



Northern Grampians Shire Council
Low Income Energy Efficiency Project
FINAL REPORT
MARCH 2016

***‘Innovation and Opportunities in Energy Efficiency for
Disadvantaged Members of Our Community’***



Australian Government
**Department of Industry,
Innovation and Science**

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Disclaimers

The views expressed herein are not necessarily the views of the Commonwealth of Australia, and the Commonwealth does not accept responsibility for any information and advice contained herein.

This document draws on and uses material from a draft version of a CSIRO report:

Romanach & Gaillard (2016). Thermal comfort and energy use of rural Victorian pensioners: Final report of home energy interventions in the Northern Grampians Shire. CSIRO Report prepared for Northern Grampians Shire Council.

Please see that final report for additional detail and updates.

Abbreviations

CSIRO – Commonwealth Science and Industrial Research Organisation

CSRC – Centre for Sustainable Regional Communities

CVGA – Central Victorian Greenhouse Alliance

CVSC – Central Victorian Solar Cities (project)

CWO – Community Welfare Organisation

GPPCP - Grampians Pyrenees Primary Care Partnership

HACCS – Home and Community Care Services

HEA – Home Energy Assessments

IHD – In Home Display

LIEEP – Australian Government Low Income Energy Efficiency Program

NGSC – Northern Grampians Shire Council

MERI – monitoring, evaluation, improvement and reporting

SRA – Sustainable Regional Australia

SV – Sustainability Victoria

Definitions

Client – people receiving a service from welfare organisations

Community Welfare Organisations – service providers of community, health, disability and welfare services

Consortia member – organisation who are partnering with NGSC in the delivery, monitoring and reporting of the project

Contractor – an individual, business or organisation contracted by NGSC to provide a service to the project

Department – Australian Government Department of Industry, Innovation and Science

Program - Australian Government Low Income Energy Efficiency Program

Project – Northern Grampians Shire Council LIEEP project '*Innovation and Opportunities in Energy*

Efficiency for Disadvantaged Members of Our Community'

Project Committee – steering group made up of representatives from the various consortia members responsible for seeing that the project is implemented according to the project and MERI plans, **Project staff** – Staff employed directly by Northern Grampians Shire Council in the implementation and delivery of the project

Research Assistant – person employed directly by the research institution to carry out household interviews, provide data management support, and other field-based activities as directed by their employer in relation the research and analytical services being provided

Research Institution – organisation contracted to provide expert research and analytical services that investigate and report on qualitative and quantitative data collected by the project

Residents – members of household's participating in the project, who may also be referred to as clients of the welfare organisations

Supplier – an individual, business or organisation contracted by NGSC to provide a product or goods to the project

Support staff/ case managers – Staff employed by welfare organisations to provide in-home support to clients

Target demographic – people with an intellectual or aged disability who receive home care support from a welfare organisation. Can be used both in relation to the cohort of project participants or, more widely, to include other people who can be similarly characterised

1 EXECUTIVE SUMMARY

1.1 Purpose

In 2014, the Northern Grampians Shire Council received funding from the Australian Government's Low Income Energy Efficiency Program (LIEEP) for a project entitled, *'Innovation and Opportunities in Energy Efficiency for Disadvantaged Members of Our Community'*.

This project aimed to understand the barriers and improve the adoption rates of energy efficiency measures within aged and disability pensioners' households. As part of the project, forty aged and disability pensioners living in the Northern Grampians Shire were identified by the local shire council as significantly disadvantaged in terms of their involvement in energy efficiency initiatives in the region.

The project intervention included:

- An in-home energy assessment to:
 - explore current energy use and needs within aged and disability pensioners' households
 - recommend energy efficiency upgrades
- Installing specific energy efficiency upgrades (up to \$5,000 per household) as approved by householders
- Ongoing provision of tailored information, advice and feedback on household energy use

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) was contracted by the Northern Grampians Shire Council as the project's research partner to conduct three rounds of face-to-face interviews with householders participating in the program, as well as to analyse energy consumption data collected by the program coordinator.

1.2 Focus

The aims of LIEEP were:

- to assist low income and disadvantaged households overcome identified barriers to energy efficiency and to better manage their energy use
- to capture and analyse data and information to inform future energy efficiency policy and programs

In addition, Northern Grampians Shire looked

- to find and test practical solutions that increased the access and participation of people who are aged or intellectually disabled to energy efficiency programs and actions. This included empowering participants by increasing their awareness and understanding of their energy use and tariffs.
- to generate real lifestyle benefits for participants, including improved thermal comfort, improved health and well-being, improved liveability or quality of life.
- to build a body of knowledge that could be used nationally by the health and community care sector to support clients in being energy efficient.

