy efficiency/cost saving/comfort improving actions themselves.

Another possible strategy to consider for those who are aged with a low income and a capacity to learn/change, is to support them to rent out their oversized homes and rent/buy for themselves a more energy efficient, comfortable, healthy, suitably sized home.

4.2.3 Some householders require high support to stay or rehouse, free up capital

Other clients needed high levels of support to improve their energy efficiency, age in place and more so, to 'age in another place' i.e. retrofit their existing homes, or relocate and downsize to a more appropriately sized, designed and constructed home that will better provide safer (in terms of hot and cold temperatures), more comfortable, affordable, aging in place. A great opportunity exists to support aged people to age in another (more suitably sized and energy efficient) place, thereby freeing up many large 4-5 bedroom homes for first home buyers, families or investors. This strategy may move low income peoples' money from being tied up in oversized, under-occupied, energy-inefficient homes to more suitably sized affordable, energy efficient, cheaper to live in and more comfortable homes, to the benefit of low income clients and society at large.

4.2.4 Many householders already doing lots

As the householder survey data indicated, this aged, low income segment of the community are generally doing a lot of actions to minimise their energy use and costs. If a similar energy action program to that provided by this project is resourced and provided to low income householders in the future, it will either confirm to householders that they are already doing lots of energy efficiency/cost saving actions, or remind them of actions they knew they about but weren't doing. Some people will be made aware of new actions they could do to increase their energy efficiency.

4.2.5 Improve energy supply plans

One of the new actions householders could do to reduce their energy costs was to investigate their gas and electricity supply contracts, their bills and seek a better deal from the retailers. Prior to the project many clients were not comfortable or aware that they could call their energy retailer and say "would you please look at my energy use over the past year and tell me if you can offer me a better deal" or, use an online portal/website e.g. *SwitchOn*, *Victorian Energy Compare* to find out if a better deal existed, based on their situation. When householders were made aware and/or supported to investigate their energy supply contracts and other deals that were available, some were very happy to get better energy deals including energy cost savings. Other clients with physical or mental health issues will need one-on-one support to implement this action.

Some examples: *for one householder, Origin has offered her a deal for new users where she will get 50% off energy and gas including the fixed costs for the first 3 months, and then it is still a pretty good deal 28% off electricity and 15% off gas…for the rest of the 12 months. She can then renegotiate after that time. She is delighted!*

Another lady who had been hesitant to ring the energy company AGL in visit 1 and 2 of her energy action intervention decided after the group visit to do so. She gained a significant improvement on her 'pay on time' discount from 7% to 20% for gas and 26 to 28% for electricity. She was delighted.

4.3 Houses

4.3.1 House profile

The age of houses can impact significantly on their energy efficiency and the indoor temperatures in homes. The vast majority of the houses (but not all) in this demographic require predominantly building envelope improvement works (insulation, draught sealing) to improve their energy efficiency and move them towards being safe to occupy in commonly occurring extreme hot and cold weather events. The average of these homes' indoor temperatures are as low as 10.1°C in winter and as high as 30°C in summer. These are not safe indoor temperatures for people with thermo-regulatory health problems, and to try to improve the indoor temperatures with only new heaters/coolers is inefficient use of money. The recurrent operating costs of heaters/coolers in a home with a bad building envelope will be very high/cost prohibitive.

The majority of the houses have four or more bedrooms and are only partially occupied/used. This makes the homes harder to keep in a safe and comfortable temperature range. There are generally only 1 or 2 people living in the majority of homes and approximately only 25% of each home is being used, so the homes are much larger than is required for this demographic. These homes are therefore more expensive to heat and cool than a more suitably sized residence.

4.4 Interventions

The project has identified that targeted energy efficiency retrofits combined with behaviour change measures can deliver significant energy (between 10-11%) and cost savings ($113 /year) in low income Victorian homes. Delivery of either of these interventions on their own is likely to have little or no energy efficiency outcomes respectively – it is critical they are delivered in combination.

Future delivery of energy efficiency support could be provided relatively cheaply at scale using the following model: a skilled ELO and trained energy efficiency apprentice could identify and support 500 council HACC/CHSP clients per year, provide them with up to 3 visits each which includes initial fact finding, home audit, identify client capacity and support needs, a home energy plan, provision of varying levels of information, logistical, basic retrofit and financial support to achieve improved energy efficiency, comfort and reduced energy costs. This is projected to cost approximately $150,000 per year, or an average of $300 per home, plus government energy efficiency rebates (STC's, VEECs etc).

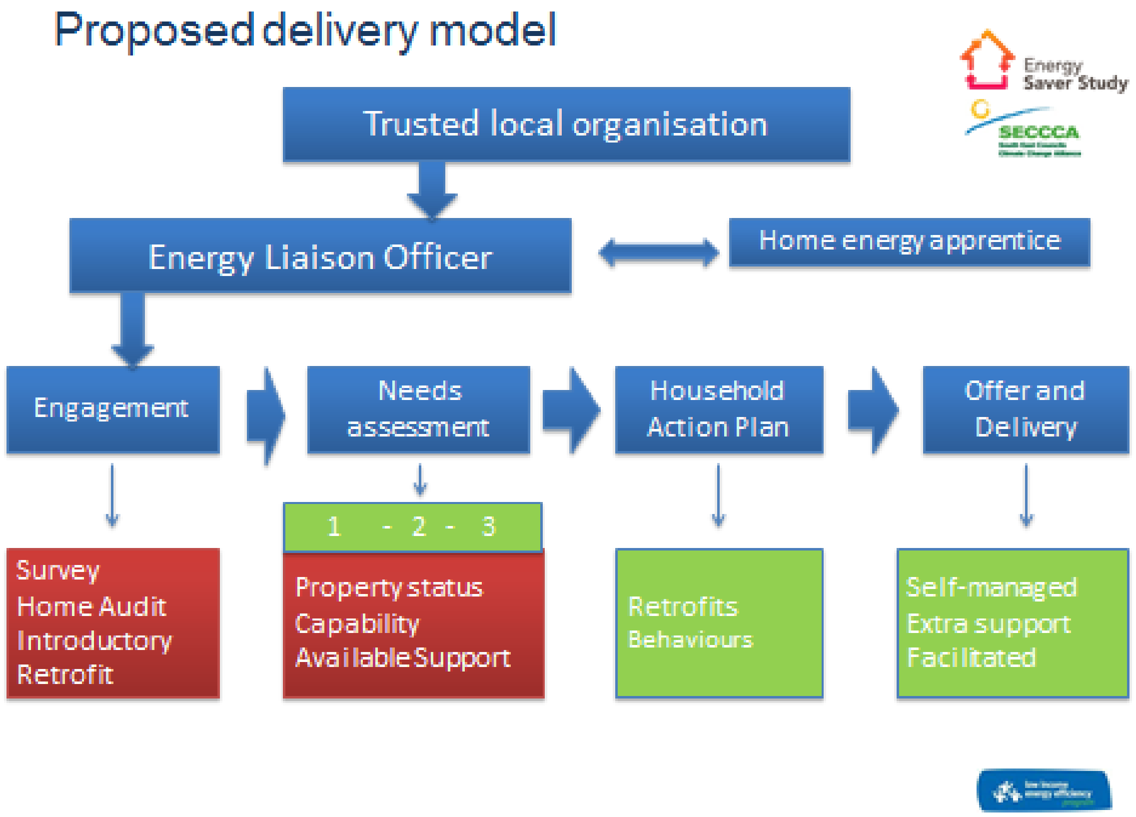


Figure 76: Proposed future energy efficiency support delivery model

A significant challenge for future delivery of the proposed Department of Social Services support services is that the existing HACC delivery model will not exist from 1 July 2016 and will be replaced by the Commonwealth Home Support Programme (CHSP) (Department of Social Services 2015). Future funding of householder support regarding energy efficiency, home safety, comfort, maintenance and modifications could be provided to and via the CHSP providers (which may be wider than local government from 1 July 2016 onwards) as they may determine how the householders' goals (e.g. achieving a safe and affordable indoor temperature, safe affordable lighting etc) are put into practice and are likely to offer home maintenance/modification services (but they will need to be funded by the Australian and/or state governments to do so).

Future providers will need to either make themselves and their staff aware of the goods and services required to deliver residential energy efficiency, safety and client wellbeing, or be trained/supported to do so. This will need to include identifying how a home can be modified and made safe in terms of indoor temperatures, affordable energy bills, satisfactory performance, low operating cost, efficient LED lighting and installation of the related goods and services (LED light globe upgrades, draught sealing, insulation).

Alternatively, for these and other home maintenance/modification services and goods, they may outsource the work to certified contractors (insulation installers, carpenters, electricians, plumbers). The CHSP home modification providers and their sub-contractors will also need to be made aware of the energy efficiency rebates that are available, their scale, eligibility and associated application procedures and delivery costs. This is so that they can keep the home maintenance/modification works affordable for low income householders.

If CHSP providers are funded to deliver energy efficiency (branded as home safety, maintenance and modifications) support to vulnerable persons, the promotion of the proposed program to the Regional Assessment Services (RAS) and to the My Aged Care call centre staff will be the next priority. Their staff will be the people that ask potential clients questions to determine which services they may need/be eligible to receive. Targeted questions will need to be created i.e. can you keep your home at 16 degrees Celsius or more throughout the year, and below 30 degrees Celsius? If they answer no, then a range of solutions exists i.e. insulation, draught sealing, heater/cooler upgrades/servicing, energy supply contract reviews and improvements etc.

In summary the improvement of existing HACC/future Department of Social Services-funded CHSP home maintenance and modification support services could align with the following existing objectives to be partially covered under existing HACC/future CHSP funding:

- Improve safety, accessibility and independence within the home environment, by minimising environmental health and safety hazards
- Mitigate or remove identified risks to a clients health and safety and/or provide services targeted at maintaining a home environment which supports a client's wellness
- Activities could include tasks such as
    - minor plumbing, electrical & carpentry repairs where client safety is an issue e.g. window furnishings to manage heat transfer and indoor temperature, service heaters/coolers, replace halogen downlights with LED downlights
    - working-at-height related repairs for client health and safety – e.g. roofs, windows, ceilings (insulation, window furnishings, draught sealing to keep indoor temperatures within a safe range of 17-30 degrees)
- The provision and frequency of on-going home maintenance services must directly relate to assessed client need in terms of maintaining accessibility, safety, independence or health and wellbeing and be subject to regular review. They are 'basic' services primarily for function and safety
- To provide home modifications that increase or maintain levels of independence, safety, accessibility and wellbeing.
- Modification services can also assist in creating a home environment that supports reablement and restorative practices i.e. suitable indoor temperatures are achieved to achieve mobility, access for arthritis sufferers for example.
- Services are provided to assist eligible clients with the organisation and cost of simple home modifications and where clinically justified, more complex modifications.

Put simply, include outcomes such as affordable safe indoor temperatures and high quality lighting in the existing safety objectives of the CHSP program and fund it for low income clients.

4.4.1 Home improvements/retrofits

The home improvements that were rated highest by recipients were shade, new heaters and coolers, insulation and draught sealing. This order is in contrast to the home auditors' NatHERS retrofit recommendations, which recommended generally improvements to lighting, draught sealing, insulation, then heating appliances and hot water services in approximately that order depending on the case in question, based on payback period. Shade/window furnishings were not recommended at all by home auditors as it is not recognised by the NatHERS software as effective to improve energy efficiency.

Home retrofits on their own appear to be a somewhat effective intervention to achieve improvements in energy efficiency. The level of effectiveness depends on each house, its age, design, construction materials and condition. The effectiveness is also dependant on the householders' health, education and capacity to operate the house and appliances in it efficiently.

4.4.1.1 LED lighting

Replacement of existing halogen and incandescent lighting with LEDs is an effective way to reduce electricity consumption for lighting. LEDs can also make significant savings in the associated electricity bills and greenhouse gas emissions.

Many clients do not have great trust in the LED marketing and information they receive via cold calling/marketing brochures. When clients were advised and supported to upgrade lights to LEDs through a local council endorsed supplier they welcomed the action, with 50% of clients in the retrofit study groups accepting LED lights to replace inefficient lights. Globes are especially easy to upgrade, with replacement of halogens requiring a licensed electrician.

Many clients commented favourably about the improved performance of the LED lights compared to existing incandescent and halogen lights. LEDs were welcomed especially by clients with poor eyesight.

Offering LED lights through trusted not for profit organisations rather than direct from retailers is an effective way to reduce energy use, cost and greenhouse emissions. It will also provide market access for retailers to low income households and the related economic growth opportunities.

4.4.1.2 Insulation

It is recommended that homes with poor and average condition and/or insufficient ceiling insulation (less than R3.5/4) are actively supported to top up their ceiling insulation. Topping up the missing or existing sub-standard insulation (especially in ceilings where it is critical, plus under suspended floors) can be done for approximately $10-20 per square metre. This is very likely to improve the comfort, health and affordability of low income homes.

With proper installation safety requirements (as per *ICANZ-HandBook-PART-2-Professional-Installation-Guide-V2-November-2013*) and active monitoring of this by regulators, this will be very beneficial for the community at large. All installers are not at present trained or implementing the safety procedures. This needs to be audited and enforced by regulators to manage this risk.

As per the handbook above, some risks identified regarding installation of insulation in this project include, but are not limited to:

1. Training – installers need to trained as per national standards
2. Electrical hazards
    a. before installers begin installing insulation the electricity supply must be turned off, tagged and isolated from access by other people at the switchboard i.e. the electrical isolation procedure implemented. Not all current installers are trained or implementing this procedure
    b. tools/materials that are non-conductive/have insulated handles must be used to move insulation around to minimise electrocution risks. Not all current installers are trained or implementing this procedure
    c. Non-conductive gloves must be worn

3. Working at heights – staff entering the building through the roof need to be trained and implementing working at heights procedures using appropriate equipment. Many installers simply use ladders to access the roof, take sections of the roof off to get insulation inside and try to transfer insulation material up onto the roof and into the ceiling without safety rails, scaffolds, harnesses etc
4. Eye and respiratory protection should be worn to manage risks i.e. safety glasses and dust masks
5. Asbestos – asbestos containing material (ACMs) are commonly found in old homes, especially in roof/ceiling cavities, roofs or in heater flues. To manage this risk, insulation installers need to be taught what ACMs can look like and where they are most likely to occur. Installers need to be on the lookout for ACMs when doing the risk assessment at each site and if they see what may be an ACM, they need to stop work, identify if the ACM is likely to be loose/mobile/friable/in the air – if it is they should stop work, leave the building and get an asbestos management specialist to inspect the possible ACM and they need to take a sample, inspect/test/assess it, identify if it is an ACM and if so, create an Asbestos Management Plan for the site. This can cost approximately $450 per home. If the suspect material is an ACM but is not in a form that is dangerous, the asbestos specialist should provide a document that indicates that it is safe to work at the site and under what conditions/procedures should be followed.

4.4.1.3 Draught sealing

Many but not all low income homes are very draughty (ACH of 10+ m^3/hr/m^3@ 50pa) and their draughtiness can often be significantly reduced for between \$50 - \$2500/home. The draught sealing could either be completed by people that buy the material themselves and do the work too, or by well trained/experienced carpenters, handypersons, or by insulation installers (they fit ceiling fan covers in ceilings whilst installing ceiling insulation, or supply and install covers on their own).

The main draughts that are a priority to seal are external doors, exhaust fans, wall vents, chimneys, holes in walls/floors, gaps between building materials, internal doors between conditioned and unconditioned rooms, windows and above windows by installing pelmets. The priority of these is based on air barrier testing results and comments by specialists in this field. Generally the bigger the air gap in the building envelope, the more important it is to seal.

Many of the clients that received retrofits reported to the project that their comfort increased as a result of retrofits (84% of retrofits included draught sealing). These retrofits generally also included ceiling insulation (89%) but many clients commented specifically about the improvement due to draught sealing as illustrated above. It is possible draught sealing received high praise from householders because it is visible to them and they can directly feel draughts.

4.4.1.4 Internal zoning opportunity

Many of the large homes could be internally zoned to reduce the size of the heated/cooled living areas i.e. install additional doors/partitions between areas. The need/opportunity for zoning was identified and confirmed in the project and was done successfully in up to 5 homes. Zoning modifications are sometimes not practical/affordable due to the old age or design of the home.

Of particular note, the success of internal zoning generally depends on occupants actively managing internal doors/other structures to zone the conditioned spaces. For some low income earners, especially those with mental and/or physical health issues, it may be more effective support to relocate/rehouse them into appropriately sized homes than to introduce internal zoning to the existing home. For people with good health, physical and mental capacity, installing zoning doors is an effective way to reduce the area of conditioned spaces, energy use and cost.

4.4.1.5 Heating/cooling systems

Heating systems in the project's homes were predominantly gas but there are increasingly electric heaters/coolers (split systems) being installed in homes as gas prices rise and split systems become very efficient.

There are 4 arguments to facilitate a change to electricity powered heating systems. Firstly, modern electric split system/reverse cycle electric heaters/coolers are far more efficient than gas heaters (for 1kW of power, 3kW of heating can be produced [300% efficiency] compared to gas heating which is only about 30% efficient).

Secondly the price of gas is increasing relative to electricity. Since at least 2014 the Australian gas market has been exposed to the international market which places a relatively high demand on Australian compressed natural gas. The development of new gas export terminals leads to a tightening of supply. This price effect will depend on how quickly new gas resources are developed and prices change.

Thirdly, if homes change to electric induction cooktops and hot water services as well as electric heaters, they will no longer need to be connected to gas. This will save householders the ongoing gas utility costs.

Fourthly, heat pumps can be either i) entirely powered by solar photovoltaic panels, or ii) powered by grid-connected solar power. This makes them a cheap way to cool houses, as peak cooling demands occur when the sun is shining at its brightest and solar power generation is highest.

In terms of heating and cooling, there is a dominant culture in Australia that has grown up being taught that gas is a clean and cheap way to heat homes. This means many people that have a split system heater/cooler often only use it as an air conditioner/cooler and they use gas or portable electric heaters to heat their homes. They also don't like the perceived or actual 'cooling' effect of a split system heater blowing convective air on them, especially when only the fan is operating, because the room has reached the temperature that the heater was set to.

Many people tend to use an air conditioner before they turn on a fan, or they don't own a fan. Fans can operate for only 2 cents/hour and are good to use before and with an air conditioner. The project provided pedestal fans to householders to assist them keep cooler for little cost and they were well received.

An education/awareness raising program is required to shift people from gas heaters to electric reverse cycle heaters/coolers, which should highlight appliance lifecycle cost (capital and operating), energy rating labeling, efficiency and effectiveness to condition homes.

In terms of the safety of heaters, this project was a great way to find that:

- faulty gas heaters exist in low income homes. 4 existing gas heaters required replacement for different reasons. The most significant of these was that carbon monoxide produced by 1 heater was causing a client to be drowsy. When the gas wall heater was removed from the wall the plumber discovered a second safety issue. It had burnt thought the plaster wall and cupboard wall behind it and scorched clothes in the cupboard in the abutting room. See Energy Safe Victoria – July 2014 article: *Faulty heater hides burning secret* at www.esv.vic.gov.au

Figure 77: fire damage and burnt clothes found behind a faulty gas wall heater

It was discovered that many heaters and coolers needed servicing i.e. the air intake filters were blocked with dust. A basic heater/cooler service includes this filter cleaning, a carbon monoxide test for gas heaters, cleaning of gas jets and a complete check of the unit. The average price for a service was around $175.

4.4.1.6 Hot water systems

Installation issues, operation of and type of hot water systems have been the main HWS issues that require future attention, noting that hot water is typically 25% of home energy use.

Many HWS are installed without much/any insulation on the pressure relief valve and pipe coming from it, or the hot water outlet pipe. Both can and should be insulated with products that are available in the retail market. Foam 13mm lagging for pipes is readily available at plumbing/hardware stores, but a fit for purpose relief valve cover is at the time of writing only available from one manufacturer. Both should be required for new home and house renovation building compliance certificates.

Operation temperatures of HWS can be set to 60^{o}C or above, but many are set to well over 60^{o}C. This wastes energy and is costly, so HWS maintenance suppliers and installers should test and reset HWS to 60^{o}C.

Many homes had inefficient electric storage HWS. The type of HWS to replace existing HWS with is critical to improving residential energy efficiency. Ensuring replacement HWS are either suitably sized, high efficiency: i) heat pumps ii) continuous gas units or iii) solar units is a reliable way to improve energy efficiency in homes and reduce energy costs. With both the Australian and Victorian governments providing rebates for solar systems (heat pumps and solar hot water panels) new high efficiency HWS that retail for up to $3200 (including installation) can cost only $850 installed at time of writing – the same retail price of a cheap inefficient HWS.

4.4.1.7 Window furnishings

Householders placed a big priority on improving window furnishing to minimise energy movement through windows when negotiating home retrofits. The home audit reports rarely recommended window furnishings, as their impact on the star rating of homes using NatHERS software is relatively low. Nonetheless only 15 window furnishings were done out of over 1000 interventions, or 1%. They included installing external awnings, internal blinds and perforated aluminium foil internally. Clients reported short term positive benefits from window furnishings. They are likely to be very popular if they are supported financially by government and can have a large effect on internal temperatures, heating/cooling costs and householder comfort.

4.4.1.8 Fridges and TVs

A lot of homes had more than one fridge, with those other than the main kitchen fridge often left on all year for social events that are few in number i.e. summer barbeques, birthdays etc. There is a large opportunity to improve energy efficiency by encouraging householders to turn unused/infrequently used fridges off most of the time and just turn on the extra fridges when they are required.

There were still old inefficient TVs in 9% of homes which could be replaced with LED TVs to reduce running costs and energy use.

4.4.2 Behaviour Change

Households which underwent behaviour change only interventions did not show a noticeable improvement in any of the energy efficiency quantitative measures. In contrast, self reported feedback from householders about the targeted behaviour change support they received was very positive and the self-reported number of actions taken to save energy increased during the project.

4.4.2.1 Combination of retrofit plus behaviour change intervention works best

Combining home retrofits plus behaviour change support is the proven way to improve residential energy efficiency in low income homes, based on this trial. Providing behaviour change support piggybacks beautifully on supporting householders with home retrofits. It appears that householders are more empowered to act to improve their energy efficiency when they have something materially new/improved in terms of energy efficiency in their home.

4.4.2.2 Feedback from householders and ELOs was positive

From both the ELOs' and householders' perspectives, the Energy Action Program was effective at increasing the number of actions householders took during the project to improve the energy efficiency at their homes.

Participating householders indicated a high degree of satisfaction with their involvement in the Energy Action Program i.e. it's likely to be politically advantageous for government to provide this support to low income householders. Most (over 70 percent) indicated it improved their understanding of saving energy and that it was useful in helping them reduce their energy consumption. So in a self-reporting sense, the participants thought it was beneficial. The energy efficiency analysis and quantitative outcomes may have been limited in scale due to the pre-existing frugality regarding energy use of the participants. They had a less than average chance of improving their energy efficiency.

4.4.2.3 Increase in the number of energy actions adopted

The Energy Action Program could be delivered in the future to achieve growth in the number of practices householders use to minimise energy usage The action topics likely to be adopted by low income householders include indoor temperature management, appliances, water, lighting and general awareness.

4.4.2.4 Free retrofits a catalyst to action

Householders that receive a free/supported/rebate assisted home retrofit are likely to adopt new energy efficiency actions after they have received something material for nothing. The retrofits appear to be a catalyst that leads to an increase in energy efficiency actions.

4.4.2.5 One-to-one versus Group support sessions

Group support sessions are far more effective use of funding/resources. Many people can be supported at a single event. Peer to peer learning is likely to occur if the ELO facilitator is good at facilitating group learning.

In terms of achieving the desired outcome of householders increasing their energy efficiency in an ongoing manner as a result of the support, this project can not differentiate whether either the one-to-one or group format is more effective. Nor can it prove that newly adopted energy actions will be sustained after the project.

Contemporary behaviour change learnings indicate that peer influence is more likely to influence the majority of people's behaviour rather than getting an expert to tell them what they should do. People are more influenced by personal experience and stories from a person that is similar to them, than by academics or experts. People often value advice or support from someone they already respect or trust.

4.4.2.6 Reflections on EAP design

It was important that the Project Reference and Advisory Group were consulted during the design of the EAP. This highlighted the likely HACC client loss rate and the need for participant retention strategies to keep people participating when possible.

The importance of identifying the householders' values/drivers/priorities was highlighted and built into the EAP design. This was only partially successful, with ELOs reporting that even if they identified a clients future desires or priorities directly or indirectly from the 'cake game', it was sometimes very hard to link this to a relevant energy efficiency action. It was even harder to set up a cause-effect relationship such that if a householder adopted action #1, the result would be some level of progress towards their previously identified value/driver/ priority. An indirect positive outcome of the cake game was that ELOs learnt more about their clients and as a result were sometimes more informed when offering support to clients thereafter.

The strategy of small incremental change was appropriate, so that clients were happy to adopt a comfortable number of actions at a time. The practice of normalising new actions was also appropriate i.e. saying "most people wash their clothes in cold water these days. The washing detergents and the way machines work now mean that you can't see the difference between hot and cold water washing for most situations".

The practice of repeat contact with clients was positive, whether by phone or another visit, to reiterate messages and remind clients of their adopted actions, checking how successful they were at remembering to do them and congratulating clients for doing their adopted actions. The active use of highly visible and interactive fridge magnet by clients also appeared to support this process.

On its own the behaviour change intervention was a qualified success and was highly regarded by clients. Behaviour change (in combination with home retrofits) was a critical element in this and future energy efficiency projects.

4.4.2.7 In-Home Displays

The custom designed In-home displays are a very expensive and ineffective way to improve energy efficiency for this demographic. They have been surpassed (for people with internet access in their homes) by free online energy use data portals created by energy retailers. ELOs and contractor staff reported there were definite waves of enthusiasm and use of these IHDs, a bit like a new toy or other device perhaps. It was definitely not worth the cost of the deluxe IHD hardware and software (over $2000 each) in terms of energy saving during the project.

In terms of learning and future IHD/energy use communication design, custom IHD design and testing as a very valuable exercise for staff and consortium members and project findings. Some of the deluxe IHD hardware and software design features were beneficial i.e. 10” tables, large font, highly visible graphs, large numbers and text and including a clock/time image on the screen as a screensaver function. This clock feature was to encourage regular use of the device, on the premise that users may be more likely to also check their energy use when checking the time.

The standard IHDs are much more affordable, but householders (especially those who are vision impaired) had trouble reading the relatively small screens and others with physical issues had trouble pressing the devices controls and buttons. The Watts Clever IHDs only showed total energy use and not energy use by circuit.

Some people had the computer experience and skills to use the IHDs whilst others did not, even with support from ELOs. Some clients showed the IHDs to their family members including grandchildren so they could see how much the energy use increased when they visited. IHDs (or their more modern, generally accessible, free online equivalent) are a good way to share energy use information with all energy users. For people with access to internet, the most cost effective way to see their real-time energy use is to use their energy retailer’s energy use portal on their own computer/smart device.

4.5 Energy monitoring data

It was a very valuable exercise to collect initially bills, plus later the monitored and distributor energy data. This allowed:

- bills to inform interventions
- comparison between the data sources to ensure they were accurate/similar
- circuit data to be collected to allow collection of particularly lighting circuit data before and following LED upgrades, heating /cooling circuit to compare before/after use
- comparison to be made between mains circuit data and the sum of sub-circuit data

4.5.1 Monitored energy

The process of identifying homes and householders within each study group that were suitable and eligible to receive energy monitoring equipment, installing and maintaining it was significant and costly (over $600,000), but the data and knowledge derived from monitored data has been very beneficial in that:

- monitored data allowed analysis of energy use patterns well before distributor data was requested or available, so the preliminary results of interventions were accessible early
- it allowed the project to identify any unusual energy use patterns, investigate them and if the householder was interested, support the householder to modify energy use or the appliance in some way (depending which study group they were in)
- householders with deluxe IHDs could access their energy use easily if they could operate the device and software

A safety issue was identified during gas energy monitoring equipment installs:

- 12 homes (or 10%) of the 120 homes that received energy monitoring equipment had gas leaks. This was discovered when the gas systems underwent pressure tests as required by law after gas works. These leaks were fixed or faulty appliances were replaced (3 cooktops and 1 barbeque) for an average price of $2000 per home

A safety issue was identified prior to electricity monitoring equipment installs:

- Asbestos is a material that was used in the creation of many pre-2004 electrical fuse/switchboards and surrounds i.e. most switchboards installed before 1990 are very likely to contain asbestos
- 'Federal' cast-iron switches are present in some homes and contain asbestos
- Houses that appeared to have asbestos containing materials in/surrounding the electrical fuse box/switchboard were excluded from the electrical monitoring component of the study

4.5.2 Distributor data

Distributor data was accessible through the energy distributors and confirmed the monitored data was approximately the same. It required good communications and relationship development between project staff and the distributors to get the data.

Accessing distributor data was much cheaper for the project than monitored data, but required a lot of work checking the format and content of the data to ensure it was correct, liaising with distributors and sensitivity regarding the providers' data management systems, capacities and constraints.

It is recommended that the role and responsibility of energy distributors to record and provide accurate energy use interval data is reviewed nationally in consultation with all stakeholders. It is proposed that clear requirements are put in place via legislation and/or the Australian Energy Regulator that will make it easy for energy users, professionals or researchers to access accurate energy use interval data that is derived from smart meters.

4.5.2.1 Smart meter data

One of the problems with using smart meter data for determining electricity consumption is that for houses with PV the actual electricity consumption cannot be determined. This is because the meter records net energy consumption not gross consumption. During the day when the PV array is generating electricity this is utilised by the house and only the additional electricity that is required from the grid in excess of what the PV array can provide is recorded by the meter. Equally, you cannot determine how much electricity the PV array has actually generated because only the excess electricity that is exported to the grid is recorded by the meter. Analysis of the smart meter data shows that within the cohort of houses in this study, the energy use difference between houses that had PV arrays and those that did not is not large.

Daily gas use data was derived from quarterly billing data i.e. by dividing the total quarterly gas use by the number of days to determine daily use. The real pattern of gas use within each quarter was therefore not available.

4.5.3 Temperature monitoring

The internal and external temperature monitoring exercise was fruitful in answering some important research questions. It showed that retrofits to the building envelope of low income homes improved the indoor winter temperatures. Behaviour change and retrofit interventions also improved the indoor temperature in winter by only 1.6 ^{O}C which was quite surprising, given that the householders reported they adopted more actions and had greater knowledge due to the behaviour support.

The temperature monitoring identified that summer maximum indoor temperatures are reaching a dangerous 30 ^{O}C at times in summer and in winter, indoor minimum temperatures going as low as 10 ^{O}C. It showed that bedrooms are about 1 ^{O}C cooler in winter compared to living rooms and this puts people with unheated bedrooms into below desirable temperatures in their bedrooms.

The temperature data was also invaluable to the RMIT research project and examination of the relationship between buildings, practices and health.