The demographic the project did engage are especially vulnerable and have very particular barriers that reduce their motivation and/or ability to uptake energy efficiency initiatives. These barriers include lack of knowledge and understanding around the issue, financial capacity, technological literacy and cultural behaviours.

Like many households on low, fixed and unreliable incomes who are affected by increases in retail energy prices, energy efficiency is a significant issue. This may also be exacerbated as a result of factors such as poor quality housing stock, health issues, limited financial ability to reduce energy use by replacing inefficient appliances, and the fact that, while these households tend to consume less energy than average households, they spend proportionally more of their income on this essential service.

The project aimed to examine these barriers and the dynamics around them, and through the use of innovative approaches (including tailored strategies, specialist tools and provision of incentives) determine what interventions lower barriers, increase the ability of this demographic to make informed choices and provide a greater degree of equity and access to the uptake of energy efficiency initiatives and/or behaviours.

The original approved submission was focused primarily on providing a qualitative, ethnographic analysis of households - rather than having an evaluation of the project based mainly on a statistical analysis. It was considered that the cohort was too small to be meaningful, and that there were too many confounding factors beyond the control of the project.

1.3 Methods

The project used interviews as the primary mechanism for collecting qualitative data and information describing participants' (and support workers') responses to energy use, understanding of energy efficiency and evaluations of the interventions implemented in their homes.

CSIRO, as the research partner in the project, had responsibility for conducting the interviews and providing analysis of the results. A series of three interviews was conducted with each household –at the commencement of the project, mid-term and toward the end of the project. Participants were asked about how their household had used the intervention technology, whether it had changed their awareness or behaviour, and how they evaluated the intervention according to their expectations.

CSIRO used face-to-face, semi-structured interviews and a conversation methodology. The interviews were recorded and then transcribed for analysis. The aim was to develop an understanding about energy use in the house and explore the ways in which participants have set about to be more efficient in their energy use given their personal circumstances.

These interviews allowed a rich and in-depth experiential account of an issue to obtain than is generally available through more structured and representative forms of interviewing.

While individual interview participant's perspectives and insights may not necessarily be representative of their sector, it enabled a variety of community perspectives to be understood in order to provide the broadest possible picture of community acceptance of energy efficiency options.

Project staff, working in close collaboration with participants (and support workers/carers as necessary) also collected empirical information – including demographic data on households, and data on electricity and other energy use through billing information, interval data and also the in-home display downloads.

This data collection and analysis, has been used to inform the project evaluation and recommendations.

Engaging with vulnerable people (i.e. people with an intellectual or aged disability) requires trust and sensitivity and benefits from specialist advice and collaboration. Therefore, the mix of consortium members who participated in the project included organisations that provide in-home support and have developed established relationships and built trust with their clients – e.g. Northern Grampians Home and Community Care services (HACCs); McCallum Disability Services; Grampians Community Health, Grampians Pyrenees Primary Care Partnership and Stawell Intertwine (later Pinnacle Inc).

They provided a trusted pathway for the project to approach and engage with households, which greatly facilitated recruitment. Later they were also valuable in helping maintain the awareness of participating households and in reinforcing key messages on energy efficiency to clients. Recruitment of households commenced in May 2014.

Control houses weren't recruited till October 2015, although billing and tariff information was collected from 2013 to 2015. This was intentional so that there was no prior intervention by project staff that may have influenced their behaviour.

Following recruitment of the households, each household was provided with a home energy assessment from trained project staff. The assessments looked at household behaviours, building characteristics and properties, appliances, energy use patterns and billing/tariff information.

A round table discussion was then held with participants (and, in many cases, their support workers/carers) that considered both the assessment recommendations and the priorities and circumstances of the participants.

Each household was able to access as much as \$5,000 worth of incentives aimed at improving household energy efficiency.

Following implementation of the interventions, the project provided follow up from visits where additional data – mainly billing and interval data - was collected, and where participants were also able to receive support and advice on a range of issues to do with energy efficiency, energy use and tariffs.

Project staff spent considerable time working with participants to improve billing literacy and their understanding of tariffs, and where possible assisting them negotiate favourable terms with retailers.

The project also installed and provided instruction on the use of In-Home Energy Displays so that participants could monitor their energy consumption.

Main households also received a cash incentive of \$100 for each of the two years of the project. As part of the ethical guidelines, there could be no penalty directed toward a house for withdrawal from the project. The incentive was offered to encourage people to stay for the full term.

In the end, seven of the forty houses that commenced the project did not remain for the full term (three deaths, one serious illness and three re-locations).