4.6 Benefits of providing energy efficiency support services to low income people

The benefits and co-benefits of providing energy efficiency support services to low income people include:

- provides progress to existing HACC objectives
- supports people to:
    - age in place
    - maintain/improve safety in the home (safer indoor temperatures during heatwaves and cold weather)
    - maintain/improve comfort in the home
    - reduce/minimise living costs
    - reduce cold-related pain/inflammation/stiffness

Other benefits appear to include:

- can lead to more visits from family/friends etc after the home and living conditions are improved
- can minimise social isolation
- can divert people away from addictions/issues i.e. gambling, alcohol, drugs
- can reduce the likelihood of domestic violence
- can provide a more comfortable/safe workplace for carers, resulting possibly in improved workplace productivity

4.7 Project outcomes

The most significant outcomes for the project included:

Category of intervention and average cost	Outcomes (compared to control study group)
Combination of Retrofit plus EAP ($2885)	From monitored data: • 10% lower total energy use/day (4.36kW) • 13% lower gas use/day (4.8kWh) • 13.1% lower gas bills/day (31 cents/day or $113.15/yr) • 13.0% lower greenhouse gas emissions/day due to gas consumption (0.95 kg CO_2-e) • 1.6 °C higher average temperature in living rooms in winter • 22.1% lower electricity use/day for lighting due to LED lighting upgrades (0.21 kWh) • 0.28 kg CO_2-e lower GHG emissions/day due to LED lighting From distributor data: • 11.4% lower total energy use/day (4.8kWh) • 18.5% lower gas use/day (7kWh) • 18.6% lower gas bills/day (45 cents/day or $164.25/yr) with a payback period of 17.4 years • 18.5% lower greenhouse gas emissions due to gas consumption (1.39 kg CO_2-e) From householders: • Met their expectations • Improved the comfort of their home • Recommend the program to others if delivered in the future • A high degree of satisfaction with their involvement in the Energy Action Program • Most (over 70 percent) indicated it improved their understanding of saving energy • It was useful in helping them reduce their energy consumption • Increase in the number of actions to improve energy efficiency
	From monitored data: • Did not show a statistically significant difference in energy, electricity, or gas consumption, or energy, electricity, or gas bills when compared against the control group. • 1.9 °C higher average temperature in living rooms in winter and householders felt more

Retrofits ($2348)	comfortable • 0.33 kWh lower daily electricity consumption for lighting due to LED upgrades • 35.9%lower electricity use for lighting • 9.5 cents/day ($34.68/yr) lower electricity bills for lighting (9 year payback period) • 0.42 kg CO2-e lower GHG emissions/day due to LED lighting From distributor data: • 7.1% lower total energy use (3.8kWh) with a 7.4 year payback period (savings on energy bills) • 14% lower gas bills/day (87 cents/day or $317/year) • 3.8 kg CO2-e lower GHG emissions/day due to reduced total energy use • 0.96 °C higher temperature in the living room in winter From householders: • Met their expectations • Improved the comfort of their home • Recommend the program to others if delivered in the future
Behaviour change ($711)	• Did not show a statistically significant difference in energy, electricity, or gas consumption, energy, electricity, or gas bills or daily greenhouse gas emissions when compared against the control group. • Did not show a statistically significant difference the average temperature in the living room during the winter months when compared against the control group • Did not show a statistically significant difference in electricity consumption (or electricity bills or GHG emissions) for lighting when compared against the control group From householders: • A high degree of satisfaction with their involvement in the Energy Action Program • Most (over 70 percent) indicated it improved their understanding of saving energy • It was useful in helping them reduce their energy consumption • Increase in the number of actions to improve energy efficiency • Recommend the program to others if delivered in the future

4.8 Cost analysis

4.8.1 Direct Trial approach: cost of delivering the trial approach to a participant

The total Home Energy Audit cost was $313,124 for 320 homes, so the average cost was $978 each. Of these 260 were standard audits (100 points) at $455 each. 60 were high level audits (120 point including measure up, house plan & star rating) at $3250 each.

With the experience that staff have gained from the project, many staff (from SECCCA or local governments) could in 2 hours audit a home, discuss the situation at the home with the householder, recommend retrofit works and likely indicative costs, identify some priority energy efficiency actions and create an Energy Action Plan. If accompanied by an apprentice energy efficiency tradesperson, some basic home retrofit works (LED light upgrades, draught sealing, and HWS insulation) could be provided simultaneously. It is estimated the total cost of the first visit might average $150-200 each. Up to 2 more visits may be required/valuable, taking total cost to $300 per household.

Home retrofit hardware and install cost per participant for 154 homes (6 other participants dropped out of project/didn't want retrofit) had a total cost of $360,000 and an average of $2348 each. In future projects it depends how much the funding organisation is willing to spend on each home. The project identified that some people from the control group and behaviour change groups were happy to arrange home improvement works up to between $500-4800 when an additional $450 for basic retrofit works from the project was contributed as a thank you for their participation.

Coaching and providing education to householders cost over $700 for each client including all the planning and preparation. This could be done for much less in the future as described above with the experience/collateral materials from this project.

Including the project coordination, planning, administration support, energy monitoring and analysis was critical to this as a research project and added considerably to its cost and outcomes.

4.9 Barriers to energy efficiency

Common barriers that stop/limit householders from improving their energy efficiency include:

- low incomes to buy the goods and services required
- age and/or presence of a disability to a point that limits their mobility and access to energy efficiency information, goods and services
- limited awareness of energy efficiency possibilities
- limited English and literacy
- beliefs (cultural, social, political and/or scientific) can result in people placing energy efficiency actions very low on their 'to do' list, or not including energy efficiency actions at all on their list
- tenants living in rented homes usually need approval from their landlord/property manager to undertake works on the home and this approval can be intimidating to seek and/or difficult to get, or is not available at all
- old homes may be inefficiently designed and constructed in terms of energy efficiency

- homes may be poorly maintained i.e. air/water/gas leaks
- home owners may not trust the energy efficiency advice given to them by the private sector or the marketing material they receive
- the energy bills, their contents and/or readability.

4.9.1 How to remove the barriers?

Delivery of future similar but delivery-focussed projects could be successful through not-for-profit organisations with existing connections to the community and well developed rapport with the target audience i.e. local government or non-government community organisations.

The existing Australian and future proposed Victorian energy efficiency rebate schemes could make the cost of energy efficiency goods more affordable, but some critical goods and services that are not eligible for rebates at present could be added to these schemes to make home improvement more affordable for low income people e.g. supply and installation of ceiling insulation and also floor insulation, reverse cycle heaters/coolers, wider varieties of LED lights and draught sealing services. Also the existing rebates could be better publicised and made more accessible e.g. replacing old TVs with LED TVs, heater/cooler duct upgrades, fridge upgrades etc.

Supply of energy efficiency advice by a trusted organisation is required to inform low income householders what they need, where and how to get it, so they are more likely to do home retrofits and actions to improve their energy efficiency. This is especially the case regarding supply of energy efficiency goods and services. This is to make sure householders can make informed choices about what they choose to buy. At present many people are confused or intimidated by the ever changing energy efficiency market place.

Skilled and well educated community engagement staff are required to support householders effectively. Staff need to have good skills in communications, energy efficiency, building design and construction, listening, financial management, people skills and reporting. There is also a role here for multilingual staff to bridge the English language gap in many homes. Staff also need to be aware of (or trained in) renters' rights and the tenancy act, lease conditions and requirements.

4.10 Learnings

The following key learnings were made from the project:

- council HACC/CHSP teams provide a highly effective context to identify, recruit, retain and support low income householders to improve their energy efficiency
- recruitment of low income households through local government HACC/CHSP services is an effective way to engage them in an energy efficiency support project
- the majority of participating councils' HACC/CHSP teams are already at full capacity in terms of delivering their existing services to clients
- HACC/CHSP staff's willingness and/or capacity to provide different (energy efficiency) services is limited/non-existent
- if extra resources (financial, leadership, training) are provided to Council HACC/CHSP teams to provide energy efficiency support to low income householders in the future, they are an existing, trusted organisation that could provide energy efficiency support to low income homes (or possibly to future HACC/CHSP providers)
- councils also provided a great environment to host group community support sessions
- 'retrofit only' or a combination of both 'home retrofit and behaviour change' interventions significantly improve energy efficiency in low income households
- home retrofit interventions alone can increase the temperature and comfort of homes during winter, can improve the energy efficiency of households by 7% and reduce the cost of energy
- behaviour change interventions alone do not improve the energy efficiency of low income households
- LED light upgrades as part of home retrofits alone can improve energy efficiency, reduce lighting costs and greenhouse emissions
- home retrofits often led to improved energy efficiency behaviours that were initiated by the householders themselves
- many people are not aware of the information on their energy bill, cannot either read or understand it and therefore don't use their bills to improve their energy efficiency or costs
- many people are not aware of the opportunity or are too intimidated to contact their energy retailer and negotiate a better energy supply deal, even though this can reduce the cost of their energy bills.

4.11 Frequently asked questions

Which trial approaches worked well?

- Recruiting the high calibre of ELOs (university educated and most had experience in community engagement/support, good people and listening skills)
- Recruiting participants through a known and trusted organisation: local council HACC service
- Completing home energy audits to inform interventions
- Installing energy monitoring equipment to monitor energy use
- The behaviour change 'cake game' provided a fun and non-threatening context for ELOs to get to know the clients
- ELOs identifying householders' priorities/desires/values and then providing relevant support and advice that took these priorities into account to do with energy efficiency

and home improvements. Most householders took the support/advice and received the recommended works.
- LED light upgrades reduced electricity use for lighting by 20-30% per day
- Draught sealing reduced air exchange rate by 28%
- Retrofits increased winter indoor temperatures by 1.9 ^{O}C
- Providing easy to access remote electricity switches for appliances
- Providing easy to read safe temperature thermometers to householders
- Informing householders about the information on their energy bills and about energy supply opportunities (how to get a better deal)

Which trial approaches didn't work well?

- EAP intervention on its own achieved very little by way of quantifiable energy efficiency (maybe didn't have long enough/include summer post-intervention data)
- Retrofit only interventions had qualified success

Why didn't some trial approaches work well?

- Retrofit only interventions were not very successful in terms of some measures (e.g. reducing total energy use) because some householders need behaviour support to achieve significant reductions in energy use

Which recruitment strategies worked?

- Recruiting through a trusted existing organisation
- Having skilled and trained staff undertake face-to-face recruitment discussions with target householders, that had information about previous householder issues from the client database

What difficulties were encountered?

- Involving householders in the project: ELOs needed to develop trust and overcome householder resistance to participate
- The initial home energy audit results were not always accurate and didn't always help the retrofitting process
- ELOs were on a steep learning curve and their employment contracts changed over time
- The project's time schedule was unrealistic/changed/could be revised/improved
- It was a challenge dealing with contractors and tradesmen, especially in vulnerable peoples' homes. Their work was often invasive of people's homes and lives
- The number of visits to homes was too many for many householders
- Some householders weren't computer literate
- Some householders had bad eyesight
- Internal temperature sensors failed to work due to battery issues
- Lots of safety issues i.e. asbestos, working at heights, electrical hazards including isolation procedure prior to insulation installs and using non-conductive/insulated tools, gas leaks, recalled heat exchangers, lone female workers

How were they resolved?

- Some people were allocated to control or other study group with a relatively low number of visits required
- ELOs provided support and training manual to computer illiterate householders

- IHDs were designed with big screens, graphics and text
- Temperature sensors had batteries checked and changed regularly and RMIT student installed additional temperature sensors of a different type.
- ICANZ training and procedures

What were the other results of the trial?

The project identified that:

- many householders are living in homes that are oversized for their needs i.e. many low income, aged, single people and couples are living in 4-5 bedroom homes and they only actively use perhaps 25% or less of the home. This is likely to have significant ramifications for both them and society at large i.e.
    - their homes may be more suited to a family of 3 or more people
    - they may be using more energy than they need to be comfortable
    - their living costs are likely to be higher than they need to be
    - they may suffer greater financial stress than required
    - they forgo heating and cooling in their house, which can lead to unsafe temperatures and them living in possibly unsafe/unhealthy conditions e.g. indoor temperatures below 16-18^{0}C and above 30^{0}C.

- this is likely to be creating a preventable and unnecessary burden on community support offerings i.e. the public health system, social services, families, friends, employers etc
- there is a significant need for more appropriate affordable housing to be available for low income people
- it isn't necessarily the case that it is always best for people to age in the same place
- aging in a 'more suitable place' may improve the quality of some peoples lives i.e. provide/support them moving to a more affordable, comfortable and healthy living situation, which may help them to be comfortable, maintain their health and wellbeing
- many of the participants were socially isolated and may be more able to re-engage socially if they are supported to relocate to more suitably sized homes.
- rehousing support may lead to 'whole of society' benefits including reduced costs for government and householders and may help to manage the demand for community services
- at an onground delivery level, an energy efficiency support services team of 2 staff could be provided to approximately 500 homes per year for approximately $300 per home (plus government rebates for energy efficiency goods i.e. VEECs, STCs). This is likely to have a total cost of $150,000 per year including a vehicle, office support, equipment for 2 staff (one Band 4-6 plus a trainee)
- once the trust of a participant has been gained, they can be supported to, for example, develop pride in their home (see Appendix 18 Case Study), refocus behaviours and address other personal challenges, which in turn can increase their capacity and result in them improving their energy efficiency.

What benefits were generated for consortium members?

- increased knowledge and experience that could contribute to possible future community support programs
- greater awareness of the outcomes and benefits of possible future community support programs including improved energy efficiency, householder wellbeing, safety and comfort, reduced energy costs and improved indoor temperatures
- they have a great network of peers both with their own organisation (councils specifically) and in other organisations (between councils and businesses)
- greater awareness of energy efficiency opportunities, products and services

- Pride within council that they were participating in a project that provided material benefit for their community

What benefits were generated for energy efficiency businesses from the project

- the project prompted additional training of some of their staff (e.g. to meet ICANZ required training)
- generated extra income and business
- led to temporary expansion of businesses i.e. more staff, temporary employment
- businesses received constructive feedback and criticism from energy efficiency expert
- Greater awareness of the benefits of delivering their technical services within a partnership with social service providers

Was it managed internally or were there external organisations involved?

- it was managed internally
- different consortium members were engaged during relevant phases of the trail
- the independent evaluator kept aware of the progress and processes, constantly evaluating and providing feedback during the trial and at key milestones

How did this work and did this approach improve trial outcomes?

- it worked well, both the involvement at relevant times of consortium members and contractors, plus the formative and ongoing evaluation and feedback provided by the evaluator
- this approach definitely improved trial outcomes as it drew on the knowledge and experience of many stakeholders, allowed ideas to be initiated, tested, reviewed and continuous improvement to occur.

What challenges did you encounter in managing your trial?

- The timelines proposed for the trail were an underestimate of the optimum/realistic time required to get the most valuable results from the trial i.e.
  - participant recruitment took longer than the projected 1-2 months
  - delivery of interventions took 10 months compared to projected 4 months
  - installation of energy monitoring equipment took 10 months compared to projected 4 months (delayed by extended recruitment period)
  - draft report date being brought forward to 1 March 2016
  - crucial staff were unavailable for the usual factors, including training and organisational needs, sick leave, annual leave etc. that come with working in diverse settings

- The combination of all these factors resulted in a much shorter time period post-intervention for the project to generate post-intervention data that covered all seasons, fully analyse the data collected and provide the most informed findings and recommendations.

- The possibility and presence of asbestos containing materials (ACMs) in the participating homes required an asbestos risk management plan to be created and implemented in 2 phases of the project i.e.:
  - during the installation of energy monitoring equipment especially in ‘Federal’ electrical switchboards

  - contractors/ELOs/other staff identified possible ACMs at homes, representative samples of these materials were safely collected & delivered to a suitable consultant for testing, testing was undertaken, consultant provided test results in a written advice to SECCCA including recommended actions to manage the ACM risk if present. This occurred during the home improvement/retrofit phase of the project in only 4 homes and was not budgeted for.

- Lone worker situations i.e. when and where we had a lone worker visiting homes, especially:
  - when a staff member was providing Basic Home Retrofits alone that required them to get into the ceiling cavity to inspect and/or install Draught Sealing to a ceiling exhaust fan
  - when the participant was a single male who may have previously displayed behaviours which intimidated the ELO. A Lone Worker Procedure/Policy was prepared and implemented to manage this risk.

- Mismatched energy use data was provided to SECCCA by distributors. This error appeared to originate during the transfer of data from retailers and distributors. Due to time constraints it was disposed of.

- LED technology progressed quickly leading to many downlight products becoming available for free due to their eligibility to receive energy efficiency rebates (VEETs). This probably meant that less opportunities to install LED downlights were available than would otherwise have been present.

- The project created 8 energy information sheets but these weren't used much at behaviour change visits due to amount of information that was already being covered in the visit. They will be made available via the project website in 2016 for the general public.

- The project decided to limit is media releases about the project even though media and communication were planned to occur from the project outset. This limit on media material was because SECCCA is an alliance of 8 local governments. For SECCCA to release media material, all participating councils' communications departments have to approve the media content. This limits the possible content in media material to manage all risks to member councils and manage community expectations.

4.12 RMIT Health Study

The findings of the Health Study were interpreted for their implications for the policies and practices of Ageing in Place, carbon mitigation and public health. In order to capture multiple benefits, it is suggested that the attention in residential energy efficiency initiatives should shift from the focus on the stand-alone issue of energy to the systems-approach to housing, energy and health. In particular, it is suggested that initiatives that target energy consumption have to be sensitive to the prevalence of cold homes in Victoria, its causes and its effects.

The finding of voluntary under-heating in this study concurs with the results of other empirical Australian studies. Non-heating of bedrooms, and allowing living room temperatures to drop below recommended levels during the night, seem to be practices that are socially shared. On the premise that exposure to temperatures below certain thresholds constitute a health risk, especially for older people, this finding may contribute to an explanation for Australia’s winter excess death rate, which is surprisingly high considering Australia’s temperate climate. Research is needed into epidemiological patterns of indoor cold and health outcomes in Australia and into the ability of common coping strategies to protect from cold related ill health.

The findings of this study also suggest that the combination of a retrofit to the building envelope and the upgrade of the heating system may be more effective in providing benefits in warmth, affordability and householder satisfaction than mere retrofits to the building envelope. However, considering the small sample of households in this study, further work is needed to establish the validity of this hypothesis. The study found that the current residential energy efficiency star rating tool is not equipped to assess this set of criteria or to predict the affordability of achieving adequate temperatures.

The study also highlighted that the prediction of energy savings from retrofits should be sensitive to the contextual determinants of indoor temperatures. This study revealed that the retrofits of fuel poor households may fall short of expectation due to the pre-bound effect. As long as this phenomenon does not lead to increases in overheating, increases in energy consumption should be interpreted as a positive outcome and as being beneficial for householder health.

4.13 Swinburne research: Who influences the householders most?

The Swinburne Masters research has indicated that the relationships of most importance to the low income householders (when they are seeking advice on energy in the home) are partners. Children are the next most important influence, followed by ELOs (from this project) and then friends. This makes partners and children a priority to target and collaborate with in future behaviour change programs regarding energy efficiency for this project’s target audience.

The study identified that householders consult children most for advice on energy in the home, followed by members of groups (that householders are themselves members of), then ELOs.

The overall story of Most Significant Change chosen by householders was to manage the use of standby power.

4.14 What were our assumptions?

The following assumptions were made in the design of the project:

Assumptions:	True/false	Facts to support this outcome
Householders that receive behaviour change support will reduce their energy use by an average of at least 10% following this intervention	False	Energy use has on average reduced by 2.8kW/day, or -5.8% per day following interventions in Groups B & C, compared to before interventions.
The project will be able to provide a simple generic package of energy efficiency items/retrofits to each home receiving home retrofits) and that this would be appropriate and agreed to by all the participant householders/owners	False	Houses were each very individual in their specific situation and the proposed interventions that were identified for them; it was determined that each home retrofit package needed to be determined on a case by case basis, to ensure agreement from the owner and so that a high likelihood of improving energy efficiency existed. Many items requested by homeowners were not appropriate.
Providing specifically developed IHDs would be effective to reduce household energy use significantly	False	Households which received IHD interventions did not show a noticeable improvement in any of the measures.
Numerous, competitive, cost-effective draught sealing service providers would be present in the local economy	False	There was a limited range and number of draught sealing contractors that were ready to provide goods and complete installation services over a wide area at scale for a reasonable/affordable cost
Engaging low income householders into an energy efficiency/community support project is effective through local council HACC services	True	The project was able to recruit, engage and retain (90% of those recruited) low income householders through local government HACC services to participate in this energy efficiency / community support project
Assisting low-income households to implement sustainable energy efficiency practices to help manage the impacts of increasing energy prices will be effective/successful	Partially true	From onsite monitored data, households which underwent a combination of retrofit and behaviour change interventions made a mean saving of $113/year (or 13.1%) relative to the control group, reducing their average gas costs/day from $2.37 to $2.05.

		From distributor data, households which underwent retrofit and behaviour change had a mean saving of $164/year (or 18%) from their gas bills relative to control group. Retrofit only interventions made a mean saving off their annual energy bill of $317 (14%) relative to the control group. The participating householders only used an average total of 44.1 kWh/day prior to the interventions, but during winter the average daily was 75.4kWh of which gas consumption contributed about 90% of the total. The average cost of energy was $5.80/day (excluding regular service charges). The average cost/day of residential energy in Victoria is approximately $7.65 (derived form Sustainability Victoria 2014 including inflation) This suggests that low income householders spend approximately 25% less than the general community and hence the capacity to reduce the daily energy use and cost of energy for low income householders was relatively low compared to the general community. Average daily energy costs in the retrofit plus behaviour change study group were reduced following interventions from $5.57/day to $5.27/day, or 5.3%. Average energy use for this group was reduced from 44 kWh to 40 kWh, or by 10%.
Assisting low-income households to implement sustainable energy efficiency practices to improve the health, social welfare and livelihood of low-income households will be effective	Somewhat true	The retrofit interventions eased subjective fuel poverty in winter, increased the average living room temperature by 1.9°C (RMIT study). Lighting interventions reduced electricity use and electricity bills with a payback of about 9 years Households which underwent retrofit only interventions and which received LED lighting interventions made a mean saving in their average daily electricity consumption for lighting of 0.33 kWh, a mean percentage saving in their daily electricity consumption for lighting of 35.9%, a mean saving in their average daily electricity bills for lighting of 9.5 cents, and a mean saving in their average daily GHG emissions for lighting of 0.42 kg CO_2-e. Households which underwent a combination of retrofit and behaviour change interventions and which received LED lighting interventions made a mean saving in their average daily electricity consumption for lighting 0.21 kWh, a mean percentage saving in their daily electricity consumption for lighting of 22.1%, a mean saving in their average daily electricity bills for lighting of 6.3

		cents, and a mean saving in their average daily GHG emissions for lighting of 0.28 kg CO2-e.
The LIEEP trial will build the knowledge and capacity of consortium members	True	Consortium members have indicated that their knowledge has increased, their capacity has increased slightly (due to the knowledge increase), but that to include residential energy efficiency support into existing council services (increase councils' capacity) will require a dedicated budget allocation, or strategic decision by each local or other level of government to fund and include residential energy efficiency support in the services offered to low income householders, plus related training, staffing review/changes etc
The LIEEP trial will build the knowledge and capacity of consortium members to encourage long-term energy efficiency among their customers or clients.	Partly true	Potential deliver providers need resources ($ and/or staff) to deliver such an energy efficiency support scheme and although the LIEEP has increased SECCCA members' knowledge of how to deliver such a scheme, and may encourage long-term energy efficiency among their customers or clients, it is unlikely that members will deliver residential energy efficiency support services to ratepayers without additional funding
18% of homes receiving gas related works will require gas repair works	False	Of 120 randomly sampled homes that received a gas pressure test, 12 homes (10%) required gas system repair/replacement of faulty gas appliances
The key to adequate ventilation in homes (in the absence of mechanical ventilation) is assumed to be appropriate occupant behaviour	Somewhat true	In a well designed and constructed home i.e. draught sealed, appropriate occupant behaviour is often the key to adequate ventilation. In contrast, some homes have leaky design/construction/building features i.e. an air exchange rate of 10+/hour that provide ventilation in the absence of occupant behaviour e.g. open chimneys, wall vents, plumbing/electrical wall penetrations or air gaps in the building envelope. These homes need little if any actions to keep them well ventilated. They rather require actions to reduce the ventilation.

Energy efficiency thinking is not in many people's minds – we have to be deliberate and insert it.	False	Most of the Study Group B & C (behaviour change) householders were already doing many actions that reduced their energy use prior to the project i.e. many people already use energy frugally, but this can be motivated by costly energy bills rather than by energy efficiency. Outcomes of improved comfort, health and wellbeing can be used rather than energy efficiency to achieve energy efficiency outcomes.
The fact that energy efficiency saves dollars is not a sufficient driver for people to become energy efficient – there are barriers that must be overcome.	True for some people False for other people	For people with available cash/money to spend with discretion, saving money is not a priority so energy efficiency a relatively low priority For people with little money, reducing costs is a necessity/high priority and being energy efficient is a pathway to reduce energy costs, but this cannot always be achieved due to one or more barriers being present i.e. cost, awareness of opportunities, distrust of providers, lack of energy efficiency literacy
Change is more likely to occur within a context of trust and familiarity	True	This appears to be true in this project. Householders were engaged in the project, changed some of their existing behaviours and adopted new actions even though the ELOs were not their existing direct care worker prior to the project. Householders had a level of trust in the ELOs for possibly a few reasons: i) because ELOs came from council HACC services, which clients had good experiences with previously ii) the existing HACC direct care workers 'facilitated' the initial introduction of clients to ELOs or 'handed them over' iii) the character and training of the ELOs empowered them to develop a good rapport with clients resulting in change.
It is easier to leverage change from an existing relationship than to create a new relationship	True	As above
Householders would prioritise reduced energy bills over comfort	Varies with context	Many householders place comfort as a higher priority than reducing energy costs. Other people prioritise reducing bill costs over comfort. Very subjective.

There would still be safety issues with ceiling insulation and its installation after the previous national program	True	Safety issues still definitely exist with installing insulation in homes i.e. contractors awareness of what they have to do as per ICANZ standards/guidelines, working at heights, training required, electrical isolation procedure, ensuring suitable lighting, PPE, lone worker procedure, asbestos identification and management
HACC would recruit vulnerable households and consider income plus equity/assets to determine eligibility	False	HACC services do not assess client need/eligibility for support based on total income plus assets test; rather eligibility to receive care/ support is based on possession of health care/concession card/social security benefits recipient status

4.16 Budget

A summary of the original and final project budget including LIEEP funding and co-contributions (both in-kind and cash) is provided in Table 47.

The original budget was indicative only and was created prior to many of the project deliverables being contracted to either consortium members or other private providers of goods and services. Variations during the project included:

- Project administration increased as independent auditing was not included originally.
- The coordinator and other staff salary lines were projected originally to continue until August/September 2015 and were extended until June, March and April 2016 respectively after a mid-project review occurred.
- Variations to energy monitoring partner contracts were required to complete the required tasks and minimise the unbudgeted cost of removing monitoring equipment from homes.
- Gas leak faults were less than projected so this money was reallocated within the project where it was required.
- In-home display hardware and software costs varied from planned costs.
- Project development, meeting and training costs were higher than those projected.
- Project staff provided the post-intervention householder surveys to minimise the cost.
- The draught testing and sealing contract was reviewed and partially reallocated within the project.
- Behaviour Change materials (6 x videos) required scripting which was not previously in the budget.
- Less printing was required than planned.
- Less advice than planned was required from Just Change to protect tenants.
- The reference group cost less to support than planned.

Much of the budget was committed to consortium partners and pre-agreed contracts, but variations occurred allowing other unplanned challenges to be addressed safely.

The project was completed on budget.

Table 47: Original and final projected project budget

Expenditure Item	original LIEEP Funding ($)	Actual LIEEP funding expenditure ($)	Activity Generated Income ($)	Actual Other Contributions ($) (in-kind)	Actual Sub-total cost ($)
Salary for SECCCA Executive Officer				77,998	77,998
SECCCA Project administration	249,821	279,749			279,749
Salary for SECCCA Project Coordinator	267,500	331,176		53,447	384,623
Salaries for 14 Aged and Disability Services / Environment Officers				417,205	417,205
Salaries for 7 Energy Saver Direct Care staff and 1 part-time research and training officer	1,042,500	1,079,112			1,079,112

Salary for CSIRO Research Officer and research overheads	855,000	855,000		300,750	1,155,750
120 gas monitoring systems	230,400	269,438			269,438
120 electricity monitoring systems	297,000	366,751			366,751
120 Telstra data plans	65,000	41,851			41,851
Gas pipe repair/replacement works for 60 households	143,000	39,103			39,103
In-home display software	40,000	34,080			34,080
Intellectual property (data collection)				199,994	199,994
In-home display monitors	20,000	48,484			48,484
High level energy audits	58,800	73,245			73,245
Standard energy audits	117,000	118,178			118,178
Star ratings for households	53,500	35,305			35,305
AccuRate Measure-up for households	77,400	86,397			86,397
Project meetings, development and delivery of training program	15,000	31,411			31,411
Assistance in development of householder surveys and software development and use of electronic devices to collect survey responses	10,000	10,000			10,000
Return visit to households to complete 120 Post project surveys	12,000	0			0
Air barrier works (test, seal, retest, and report)	118,200	79,975		57,600	137,575
Full retrofit works	384,000	343,732	12,069		343,732
Basic retrofit works	48,000	55,638	4,464		56,638
Behaviour Change program material	83,930	92,430		19,093	111,523
SECCCA project printing material	20,000	985			985
Salary for Just Change staff member	32,200	16,100		28,300	44,400
Salary for Briar Consulting staff member	156,000	156,000		32,054	188,054
Salary for reference/advisory group consultant	10,000	4,641			4,641
RMIT PhD student				314,951	314,951
Totals (ex GST)	**4,406,251**	**4,448,781**	**16,533**	**1,501,392**	**5,950,173**

NB: The project earned $25,872 from interest payments due to cash held in bank account, plus $4,464 voluntary co-contributions from householders for larger than budgeted retrofit works, plus $12,069 in renewable energy certificates; totalling $42,405.

5 Conclusion

This project has tested and evaluated a range of trial approaches to assist low income households to implement sustainable energy efficiency practices. It has recruited 320 low income householders through local government community care services, retained 299 of them to project end and assisted these households using different combinations of home retrofits, behaviour change and combinations of both to become more energy efficient. The project has captured and analysed pre- and post-intervention data and information. It has determined statistically significant findings regarding energy efficiency, householder-reported feedback and other valuable outcomes. These findings and evidence can be used to inform future energy efficiency policy and programmes.

The project has identified and reported how low-income households have benefited from the range of support services it provided. The project has demonstrated findings of improved indoor temperatures and comfort in winter, optimum ways to improve the draught sealing of homes, as well as some interventions leading to more efficient energy consumption, reduced energy bills and greenhouse gas emissions. The project has contributed to greater knowledge and capacity in the energy efficiency industry including client engagement, services, technology and equipment.

Benefits from the project have included:

- assisting low-income households to implement sustainable energy efficiency practices
- helping households to manage the impacts of increasing energy prices
- improving the energy efficiency of low-income households
- supporting people to:
    - age in place
    - maintain/improve safety in the home (safer indoor temperatures during heatwaves and cold weather)
    - maintain/improve comfort in the home
    - reduce cold-related pain/inflammation/stiffness
    - receive more visits from family/friends etc after the home and living conditions are improved and may minimise social isolation
    - develop pride in their home
- increasing the knowledge, experience and capacity of consortium members to facilitate long-term energy efficiency among their customers or clients e.g. working and sharing information collaboratively with other consortium members to develop a wealth of new knowledge, capacity and experience
- increasing the capacity of Australia’s energy efficiency technology and equipment companies by providing opportunities for them to participate in the project e.g. calling for, assessing and awarding competitive works contracts for energy efficiency goods and services.

This success of the project from the householders’ point of view in all three intervention groups was demonstrated by their strong endorsement of the Energy Saver Study in the post-intervention householder survey. Over 95 percent of householders would recommend a similar program to others. When asked why they would recommend it, the major reasons given were that the project helped lower energy bills, they enjoyed the visits by project staff to their home, it helps to keep people in their own homes, they trust the home care service and it was awareness raising and educational.

The most significant outcomes for the project were:

<table>
<tr><th>Category of intervention and average cost</th><th>Outcomes (compared to control study group)</th></tr>
<tr><td>Combination of Retrofit plus EAP ($2885)</td><td>From monitored data:
• 10% lower total energy use/day (4.36kW)
• 13% lower gas use/day (4.8kWh)
• 13.1% lower gas bills/day (31 cents/day or $113.15/yr)
• 13.0% lower greenhouse gas emissions/day due to gas consumption (0.95 kg CO_2-e)
• 1.6 °C higher average temperature in living rooms in winter
• 22.1% lower electricity use/day for lighting due to LED lighting upgrades (0.21 kWh)
• 0.28 kg CO_2-e lower GHG emissions/day due to LED lighting

From distributor data:
• 11.4% lower total energy use/day (4.8kWh)
• 18.5% lower gas use/day (7kWh)
• 18.6% lower gas bills/day (45 cents/day or $164.25/yr) with a payback period of 17.4 years
• 18.5% lower greenhouse gas emissions due to gas consumption (1.39 kg CO_2-e)

From householders:
• Met their expectations
• Improved the comfort of their home
• Recommend the program to others if delivered in the future
• A high degree of satisfaction with their involvement in the Energy Action Program
• Most (over 70 percent) indicated it improved their understanding of saving energy
• It was useful in helping them reduce their energy consumption
• Increase in the number of actions to improve energy efficiency</td></tr>
<tr><td></td><td>From monitored data:
• Did not show a statistically significant difference in energy, electricity, or gas consumption, or energy, electricity, or gas bills when compared against the control group.
• 1.9 °C higher average temperature in living rooms in winter and householders felt more comfortable</td></tr>
</table>

Retrofits ($2348)	• 0.33 kWh lower daily electricity consumption for lighting due to LED upgrades • 35.9%lower electricity use for lighting • 9.5 cents/day ($34.68/yr) lower electricity bills for lighting (9 year payback period) • 0.42 kg CO2-e lower GHG emissions/day due to LED lighting From distributor data: • 7.1% lower total energy use (3.8kWh) with a 7.4 year payback period (savings on energy bills) • 14% lower gas bills/day (87 cents/day or $317/year) • 3.8 kg CO2-e lower GHG emissions/day due to reduced total energy use • 0.96 °C higher temperature in the living room in winter From householders: • Met their expectations • Improved the comfort of their home • Recommend the program to others if delivered in the future
Behaviour change ($711)	• Did not show a statistically significant difference in energy, electricity, or gas consumption, energy, electricity, or gas bills or daily greenhouse gas emissions when compared against the control group. • Did not show a statistically significant difference the average temperature in the living room during the winter months when compared against the control group • Did not show a statistically significant difference in electricity consumption (or electricity bills or GHG emissions) for lighting when compared against the control group From householders: • A high degree of satisfaction with their involvement in the Energy Action Program • Most (over 70 percent) indicated it improved their understanding of saving energy • It was useful in helping them reduce their energy consumption • Increase in the number of actions to improve energy efficiency • Recommend the program to others if delivered in the future

Both qualitative and quantitative data has been collected and analysed statistically to determine the project findings. Participants indicated home improvements completed for them met their expectations, improved comfort resulted from these works and that their personal awareness and activity relating to energy efficiency had increased as a result of the project.

The energy use analysis did not include data from January or February 2016 and is therefore skewed to the autumn, winter, and spring seasons.

It must also be noted that the retrofit and behaviour change study group was more likely to contain households judged as being more able to cope with a high level of interaction. This has the potential to introduce bias into the randomised control process.

Ideas for future research include:

- the collection of a full year's worth of data both pre-intervention and post-intervention to give a more complete assessment of intervention impacts across a whole year with a focus on summer months
- conduct randomised control trials to test the efficacy of different retrofit subtypes
- further exploration of behaviour change subtypes
- epidemiological patterns of indoor cold and health outcomes
- the ability of common coping strategies to protect from cold related ill health
- to establish the validity of the hypothesis that the combination of retrofit of building envelope and upgrade of the heating/cooling system may be more effective in providing benefits in warmth, affordability and householder satisfaction than merely improving the building envelope

5.1 Key learnings

The following key learnings were made from the project:

1. council HACC teams provide a highly effective context to identify, recruit, retain and support low income householders to improve their energy efficiency
2. recruitment of low income households through local government HACC services is an effective way to engage them in an energy efficiency support project
3. the majority of participating councils' HACC teams are already at full capacity in terms of delivering their existing services to clients
4. HACC staff's willingness and/or capacity to provide different (energy efficiency) services is limited/non-existent
5. if extra resources (financial, leadership, training) are provided to Council HACC teams to provide energy efficiency support to low income householders in the future, they are an existing, trusted organisation that could provide energy efficiency support to low income homes (or possibly to future CHSP providers)
6. councils also provided a great environment to host group community support sessions
7. either 'retrofits only' or a combination of both 'home retrofit and behaviour change' interventions can significantly improve energy efficiency in low income households
8. 'retrofit only' interventions achieved a statistically significant energy efficiency outcome of 7% reduction in total energy use based on distributor data (compared to

control group), whilst simultaneously increasing winter indoor temperatures by an average of 1-1.9°C.

9. this project's behaviour change interventions alone did not improve the energy efficiency of low income households
10. LED light upgrades as part of home retrofits alone can improve energy efficiency, reduce lighting costs and greenhouse emissions
11. home retrofits often led to improved energy efficiency behaviours that were initiated by the householders themselves
12. many people are not always aware of the information on their energy bills, cannot either read or understand them and therefore can't use their bills to help improve their energy efficiency or costs
13. many people are not aware of the opportunity or are too intimidated to contact their energy retailer and negotiate a better energy supply deal, even though this can reduce the cost of their energy bills
14. partners, children, family and local government HACC staff are of significant influence regarding energy efficiency for low income householders and are the most likely people that will be asked for energy efficiency advice
15. living room temperatures were found to drop below recommended levels during the night in winter
16. the air tightness of most homes pre-intervention was poor but was generally fair following draught sealing
17. intermittent overheating was common

6 Recommendations

For future policy and program design the project makes the following recommendations:

1. Provide resources to and/or widen the role of organisations that provide community care services as follows:
    a. Educate/inform future CHSP assessment, team leader, direct care and home maintenance workers of the opportunities and benefits to improve the energy efficiency of homes and in doing so, increase their capacity to provide clients with relevant resources and support
    b. Redefine CHSP teams (including Home Maintenance/Modification) roles to include improving energy efficiency (and therein safety) of homes as a core responsibility of supporting the community to age in place
    c. Support CHSP providers to have and provide useful energy efficiency information to clients about how they can improve the energy efficiency at their home, as well as the additional benefits of energy efficiency i.e. reduced energy bills, improved comfort, health and wellbeing
    d. Ensure that as part of the process to identify and support first the most vulnerable, assessment of clients' eligibility to receive support services takes into account the client's current income, the value of their assets and access to cash. This will be critical to ensure that the most vulnerable and those with the lowest incomes and capacity to improve their wellbeing are supported by future programs first as a priority.

e. Support CHSP providers to support clients to do their own home retrofits i.e. CHSP services to:
    i. facilitate clients to get their homes audited with reports provided for free by Archicentre (funded by Victorian DHHS) including a list of the priority actions, costs & benefits
    ii. advise clients of the preferred local suppliers of energy efficiency goods and services
    iii. advise clients of the finance/rebates/loans available to pay for the works/actions and support them to access these
    iv. identify and support clients first who are most vulnerable and have the lowest capacity (i.e. mental, financial, physical)
    v. buy energy efficiency products in bulk and sell them on to clients at relatively low costs
    vi. employ low cost energy efficiency apprentices into their Home Maintenance/Modification teams to provide low cost basic retrofits

2. Balance the effects of home retrofit support programs on summer and winter temperatures including in the residential star rating software
3. Shift the focus of residential energy efficiency policy/programs from the stand-alone issue of energy to the systems-approach of housing, energy and health.
4. Initiatives which target energy consumption need to be sensitive to the prevalence of cold homes in Victoria, its causes and its effects.
5. Provide home retrofits plus behaviour change support to low income households to improve energy efficiency, reduce gas use and greenhouse gas emissions and to make homes warmer and more comfortable during cold weather, as well as cooler and safer during extreme hot weather
6. Support residential lighting upgrades with LEDs to reduce household energy bills, electricity use and greenhouse gas emissions and improve lighting performance for the sight impaired

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8 Appendices

Appendix 1 Privacy Notice

1. Background

A. This privacy notice has been developed for the Energy Efficiency Program (the Program) which is funded by the Commonwealth and delivered by organisations that have been successful in obtaining funding for their project from the Commonwealth. The objectives of the Program are:

a. to trial and evaluate a number of different approaches in various locations that assist low income households to be more energy efficient;
b. to capture and analyse data and information to inform future energy efficiency policy and program approaches.

B. Further details about the Program can be obtained by contacting the Department of Industry, Innovation & Science (the Department) or visiting the Department's website: www.industry.gov.au or by contacting the South East Councils Climate Change Alliance (SECCCA). The contact details for the Department and SECCCA are listed at the end of this notice.

2. Why is my personal information being collected?

A. I, ………………………………………..<insert name of individual> of

……………………………………………………<insert address of individual>, understand that my personal information is being collected by council staff and SECCCA on behalf of the Department for the purposes and functions of the Program.

B. For the purposes of paragraph 2(A) above, I understand that I have the option of dealing with the Department anonymously or through the use of a pseudonym unless:

a. the Department is required or authorised by law or a court/tribunal order to only deal with individuals who have identified themselves; or
b. it is impracticable for the Department to deal with un-identified individuals.

I understand that if I choose to use a pseudonym or wish to remain anonymous then this may affect my eligibility to participate in the Program.

3. What personal information is being collected?

A. Personal information collected by council staff and SECCCA on behalf of the Department will consist of the following:

a. Household physical characteristics such as:

- size;
- building type;
- material; and

- roof type and material;

b. Information relating to your:
   - hot water system;
   - space heating; and
   - cooling system;

c. Lighting used within your household and property;
d. Appliances used within your household and property;
e. Income level of your household;
f. Details of people that reside at your household;
g. Energy sources including billing details for the following:

   i. electricity;
   ii. gas; and
   iii. other sources;

h. Energy use behaviour data from your household.

4. Who will have access to my personal information?

A. I understand that my personal information will be shared for the purposes of the Program with:

   a. the Department;

   b. SECCCA, its project partners and contractors; and

   c. *Commonwealth Scientific and Industrial Research Organisation* (*CSIRO*)

B. In addition, my personal information may be made available to other organisations if it will prevent or lessen a serious threat to the life, health or safety of any individual; to the public health or safety; if disclosure is required or authorised by law; or if the disclosure is reasonably necessary for law enforcement related activities.

5. How will my personal information be used?

A. I understand that my personal information will be used for the Program in the following way:

   a. compiling information and preparing reports to be disclosed to the Department to deliver the Program according to the Program objectives;

   b. to enable the Department to evaluate the outcomes of the Program;

   c. to enable CSIRO to conduct an analysis of the data collected and report on the results. This report will be based on aggregate data and personal information will not be identifiable;

   d. for the purpose of auditing compliance and safety and resolving relevant complaints;

   e. as authorised or required by or under law; and

f. 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.

6. How will my personal information be protected?

A. I understand that once the Department receives my personal information:

a. my personal information will be maintained in a secure environment and will not be released by the Department unless the law permits it or I consent to the disclosure;
b. that the Department will take reasonable steps to ensure that my personal information is protected from misuse and loss and from unauthorised access, modification or disclosure. I understand that my personal information will be stored in a safe and secure location; and
c. my personal information may be held in either electronic or hard copy form and will be destroyed or de-identified when it is no longer needed in accordance with the requirements of the *Archives Act 1983* (Cth).

B. I understand that the Department cannot provide any assurances regarding the security of any information that I send to the Department via the internet, including any guarantees that my personal information will not be intercepted whilst being transmitted over the internet. I understand that if I have any concerns regarding the transmission of personal information that I may provide my personal information to the Department via other means (e.g. mail, telephone and facsimile).

7. What happens if I refuse to provide my personal information for the Program?

A. I understand that I do not have to provide some or all of the personal information that is being requested. However, if I refuse to provide some or all of the personal information being requested, this may affect my eligibility to participate in the Program.

8. Can I change my mind about providing my personal information or update my personal information?

A. I understand that once my personal information has been collected, I can request:

a. access to my personal information; and
b. corrections, deletions or additions to my personal information.

9. Authority from the other household members

A. I have authority to provide personal information on behalf of the other members of my household who are listed below:

<insert details of other household members>

1………………………………………….. , 2…………………………………………

3…………………………………………... , 4 ………………………………………

10. Who to contact for further information about the Program, your personal information or to lodge a privacy complaint?

Contact person's name: Adam Shalekoff
Address: SECCCA. C/O City of Casey, PO Box 1000, Narre Warren VIC 3805
Phone number: 03 9792 7042
Email address: info@seccca.org.au

Contact Details in the Department:

Contact person's name: Program Manager, Low Income Energy Efficiency Program
Address: GPO Box 1564, Canberra ACT 2601
Phone number: 1800 609 507
Email address: lieep@industry.gov.au

Privacy Officer
Department of Industry, Innovation & Science
GPO Box 9839, Canberra ACT 2601
Email: privacy@industry.gov.au

11. Your consent

A. I consent to the collection, use and disclosure of my personal information as described in this privacy notice.

Name of individual:______________________

Signature/s: ________________________

Date: ________________________

Appendix 2 Introductory letter to target HACC clients

SECCCA South East Councils Climate Change Alliance

Energy Saver Study

COUNCIL LOGO

<Date>

Re: Energy Saver Study

Dear Householder,

You are invited to apply to be part of the *Energy Saver Study* which is funded by the Australian Government and being delivered by <XX> City Council and the South East Councils Climate Change Alliance (SECCCA).

If you apply and are selected to take part in the *Energy Saver Study*, you will receive:

- at least $500 of energy saving home improvements
- a home energy audit and education
- gas and electricity monitoring
- assistance getting landlord approval for improvements (rented homes only).

You are receiving this invitation because you are a Home and Community Care client of <insert name> Council. The study aims to find out how councils can help residents to reduce gas and electricity bills and to explore the relationship between residential energy efficiency and health.

Included with this letter is some information about the study, an *Expression of Interest form*, a *Privacy Notice* and a reply paid envelope. **If you want to apply to join the study, please fill in the forms and post them in the enclosed *Reply Paid* envelope or hand them to <HACC worker>. If you need help to apply, please call <HACC worker> on <insert phone number>.**

Households will be selected so that participants are spread across the <Council name> area. If your home is selected to participate, you will be contacted by council staff, given more information about the study and asked to sign an agreement.

Thank you for considering participating in this study. If you have any questions please call <HACC worker> on <insert phone number>.

Regards,

<Council, Officer Name, Position>

Australian Government
Department of Industry

This Activity received funding from the Department of Industry as part of the Low Carbon Communities Program

Appendix 3 Energy Saver Study flyer provided to clients at first visit

Energy Saver Study

Do you wish your energy bills were lower?

Would you love your home to be warmer in winter and cooler in summer?

Is your house too draughty?

We can help you.

Apply now to see if you qualify.

SECCCA South East Councils Climate Change Alliance

www.seccca.org.au

WHAT WILL HOUSEHOLDERS GET IF THEY PARTICIPATE IN THE ENERGY SAVER STUDY?

1. An Energy Upgrade/Support Pack worth at least $500
2. Gas and electricity monitoring for 2 years and the option to retain
3. An energy efficiency assessment of your home – completed by a qualified professional
4. Tailored energy efficiency information and training
5. Assist councils to better deliver energy efficiency services to the community

→ Householders will receive energy efficiency packages at different times during the two year study period.

All works will be carried out by fully qualified, accredited and insured professionals.

To see if you qualify, complete the Energy Saver Study 'Expression of Interest' Form and 'Privacy Notice' and return them to council.

From the Expressions of Interest across the region 320 eligible households will be randomly selected to participate in the study.

For more information contact

____

____

info@energysaverstudy.org.au

→ or contact your local council.

This Activity received funding from the Department of Industry as part of the *Low Carbon Communities Program* and is supported by Bass Coast, Baw Baw, Bayside, Cardinia, Casey, Kingston and Mornington Peninsula Councils.

Appendix 4: Draught Testing & Sealing Process

Draught Testing

Step One: Setting up the Home

1. All the internal doors will be opened
2. All external doors and windows will be closed.
3. The home will be checked for any un-flued gas heaters. If there are any, we can turn them off and go ahead with the draught testing, but we will not go ahead with any draught sealing.
4. On evaporative coolers, we will install a winter cover or close the damper if it is available.
5. Any vents on wood combustion stoves/heaters will be closed. We will make sure the fire is out. If ash bed is warm, we cannot proceed with the draught test.
6. Any clothes dryers, range hoods and/or exhaust fans will be turned off.

Step Two: Setting up the Draught Testing Fan and Testing for Draughts

1. A temporary frame and fan will be installed to an external door.
2. The fan will be started and we will make sure all internal doors are open, external doors and windows are shut, any fireplaces are undisturbed and the fan is secure in the door.

3. We will test the home for draughts at a range of air pressures.

Retrofitting: Draught Sealing (Fixing Leaks)

Step Three: Locating Leaks

1. The technician will move through the property and look for obvious leakage points.
2. The technician may use a smoke pen to locate points where air is entering the home. Only very small quantities of smoke are emitted from the pen and its use is kept to a minimum.

3. The technician will use their experience to feel airflow areas

Step Four: Fixing the Leaks

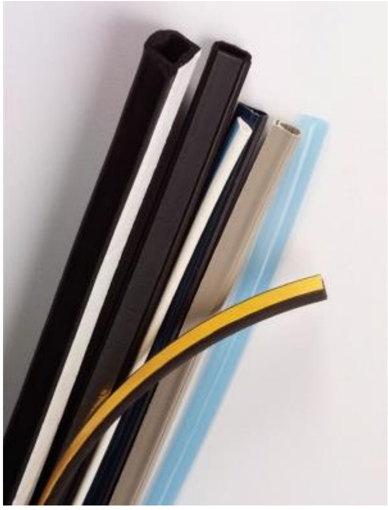
1. Common air leakage areas

- Electrical and plumbing penetrations
- Switches and power points
- Doors and windows (fixed and operable)
- Architraves around doors and windows
- Ventilation vents in plaster
- Open fireplace without damper
- Exhaust fans in bathrooms & laundry
- Exhaust fans in kitchen
- Recessed down lights
- Skylights
- Evaporative cooling grills
- Ducted heating grills

2. Technician will work using the appropriate sealing system to reduce draughts.

Common non- structural methods may involve:

Caulking



Window Weather Strips

Fire Rated Lighting Covers

Exhaust Fan covers

Sealing plumbing holes

Door draught stoppers

3. The technician retests the home with the fan.
4. The technician repeats the process until an acceptable result is achieved.

For further information:

www.yourenergysavings.gov.au

www.sustainability.vic.gov.au

www.airbarrierdraftproofing.com.au

This Activity received funding from the Department of Industry, Innovation & Science.

Australian Government
Department of Industry, Innovation and Science

For more information contact SECCCA:

Ph: 03 9705 5129

enquiries@seccca.org.au

www.seccca.org.au

Appendix 5: Householder pre-intervention survey

Question ID	Question	Answer
1	Enter Home Details	
	House ID Number:	
2	Home Owner Intro - provide information about the survey to the householder	
3	Electrical energy use per year (bills)?	$500-$1500 $1500-$2500 $2500-$3500 >$3500
4	If Mains Gas User: On average, how much does your household spend on mains gas per year?	<$300 $300-$1000 $1000-$1600 >$1600 Do not use mains gas
5	How are you managing the cost of your energy bills?	With difficulty Can just get by No problems Don't think about it
6	Does the householder need help in paying their energy bills?	Yes Sometimes No
7	How empowered do the householders feel in relation to their energy consumption?	Very empowered Empowered Neutral Rarely empowered Not empowered
8	How in control of their finances do the householders feel?	In control Sometimes in control Neutral Rarely in control Not in control
9	Have you undertaken any actions in the last 3 years to reduce the amount of electricity, gas or water you use?	Turn lights off when not required More efficient use of hot water e.g. shorter showers Effective use of curtains or blinds Turn appliances off at power points when not in use Installing electrical switch off devices Take into account energy efficiency rating when purchasing appliances Not having air conditioner so cold in summer or the heater so hot in winter Washing clothes in cold water Closing off areas that don't need to be cooled in summer/heated in

		winter Using fans instead of an air conditioner Only putting on washing machine or dishwasher with a full load Shutting blinds/curtains during the day in summer to reduce heat getting into the home Installed insulation, installed draught stoppers Other (please specify) None
10	How interested are you in conserving energy in your home?	Very interested Interested Neutral Rarely interested Not interested
11	Think of a cold day in winter. How do you keep warm in your home?	Central heating Gas heater Electric heater Open fire Slow combustion stove Mixture of appliances Put on jumper/appropriate clothing Other - pls specify
12	If central heating or portable heaters, what rooms do you heat?	All living and sleeping rooms (excl. Bath/WC/L'dry/Garage Living rooms Bedrooms Bathroom(s) Toilet Kitchen Other - pls specify None/NA
13	When do you use your heaters?	All day Night time only Day time only When I'm in the room When it is cold Other - pls specify
14	What temperature do you like your heated rooms to be at during a cold day?	Very hot/toasty Hot warm Pleasant just warm enough Take the chill off No heating
15	In winter, in general, do you feel that you are able to heat your home adequately?	Yes Sometimes No
16	If No, Why?	Home difficult to heat Cannot afford it Both Other - pls specify

17	To reduce energy the householder is doing? (Select all that apply)	Temperature low and monitored Heating only when room occupied Zoning their house Closing doors to non-heated rooms Wear/put on warm clothes Keep house doors and windows closed Not using appliances Cooking using oven None/Very little
18	Think of a hot summer's day. How do you keep your house at a comfortable temperature?	Air Conditioner Fans Close blinds/curtains Shut off rooms Ventilate before/after a hot day Other - pls specify None
19	If air conditioner - what rooms do you cool?	All rooms Living rooms Bedrooms Other - pls specify
20	How hot in degrees Celsius does it have to be inside before you turn on your air conditioner?	25 30 35 40 40+ Don't Know
21	How long do you leave your air conditioner on?	Whenever it is hot All day Night time only Day time only A few hours at the end of the day Other (temporarily - just to cool down) (please specify)
22	What temperature do you like your rooms to be at during a hot day?	As cold as possible (18 degrees) Cold (20 degrees) Moderate (22-24 degrees) Drop the temperature a bit (>=26 degrees) No cooling
23	In summer, in general, do you feel that you are able to cool your home adequately?	Yes No
24	If no, why?	Home difficult to cool Cannot afford it Both Other - pls specify
25	To reduce energy they are doing:	Blinds closed Doors and windows closed Closing doors to rooms not cooled Air conditioner off/not used Minimal use of air conditioner Fans

		External blinds used Avoid cooking inside the house Leave the house on hot days Ventilate the house in the cool hours None
26	How comfortable is your home? (heating/cooling/lighting etc.)	Very comfortable Comfortable Neutral Rarely comfortable Not comfortable
27	Do you use a dishwasher? If so, how often do you use it?	Multiple times each day Once a day Most days Once a week A few times a month Never Don't have one
28	Do you use a clothes dryer? If so, how often do you use it?	Multiple times each day Once a day Most days Once a week A few times a month Once a month Never Don't have one
29	Do you have a washing machine? If so, how often do you use it?	1-2 times per week 3-4 times per week 5-6 times per week 7-8 times per week 9 + times per week Do not have a washing machine
30	If you have a washing machine, what water temperature do you use?	Hot Warm Cold
31	To reduce energy they are doing? (Select all that apply)	Turning off appliance when not in use Drying washing outside/minimal use of dryer Using cold water washing cycle Don't use a dishwasher/only occasional Have reduced the number of fridges they use Using a fan to assist other cooling/heating appliances Other - please specify
32		
33	Please rate how strongly you agree or disagree with the following statements: Energy Efficiency is too much hassle.	

34	Energy efficiency means I have to live less comfortably.	
35	My quality of life will decrease when I reduce my energy use.	
36	Energy efficiency will restrict my freedom.	
37	Energy efficiency is not very enjoyable.	
38	Equipment Check: do you have all equipment?	

Appendix 6: Householder post-intervention survey

Question ID	Question	Answer
1	House ID number	
2	Household address	
3	Date of Survey	
4	What group is this household in?	Group A Group B Group C Control Group
5	Explain to the homeowner that the survey consists of two sets of questions. 1. revisits questions that were asked on the pre-survey to see if any changes have occurred over the time of the project. 2. explores their views of their involvement in the project.	
6	Ask the homeowner if they mind if the last part of the survey is recorded so we can record the responses in their own words. If the participant is not comfortable then please take notes of this part of the interview.	
7	How are you managing the cost of your energy bills?	With difficulty Can just get by No problems Don't think about it
8	Does the householder need help in paying their energy bills?	Yes Sometimes No
9	How empowered do the householders feel in relation to their energy consumption?	Very empowered Empowered Neutral Rarely empowered Not empowered
10	How in control of their finances do the householders feel?	In control Sometimes in control Neutral Rarely in control Not in control
11	Have you undertaken any actions in the last 3 years to reduce the amount of electricity, gas or water	Turn lights off when not required More efficient use of hot water e.g. shorter showers Effective use of curtains or blinds

	you use?	Turn appliances off at power points when not in use Installing electrical switch off devices Take into account energy efficiency rating when purchasing appliances Not having air conditioner so cold in summer or the heater so hot in winter Washing clothes in cold water Closing off areas that don't need to be cooled in summer/heated in winter Using fans instead of an air conditioner Only putting on washing machine or dishwasher with a full load Shutting blinds/curtains during the day in summer to reduce heat getting into the home Installed insulation, installed draught stoppers Other - doing physical activity every day Other - switch energy retailer Other (please specify) None
12	How interested are you in conserving energy in your home?	Very interested Interested Neutral Rarely interested Not interested
13	Think of a cold day in winter. How do you keep warm in your home?	Central heating Gas heater Electric heater Open fire Slow combustion stove Mixture of appliances Put on jumper/appropriate clothing Other - electric blanket Other - pls specify
14	What rooms do you heat?	All living and sleeping rooms (excl. Bath/WC/L'dry/Garage Living rooms Bedrooms Bathroom(s) Toilet Kitchen Other - pls specify None/NA
15	When do you use your heaters?	All day Night time only Day time only

		When I'm in the room When it is cold Other - For a few hours when it is cold Other - pls specify
16	What temperature do you like your heated rooms to be at during a cold day?	Very hot/toasty Hot warm Pleasant just warm enough Take the chill off No heating
17	At what temperature do you set your heater?	Don't know 18-20C 21-22C 23-25C 26+
18	In winter, in general, do you feel that you are able to heat your home adequately?	Yes Sometimes No
19	If No, Why?	Home difficult to heat Cannot afford it Both Other - pls specify
20	To reduce energy the householder is doing? (Select all that apply)	Temperature low and monitored Heating only when room occupied Zoning their house Closing doors to non-heated rooms Wear/put on warm clothes Keep house doors and windows closed Not using appliances Cooking using oven None/Very little
21	Thinking of next summer. How would you keep your house at a comfortable temperature?	Air Conditioner Fans Close blinds/curtains Shut off rooms Ventilate before/after a hot day Other - pls specify None
22	If air conditioner - what rooms would you cool?	All rooms Living rooms Bedrooms Living and bedrooms only Other - pls specify
23	How hot in degrees Celsius would it have to be inside before you turn on your air conditioner?	25 30 35 40 40+ Don't Know
24	How long would you leave your air	Whenever it is hot All day

	conditioner on?	Night time only Day time only A few hours at the end of the day Other (temporarily - just to cool down) (please specify)
25	What temperature do you like your rooms to be at during a hot day?	As cold as possible (18 degrees) Cold (20 degrees) Moderate (22-24 degrees) Drop the temperature a bit (>=26 degrees) No cooling
26	In the coming summer, in general, do you feel that you would be able to cool your home adequately?	Yes No
27	If no, why?	Home difficult to cool Cannot afford it Both Other - To save money Other - pls specify
28	To reduce cooling energy they are planning to:	Blinds closed Doors and windows closed Closing doors to rooms not cooled Air conditioner off/not used Minimal use of air conditioner Fans External blinds used Avoid cooking inside the house Leave the house on hot days Ventilate the house in the cool hours None
29	How comfortable is your home? (heating/cooling/lighting etc.)	Very comfortable Comfortable Neutral Rarely comfortable Not comfortable
30	Do you use a dishwasher? If so, how often do you use it?	Multiple times each day Once a day Most days Once a week A few times a month A few times a year Never Don't have one
31	Do you use a clothes dryer? If so, how often do you use it?	Multiple times each day Once a day Most days Once a week A few times a month Once a month Only during cold, wet weather Never

		Don't have one
32	Do you have a washing machine? If so, how often do you use it?	1-2 times per week 3-4 times per week 5-6 times per week 7-8 times per week 9 + times per week Do not have a washing machine
33	If you have a washing machine, what water temperature do you use?	Hot Warm Cold
34	To reduce energy they are doing? (Select all that apply)	Turning off appliance when not in use Drying washing outside/minimal use of dryer Using cold water washing cycle Don't use a dishwasher/only occasional Have reduced the number of fridges they use Using a fan to assist other cooling/heating appliances Other - Use pedestal lamps instead of whole room lighting Other - please specify
35	ELO to remind householder by outlining the retrofits that have occurred. You were randomly selected to be part of a retrofit group in the study which involved a number of home improvements these included…	
36	Did these home improvements meet your expectation?	Yes No Unsure
37	Over all, how useful were these changes in improving the comfort of your home? (scale from 1 to 5)	
38	More specifically, rate the impact of the following home improvements on the comfort of your home (only ask the relevant retrofits)	Not Applicable Useless Not Useful No change Useful Very Useful
	Insulation	
	Draught Sealing	
	Shade	

	Lighting	
	Heaters and Coolers	
	Appliances (Incl. TV)	
	Hot water service replacement	
	Other - please describe	
39	Please tell us more about the other improvements.	
40	Study Groups B and C - Behavioural change ELO to remind householder what was involved in the energy action plan.	
41	Think about the different visits from me and the activities I conducted with you: How would you rate the experiences you had with the energy action program?	
42	How useful was the energy action program in helping you reduce the amount of energy you use? (this group will be investigated in greater depth later in the project)	
43	If a home improvement program was provided in a similar way, through the home and community care area of the council, would you recommend it to other householders?	Yes No Unsure
44	Why? (expand on response q42)	Trust the council Trust home care service I liked the ELO visits/trusted them People need help to stay in their own homes Cheaper energy bills It is a waste of time Too intrusive

		See no benefits Other - please specify
45	As a result of being in the Energy Saver Study, did you find out anything new about saving energy?	Yes No Unsure
46	On a scale from 1-5 how would you rate your improved understanding of saving energy	
47	Have you completed any home improvements as a direct result of participating in the project that save energy, but were not funded by the project?	Yes No
48	What improvements did you make?	Insulation Draught sealing Shade Lighting Heaters and coolers Appliances (inc. TV) Hot water service Other - please specify
49	You mentioned earlier in the survey what you have done around the house to save energy. Did you adopt any new energy saving practices around the house as a result of participating in this study?	Yes No Unsure
50	How many new energy saving practices did you adopt?	We didn't adopt any new practices We adopted one new practice We adopted two new practices We adopted three new practices We adopted four or more new

		practices
51	What were they?	Indoor temperature management (use of thermometer, heater type [fixed/portable], time of heater/cooler use, wearing suitable clothes, windows/doors open/closed, shade, use of blankets etc) Draught sealing (seal doors, wall vents, holes in walls, fixed louver windows etc) Water (only boil what you will use, clothes wash full load/in cold, short showers, cold rinse dishes) Fridges (1 only, no hot food, defrosting, seal) Lighting (when on/off, zone/pedestal lights) Appliances (buying more efficient, switches off, standby) Improving energy bills and retailers Clothes drying on wash line Other - Please specify
52	Which new practice was most important to you 1. If the householder chose to describe a retrofit. Ask: did you change anything as a result of this home improvement? If so, what? 2. Why is this change important to you? 3. What do you think influenced you to make that change 4. If I can just ask you to recall making that change and can you tell me your story in your own words of how this came about? Use prompting questions below if	

	not covered: Was this personally challenging for you? If YES ask - How did you get around it? If NO ask - Why was it so easy? Had you considered doing this before? Did the household retrofits influence your decision to do this? Who did you chat to about this? What did they say? 5. How did you manage to keep doing it? 6. What results or changes have you seen specifically from doing this? 7. Did anyone you spoke to also have a go?	
53	Was there a story of “significant change”?	Yes Partial No

Appendix 7 Questions used to frame the local council focus groups

Questions	Possible answers
1. The project in your Council Area	
a. What difficulties needed to be overcome to establish and implement the project in your council?	
b. Were they overcome?	
c. Was there anything unique in the way the project was established and conducted in your council?	
2. In your view how well was the project was organised and conducted? Why	Poorly – ok – well – very well
3. How well were the activities of the project communicated to your council or organisation? Why	Poorly – ok – well – very well
4. Was it worthwhile for your council (or organisation) to participate in this project? Why?	No – Unsure - Yes
5. Benefits What benefits (for the council) can you see accruing from participating in this project?	
6. Barriers What difficulties needed to be overcome to implement the program and work successfully with clients?	
7. Flaws What reservations do you have about this project?	
8. Futures What can be taken from this project that would be useful to councils (your own and others)?	
9. Learnings What have you learnt from participating in this project?	
10. Any other thoughts or comments you would like to make about the project?	

Appendix 8: EAP task list

Detail of tasks for Energy Liaison Officers to implement EAP

<table>
<tr><th>Action</th><th>Tasks</th></tr>
<tr><td>Preparation to Visit 1</td><td>1. Review householders energy use, household survey and audit data.
2. Book visit with householder including preferred cake type/dietary preferences.
3. Brief HACC staff about the Energy Saver Study, why it is important, then encourage them to say to householders “Well done for doing the Energy Saver Study. Good on you. How are you going with the actions?”</td></tr>
<tr><td>Visit 1</td><td>1. Identify householders, dreams motivations, drivers (See tools)
2. Identify Energy Efficiency actions to assist householder’s progress to identified motivations (refer to Top 15 Actions List)
3. Associate personal driver to energy efficiency action
4. Provide householders with tools to list pledged action on fridge.
5. Help householder to develop a Pledge (a single action pledge)
6. If householder is ready for greater than three actions, then deliver Household Action Plan including house plan. (See visit 2 below)
7. Arrange next contact i.e. Visit 2/ Contact 1
8. Identify preferred contact method (phone, email, text?) and frequency of contacts until next visit</td></tr>
<tr><td>Contact 1</td><td>1. Phone call(s) to householder 2-3 weeks after Visit 1 to check progress, celebrate progress and offer support to householders.
2. Send letter of encouragement after 2 weeks of action e.g.

“Congrats on being part of the program…
Lots of other similar householders are doing actions like you i.e. list a few common actions.
Everyone is doing well.
You are really putting in a great effort. Etc”</td></tr>
<tr><td>Preparation for Visit 2</td><td>Prepare for this visit by looking at:
1. Past energy use data from gas and electricity monitoring equipment
2. Home Energy Audit results for each house (appliances, numbers of occupants etc)
3. Identify any obvious high energy use appliances and/or behaviours
4. Identify some desired actions that are likely to reduce energy use/cost</td></tr>
<tr><td>Visit 2</td><td>1. Check progress to Pledge
2. If relevant, show householder the relevant ESS animation/video on a tablet
3. Introduce Household Action Plan concept. The Household Action Plan is the complete list of actions that each householder decides to do – it builds on Pledge with additional energy efficiency actions.
4. Develop Household Action Plan
5. Arrange next contact i.e. type & frequency.
6. Phone call, text, email etc in 2 weeks
7. Identify and note if the householder might be an energy efficiency mentor i.e. willing and suitable to talk to other householders about their</td></tr>
</table>

	experiences.
Contact 2	1. Contact householder to check progress 2. Celebrate success if 4 or more actions have been attempted/achieved already (attempted/achieved = at least 5 weeks out of 8) with: • letter from a significant person (mayor, celebrity etc) • offer householder the option to share experience with other(s) i.e. at a group coffee/tea (Visit 3 below) and note if they are willing 3. Offer support to householders that require it (e.g. reminders via text, alarm on ph., email etc)
Visit 3	Visit 3 is a pre-arranged gathering for a group of householders that are participating in the ESS at a suitable location such as a café /house/council facility. The aim of this is to: • Provide an opportunity for participating householders to meet to discuss their experiences/ barriers/opportunities with others involved in the project in order to increase the number of desired actions that are practiced • Motivate people to continue to act to increase their energy efficiency by getting them to share stories in order to maintain the behaviour change • Provide an opportunity to showcase high achievers and other successes to other participants • One or more participants to pledge and adopt one or more desired behaviours following the session • See if any participants are interested to attend and/or arrange a further event like this one • Set another date for additional event • Share knowledge **Actions** 1. Arrange Visit 3 i.e. 2. Identify and book a suitable venue 3. Invite all local and suitable participating householders 4. Populate the *Visit 3 Itinerary Template* with relevant details i.e. speakers names, location, times etc 5. Contact all invitees 2-3 days prior and confirm event, attendance, transport arrangements etc

Appendix 9: Script for EAP Visit 1

Introduction

Over the next few months we will going on a bit of a journey exploring and building a personalised householder action plan to support you to reduce your energy use & bills.

Today we will **identify the actions for you that can help reduce your energy usage, whilst maintaining your comfort** - and you can choose whatever actions you think you would find easy to do. I am here to support you in whatever way I can.

Before we can really get started it is important to understand how your home fits into your life.

Slice of cake

Remember I asked you what type of cake you like? Well I have brought a *(insert type of cake)* for you and your friends and family, but first I am going to ask you to slice it up into proportions of the time you allocate to various activities.

I have a selection of labels here with different activities that people tend to do such as gardening, health, home, social, grandkids, holidays, reading and lots of blank labels too. I will show you a few examples of different households and how they have divided up their activities - and ask you to do the same. Just take your time - it is a bit of fun

Present several pictures of different sliced up cakes

Fantastic. Are you happy for me to take a picture of the cake? *Take photo*

Highlight the larger slice of the cake and use to start discussion to try and identify the things in life that are most important to the householder and can be used as a motivator to instigate change.

Example: You spend a lot of time on *(insert primary priority eg health, family, etc) and then support their decision with a positive comment such as:*

- it is so important to keep your health ……health

- how lovely to enjoy your grandchildren growing up …..family

- it is so important to get out and have a chat and a laugh………social

Identify *with open questions* ***what is important to them, and how they allocate their time.*** *Indulge your time on this stage.*

Then ask them ***how they would like the cake to look if they could do what they really wanted to in the future*** *i.e. holidays, presents for grandkids, new house, new car, more time with family/friends, gardening etc. Encourage them to redo the cake so that it is how they'd like things to be, using '+' and '-' signs to change things.* ***Take a photo of the ideal cake. Note the biggest slice/their priority.***

Once you have learnt what you can, you need to find a link to reintroduce the idea of a first pledge

Health…….. have the right atmosphere and temperature to relax in

Family……have a warm house for the kids to come to or money to take them on adventures

Social…some of your friends may be quite interested in what you are doing with this study

Wouldn't it be great to *(list top 6 outcomes)* save money on bills, increase your comfort, time for friends and family……. And make the house healthier, so you can spend less time at *('-' signs on cake)* medical appointments/visits and more time with family & friends *('+' signs on cake)* by changing the way you operate the house.

Introducing actions

To get "*benefit"* let us start the journey to a personalised **Householder Action Plan**. I have a list here of some of the actions that may help you to achieve progress to your goals **and** reduce energy usage for your house - so let us have a look, as you may already be doing some of these?

Present list of actions (top 15, or full list as required) and get them to acknowledge what they do and what they don't.

*Following this process **introduce the idea of choosing one action** they think they could implement*

Do you think there is one action out of these you could have a go at doing?
If they want to do more than one action, they can, but do not encourage it.

Yes - great tick whichever one you like and progress to fridge magnet.

No – explore objections but do not apply pressure

- *Objections*
- *I do not want to be cold*
- *I think at this age I am allowed to be comfortable*
- *Do you really think such a small measure would make any difference*
- *I may do it but I will never get partner/family to agree etc….*

Fridge magnet

This is a fridge magnet and you can mark it off each week as you do this action.

Get them to write the pledge on the magnet and stick on the fridge with them. Use paper copy if they do want to use fridge magnet.

Encouragement - and what is next?

*Well done. That is a great action to choose. Good luck, and I will call you within the next couple of weeks to see how you are going. Try to **link your farewell back to their core pleasure** - this verifies you have been listening.*

- *Hope that doctors appointment goes well*
- *Enjoy those grandchildren of yours*
- *Enjoy your walk next week*

I'll speak to you soon - and thanks for your time.

Appendix 10: Script for EAP visit 2

Seek Feedback on the first pledge attempt

How did you go with the <*insert pledge*>? Use information from telephone conversations and examine fridge magnet. How hard did you find it? Did you have any relapses? *With couples* Did you both manage to do it?

Offer lots of praise and compare this action to other success for norms

To make this effort truly meaningful <*insert links to core motivations*> we can build together a *Householder Action Plan* exploring other actions you can chose to do over time, to increase your comfort and reduce your energy use. Overall this study is trying to achieve a 10% reduction for householders in the Energy Action Program.

You may want to have a look at this video that has been produced on this (many little things combined together).

Present and discuss the other list of actions

- *Guess the priority*

See all these different actions that you could do in the house. Do you want to have a go at putting them in order as to which would have the biggest impact on reducing your energy use? (Discuss and take a photo of selected order).

Repeat this process of actions, but this time ask them to put actions in the order of 'ease of implementation' (Discuss and take photo of selected order).

Help them choose a few more actions for the fridge magnet (about 3 is sensible) and explain they can add to this when they choose (with couples you may get them each to choose actions and persuade the other to do theirs). Get them to write chosen actions on the fridge magnet

Present pictures of ease and impact actions, and write into householder plan.

Summarise on potential cumulative impact and link to core motivations.

Show more videos on tablet that are relevant to specific actions

Discuss the potential of getting out and meeting with fellow householders to discuss this.

We are planning a social get together with other householders in a nearby meeting place for a morning or afternoon tea. The aim is to get together and share some experiences on things we have found easy and hard.

We would love you to join us.

Would it be something you would consider? Offer transport as required, suggest some date and location options and maybe talk about some of the other lovely householders. Do not ask for commitment at this stage, but just sow the seed.

Explain that you will send through an invitation in a month or two to some of the householders involved in this process.

I will call you between now and when we all get together to see how you are going.

Speak to you soon and thanks for your time

Appendix 11: EAP Group workshop information

Group visit structure

The invitation: The suggested invitation is attached and comments are welcomed. Your council logo can be added to the first page. You may need to ring and see whether they would attend as follow up.

Food: Most organisations are using external catering and buying in advance cakes from a local bakery. Coffee and tea is usually provided at the local venue.

Timing and meeting format: Suggest that this is a 1.5 to 2 hour event. Suggest that 10.30 to 11am is the preferred start time.

The Group meeting structure will be:

- Meet and greet - informal casual chatting, food and drink orders
- More formal introductions by ELO (see suggested script)
- Successful Energy action experiences (starting with the mentors) and let the conversation evolve.
- Go round the table at some point to give the shyer householders the chance to speak –possibly use top 15 versus 45 lists for this.
- Cover the 4 key behavioural areas of: heating and cooling, appliance management, hot water and bills
- Show the energy action videos for feedback – there are 6 videos, invite comment after each one.
- Encourage self-managed future meetings. – Option of coordinating another get together to arrange a visiting speaker or to discuss independent actions taken. Clearly highlight council responsibility stops here.

Tools

- Bills laminated
- Top 15 and top 45
- Info sheet for solar
- Info sheets on tables
- Case studies if possible
- Leaflet to inform other groups and spread the word

ELO script

<u>Introduction</u>

The study has been running now for nearly 2 years and there have been some fantastic learnings. Within Australia there have been 20 different studies funded by the Australian Government looking at household energy and our project south east of Melbourne has been very successful thanks to your support. We recruited 320 households across 6 different councils and there has been a "*number*" households involved within this council area. It is too early to assess actual savings, but CSIRO has been working on that data following all the consent forms you signed. We hope this information will help inform future government policy and programs, and help householders to learn how to take control of bills whilst still ensuring that comfort levels are as required. Half of those households have received advice on energy actions in the home and that is really what we are here to chat about today. The number of actions already being taken was really re-assuring, but there are clearly new learnings for many which we can talk about today.

We will aim to finish by noon and we will share some of the things that have been done by you all here, or some that have been more challenging and why. I will also be showing you some new videos we have designed to encourage specific actions and your feedback on them is welcomed. There will be plenty of opportunity to chat further at the end and to share contact details if you wish.

I now handover to you and invite anyone here to give us an experience of an energy action that has been new to you or that you feel strongly about.

Mid-session guidance: Use these 4 categories below to redirect the conversation to an area that has not been fully covered to date.

For example- “we have had a good look at bills and heating and cooling - has anyone got any experiences with how they use their appliances……”

- Heating and cooling,
- Appliance management,
- Hot water and
- bills

We have 2 lists of the top 15 and another 30 actions - did anyone find these lists of action useful or think we could have added other actions to them? (Perhaps go around the room with this for the shyer people – it is a safe subject area).

How did you find the meetings with the energy action advice? (This is optional and dependant on time management).

Showing the videos

I will just play them one at a time and open up the opportunity for feedback at the end of each one.

Closing the meeting

It is nearly noon so we will finish the formal elements of this gathering. Your feedback has been invaluable to the study and hopefully useful for yourselves.

If there is anybody in the group who wants to arrange another gathering that would be fantastic - to share these learnings.

There are no other group meetings now as part of the study, except for those who have signed up for the additional research.

There is a leaflet here to use if you want to set up meetings on this within your own groups, but if anyone wants to stay and finish off the cake, have another drink and a natter then please do so. Nobody will throw us out until at least 1pm.

Thankyou all so much for your time and contribution.

Appendix 12: Top 15 Energy Actions

Switch heater off overnight.

Close windows when heater/cooler is on.

Turn the heater thermostat down to 18-20°C. Every degree above 20° can add 10% to your bill.

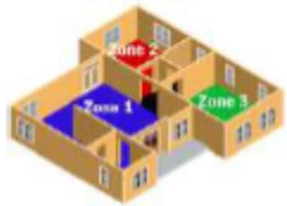
Washing your clothes in cold water can save around $115 per year (between 50-70% of people do this).

Use a fan for cooling on hot days before, or in combination with, an air conditioner.

Open doors & windows the night before a hot day.

Close windows early on hot days.

Close doors inside to reduce area to be heated/cooled (zoning).



Try to do some physical activity every day. Activity can make you feel warmer & may reduce the need for heating. Make sure any activity is approved by your doctor.

Use pedestal lamps instead of whole-of-room lighting.

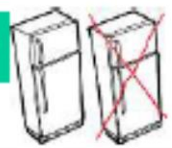
Task lighting

Turn off appliances when they are not being used.

Switch off appliances at the wall to save standby energy. Up to 10% of your electricity use could be from gadgets on standby.

Switch off the second fridge except for events.

One fridge, not two



Switch energy retailer.

Use window coverings to protect windows from heat loss through glass.

Appendix 13: Other EAP Action Cards

Use a thermometer to manage heating/cooling/house temperature 	Switch lights off whenever they are not needed 	Set the thermostat on the air conditioner to 26 degrees 	Avoid using portable heaters to save energy 	Go to bed early instead of using a heater 
Only boil as much water as you need to use 	Wear suitable clothes to minimise use of heater/cooler 	Avoid putting hot food in the fridge 	Buy energy efficient (high star rating) appliances: fridge, freezer, dishwasher, washing machine, TV, etc. 	In summer, open windows when it is cooler outside the house than inside - at night or when a cool change arrives 
Dry washing outside on a washing line, or use a clothes rack indoors rather than a clothes dryer 	Close curtains to keep the house warm/cool 	Set flip mixer taps to the right (cold) 	In summer use outside shading to keep the direct sun off windows. 	Have short showers to save water, and the energy used to heat that water 

Appendix 14: Fridge Action Magnet

Things to do

Energy Saver Study

-
-
-
-

Actions that you are trying to do	Indicate the week when action was done (✓)							
	1	2	3	4	5	6	7	8

Case studies *(names have been changed to protect peoples' identity)*

Appendix 15 – Case study (behaviour and IHD)

Before the Energy Saver Study

Maureen lives with her son in a property she owns. She loves to get up, go out and do a bit of shopping with her girlfriend or daughter.

The intervention from the Energy Saver Study

She received home retrofits and advice on energy actions from the Energy Liaison Officer, plus a deluxe In-home display. Retrofits included ceiling insulation, draught sealing and the hot water pipes being lagged.

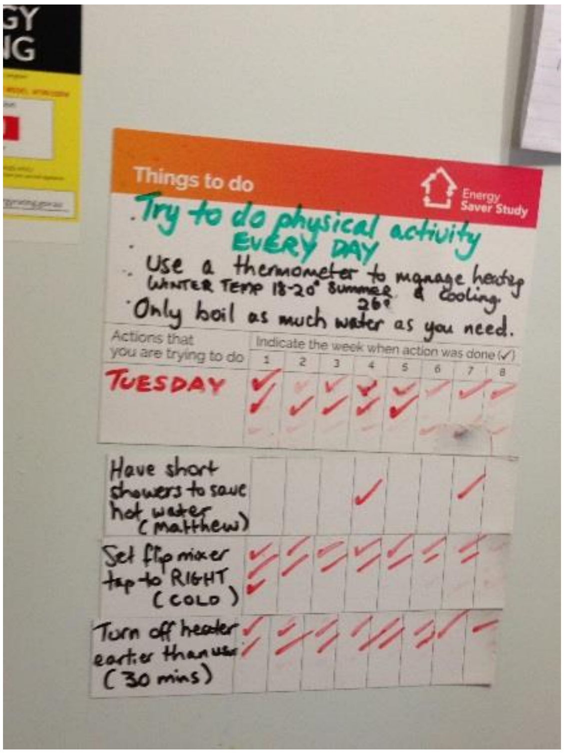
The Energy Action intervention included two face to face visits. The householder pledged to try and change a few behaviours which she had identified as possibilities. These actions were written on her fridge action magnet and she completed these over a 6 week period including:

- to use a thermometer to measure temperature
- adjust heater temperature down during winter
- try to get her son to have shorter showers
- do some physical activity herself.

Post intervention

Maureen initially found the IHD hard to understand but she learnt how to use the touch pen on the IHD and started to understand the different graphs.

Motivated by the thought of more holidays she pledged to do these actions. She found the fridge magnet useful.



Fridge action magnet

Data pre and post intervention

Location	Max temp bedroom	Max temp living room	Minimum temp bedroom	Minimum temp living room	Average temp bedroom	Average temp living room	KW main electricity daily	Gas Kwh
Before intervention Aug 2014	21.76	22.86	7.55	7.45	13.79	14	53.04	45.87
Post intervention Aug 2015	20.43	22.88	14.9	15.11	17.48	18.2	49.13	43.93

Comfort levels

The minimum temperature moved in both the bed and living areas from under 8 degrees before intervention to 15 degrees, bringing the average temperature in the household up by 7 degrees.

Energy/$ and CO2 Saving

The gas and electricity usage decreased with electricity reduced by 27%, lighting by 14% and gas by 4%. Overall financial savings were 72cents per day and 2.6 kg CO2 were saved daily.

Appendix 16 – Case study (retrofit)

Before the Energy Saver Study

Betty lives on her own and is reliant on her pension so careful money management is critical to her. A*s a previously successful business owner she knows how to watch her money and manage her bills and she already owns her house.*

She is already turning her power points off every day and she is very careful as to when to turn the fire on. She closes doors, she has an energy rated washing machine and when her children come to stay she tries to ensure that they don't open the fridge all the time.

When she received a phone call from the Energy Liaison Officer in January 2014 inviting her to get involved in the Energy Saver Study, she was keen to sign up as draughts and lack of money were a real concern for her.

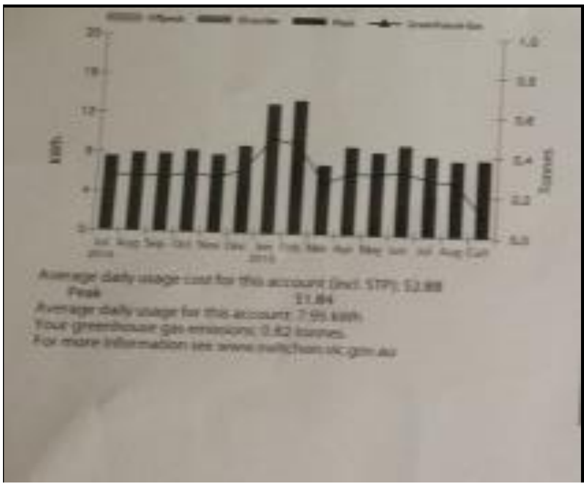
Intervention by the Energy Saver Study

Betty is receiving a home retrofit but not behaviour change support. She received insulation batts in the ceiling, draught sealing and lighting improvements. The lighting improvements included three LED lights to replace 150w globes which were very expensive to run. The draught sealing included perimeter door seals and a door was installed to separate the kitchen from the back porch area. This also increased her security. The hot water service pipes were lagged and a valve cosy installed on the hot water pressure relief valve.

Post intervention

"I still use the heating sensibly and I am quite comfortable after these retrofits. The benefits are that the gas bill has gone down year on year in August and September 2015, the month after the interventions and this is despite an exceptionally cold winter."

"I could tell the difference immediately" Betty said.



Energy use in the 3 winter months before and after interventions demonstrated strong savings.

Gas use (MJ) 2014	Gas use (MJ) 2015	Gas use (MJ) Change
264.83	231.8055	-33.02453436
200.2557	183.5991	-16.65661449
181.4215	169.5389	-11.88263786

Electricity use (KWH) 2014	Electricity use (KWH) 2015	Electricity use (KWH) Change
12.62309677	8.139913043	-4.483183731
13.22477419	7.607612903	-5.61716129
13.11606667	7.9693	-5.146766667

Energy use (KWH) 2014	Energy use (KWH) 2015	Energy use (KWH) Change
86.24584	72.58183378	-13.66400428
68.89585	58.64815386	-10.24770012
63.55125	55.10110519	-8.450139992

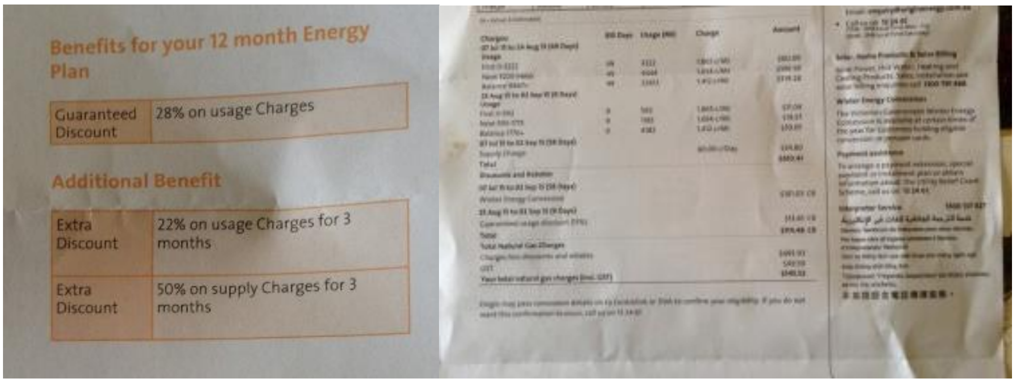
(Data is for July August and September 2015)

Appendix 17 – case study (challenging energy pricing)

Ester described her conversation with her energy retailer.

"I rang the energy retailer who are Origin with the assistance of the Energy Liaison Officer and I asked, am I on the best scheme? After various questions they then gave me a new and better scheme. This is the story which is laughable to me. They said as an old customer I could get 50% discount on usage and service charge for 3 months and then it would drop to 18% after 12 months. They asked what did I think about it and I said yes. Under the present system I knew I had 28% discount I think but I worked it all out in a mathematical manner. I challenge everything. I have a right to challenge everything and we need to fight for our rights."

On the electricity bills the usage charge showed a guaranteed discount of 28% for 12 months and the additional discount off both service charge and usage were added. This was effective for this householder as she would challenge her retailer again in 12 months and she had received strong short-term savings. The 10% reduction in the usage discount longer term may not have been a benefit for some householders without a further challenge.The discounts available for gas were limited.



This bill on 25th August shows a usage discount guaranteed for 12 months of 28% already negotiated plus an additioonal 22% discount off usage for 3 months and a 50% discount of supply charges for 3 months.. The plan is called a "daily saver half year powerplan".

Savings start to come through in the bill one month after the phone call.

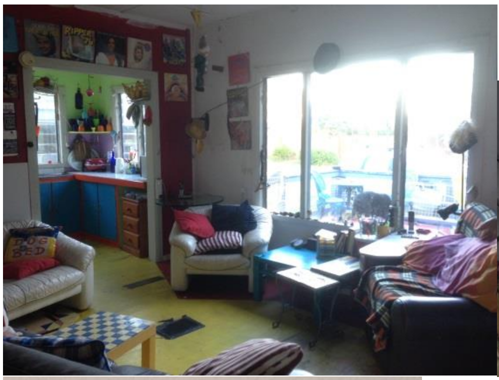
Appendix 18 – case study (Energy efficiency leads to pride)

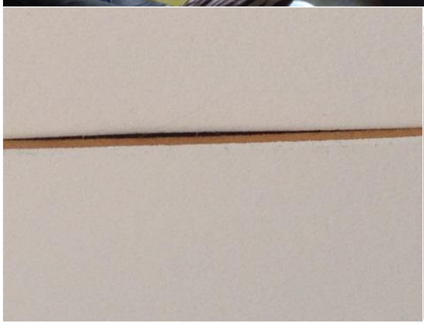
<u>Before the Energy Saver Study</u>

Max has lived in his house alone for 25 years which he owns. However it needs some maintenance work and is generally in need of repair.

He has tried to do several things to keep himself warm in the winter. He uses a blanket with string around the top to act as a home-made poncho and gets cheap blankets from the op shop instead of spending a lot of money on heating. He has a small electric bar heater as his sole source of heating. The house is very draughty with minimal insulation, slatted windows and gaps in walls and ceilings

Max was just not able to get comfortable in his home without running up high energy costs and his bills were becoming unmanageable. He has also had to contend with numerous personal challenges in his life including health concerns, financial management issues and family relationships.





<u>Interventions provided by the Energy Saver Study</u>

He was invited to join the Energy Saver Study in late 2014 by his local council Energy Liaison Officer. This involved:

- Home retrofits
- referral to the Good Shepherd for financial management counselling
- Advice on energy actions to help reduce bills and improve comfort.

In June 2015 insulation batts were installed in the ceiling and a reverse cycle heater was fitted as part of the retrofit interventions. Following the energy action advice he immediately started zoning the part of his house he heated or cooled, turning off all appliances at the wall when not in use, only heating the quantity of water he needed.


Post intervention

Max took on some additional personal initiatives to improve the quality of his environment. He made a hand-crafted door snake, he upgraded his zoning method, he tried to draught seal his slatted windows and he planned an external shade for his north facing window. The money for the external shade was to come from his TAB betting account as the $300 now had a preferred use. The householder had a new pride in his home and was enjoying planning, implementing and presenting his projects to others.

The Good Shepherd had helped remove a large water utility bill that together with energy bills were causing considerable stress and helped the householder arrange his finances in a more pro-active way to stop bill shock for his energy bills. This progress was initially highly successful however a new stress over health treatment bills is occurring.

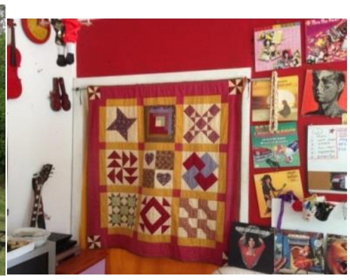
He took advice on his nutrition from a local neighbour and has improved his diet. He has also increased his daily physical activity, despite some mobility challenges.

He also planned to adjust his once “adult playroom” full of old motor bikes and cardboard cut-out models and turn it into room for his family, with photos of his children and grandchildren. This would give them a suitable room if they came to stay. Spending more time with his family was a core motivation for the householder and this action was perhaps one step closer to enabling that.

The pride in the house extended to the garden with new tomato and lettuce plants for the summer

Max continues to plan home improvement initiatives and stay healthy, despite his health prognosis. The attention and support provided by the Energy Saver Study has clearly been a significant factor in addressing some of the challenges in his life.



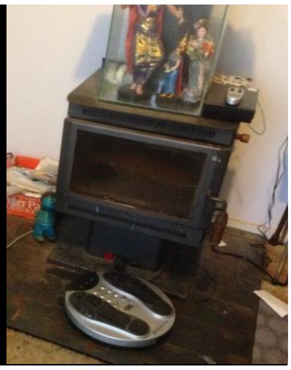



Appendix 19 - case study (From many heaters …. to a better life)

<u>Before the Energy Saver Study</u>

This small semi-detached house in a Victorian rural town was in poor repair. Edna was elderly, lived alone and the front room is where she would watch TV. The front door from the street opened directly into this room, which was about 12m^2. The roof insulation was inadequate and there were 4 different heaters in this one room. Edna has purchased various heaters as she was having difficulty keeping warm even with a heater with a thermostat setting. The room contained a wood heater which she no longer uses as it is broken, an oil heater, a small electric heater and a cooler but it was clear she was still not comfortable. At bedtime she sometimes uses an electric blanket for her bed and uses a throw rug over her knees in the living area, to reduce the pain and stiffness of the arthritis.



Edna was relatively immobile and has severe arthritis especially in her hands. She receives several support service from the local council community care services. Edna received energy monitoring equipment soon after joining the project that showed energy usage by circuit (lights, hot water, power etc) for 30 minute periods. The temperature in the living room and bedroom was also measured.

Edna said "I decided to become involved in this study because I was told it could make me more comfortable and aimed to help me reduce my bills. My greatest concern about the energy usage in this house is the heating."

<u>Intervention from the Energy Saver Study</u>

Edna was given home retrofits on 28 May 2015 but not energy action support. Additional ceiling insulation and a reverse cycle heater/cooler were provided.

"I got given insulation even though I thought insulation was in the ceiling and a reverse cycle heater and I have noticed it is a lot better, more comfortable. The heater is very easy, it works at the press of a button. The most important thing for me has been the improved comfort and hopefully it will cut down bills a bit. I would recommend having insulation and a new heater to anybody else" said Edna.

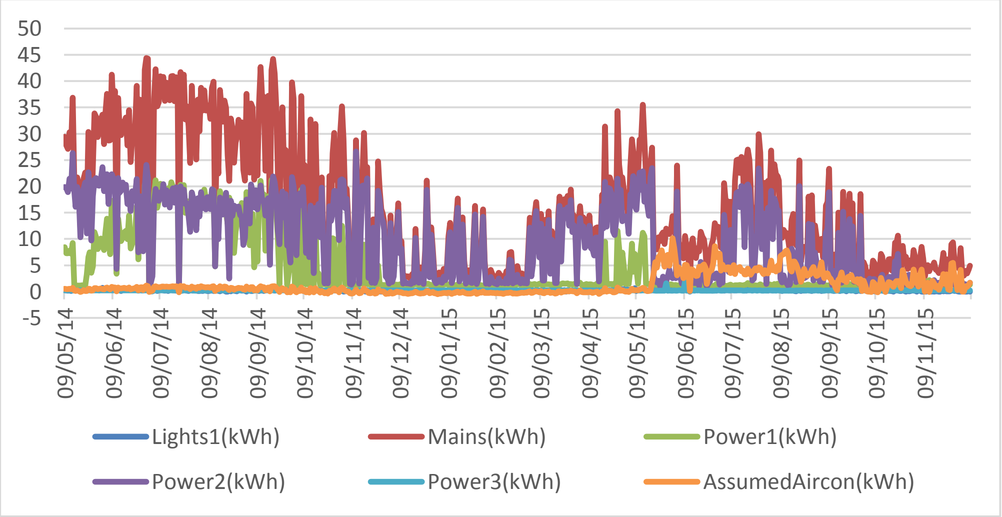
The front living room

Over a 50% reduction in electricity usage and $5 saving a day has been achieved.

Months	2014 pre intervention (kW)	2015 post intervention (kW)	% KW change	Total Energy/Day $ Change	Total Energy/Day Kg CO_2 Change
5	24.96	18.22	-26.99	-2.529243	-11.19
6	31.58	9.68	-69.35	-7.52	-32.84
7	34.04	17.74	-47.88	-5.65	-24.78
8	31.32	13.96	-55.41	-6.16	-26.86
9	28.39	9.83	-65.39	-5.93	-25.85
10	19.64	5.29	-73.09	-4.46	-19.45
11	14.94	5.31	-64.43	-3.33	-14.47
Average	26.41	11.43	57.5	-5.08	-22.2

In the graph below, the ‘Power 2’ circuit reduces at the point of intervention and is replaced by the orange circuit which is the new heater/cooler. The overall power usage reduces consistently after the home retrofit.



9 DECLARATION

The Authorised Officer of the organisation makes the following declarations:

☐ I declare that I am authorised to submit this Final Report (including any attachments) on behalf of …………………………………………………………………………… *(Name of organisation)*

☐ I declare that the information provided in this Final Report is true and accurate.

☐ I understand, and acknowledge that giving false or misleading information in this Final Report is an offence under the *Criminal Code Act 1995*.

☐ I understand that final payment will only be made in accordance with the Funding Agreement including on satisfactory completion of Milestones.

Authorised Officer Signature: .... Date: ..../........../.............

Name: ....

Position: .... Organisation: ....

Witness Signature: .... Date: ..../........../.............

Name: ....

Position: .... Organisation: ....

The use and disclosure of information provided in this Final Report is regulated by the relevant provisions and penalties of the *Public Service Act 1999*, the *Privacy Act 1988*, the *Freedom of Information Act 1982*, the *Crimes Act 1914* and the general laws of the Commonwealth of Australia.

Information contained in the Final Report may be disclosed by the Department for purposes such as promoting the program and reporting on its operation and policy development. This information may also be used in answering questions in Parliament and its committees. In addition, the selected project information will be made publicly available. Public announcements may include the name of the grant recipient and of any project partners; title and description of the project and its outcomes; and amount of funding.