Control houses received a \$200 incentive and a free home energy assessment as reward for their participation and agreement to provide the requested billing and interval data.

1.4 Outcomes and Findings

Findings from the project clearly demonstrate that participants on aged or disability pension are not a uniform category of energy-users.

While some of their needs, interests and the barriers they face in improving their home energy efficiency might be similar, overall they have mixed abilities and technical skills as well as differing levels of energy awareness, understanding, motivation, interest and goals around energy use and energy efficiency.

This individuality made the project's personal, face-to-face delivery a key strength, with participants commonly expressing a preference for receiving information and advice through face-to-face delivery from a dedicated professional and from someone they trusted.

Most found information and advice more useful (and tend to remember it better) when it involves personal contact and a chance to discuss issues.

Another key strength was to utilise trusted pathways to initiate and maintain relationships with households, and to assist with the communication and reinforcement of key messages.

This was particularly important in situations where, despite the personalised approach, some participants in both the aged and disability groups experienced difficulty fully understanding and/or remembering some of the information or advice provided – for example, how to set air-conditioners to operate effectively and efficiently.

Support workers, family carers and repetition all proved valuable channels to help overcome this challenge.

There was a high level of interest from participants in receiving information, advice and assistance in relation to bills and tariffs which most participants found complex and confusing. This interest was also clearly evident in the control houses - highlighting the fact that discussion on this subject alone can be effective in engaging households in discussion on energy efficiency.

The project endeavoured to look at bill and interval data from each households (both main households and the control households) over as long a period between June 2013 and post June 2015 as it was possible to gather.

There is some indication from interval data and billing data that the project did reduce peak usage by 3.213% and off-peak usage by 8.712% (for an average total savings of about 345.97 kWh/yr per household). However, there is also a large error attached to these calculations given the small cohort numbers.

Similarly, while some participants felt that the program had a positive impact on their energy bills, it was difficult for them to really know if this was the case or not.

The reasons for this were many including gaps in consumption and/or billing data; insufficient long-term data to reduce confounding factors; inconsistent billing cycles and difficulty comparing similar time periods (e.g., similar time periods had little correlation to actual temperatures and seasonal variations, or to the dynamic circumstances and situations of individual households during these periods – changes whose effect was likely to be more significant than changes brought about by the project).

This view is substantiated by the scale of standard deviation shown in the data.

Nevertheless, individual histories for each house were still collected and collated for analysis.

In relation to data capture and analysis, it is probably the area where the project had its most difficulty and where there is room for the greatest improvement.

This was true of the following aspects.

- Utilisation of the data schema – mainly in terms of the level of detail required but also complicated in part by its ongoing development/refinement
- consistency in the format of interval data received from providers
- level of cooperation from providers
- consistency in the integrity and comprehensiveness of the data
- confounding factors that hid project outcomes

Electricity consumption data collected during the project generally indicates high winter peaks and lower summer peaks in houses that were primarily dependent on electric heating and cooling devices. This clearly indicates that heating and cooling devices accounted for a high proportion of energy costs amongst participant households.

Most project households had had relatively poor energy performance and therefore, retrofits installed by the project in participants' homes were mostly aimed at improving the home's thermal efficiency – e.g. window treatments to retain or reflect heat; underfloor insulation to moderate temperature losses/gains; split-system reverse-cycle inverter air-conditioners to provide more efficient heating or cooling.

Feedback about the effectiveness of any upgrades (whether appliances, HVAC units, window treatments, insulation, draught proofing etc.) has been overwhelmingly positive with 29 responses from the possible 32 reporting improvements.

Gauging this feedback, satisfaction with the program was high. The majority of participants felt that their homes were generally more comfortable and reported improvements in thermal comfort for themselves and/or a household member as a result of the project (n=27).

Much of this was attributed to new home energy upgrades installed as part of the project – but also to the fact that some new behaviours were being practiced.

Participants reported some changes in their cooling and/or heating practices regarding both the use of energy-consuming appliances (such as turning on heaters, air-conditioners, fans, electric blankets) or other measures (such as closing or opening blinds, windows or doors).

Interview findings suggest that low-energy consuming energy retrofits (i.e. draught proofing works, internal/external window coverings) properly targeted and coupled with tailored advice can assist householders to increase thermal comfort and reduce use/reliance on high energy consumption appliances such as air-conditioners.

Both participants and carers reported improvement in their awareness and understanding of home energy use and ways to save energy.

Participants reported that information received through the project either reinforced pre-existing energy-saving actions or encouraged new energy-saving actions, in particular in relation to heating and cooling.

However, the level of interest and cognitive capacity of some participants presented significant barriers for engaging participants with impaired cognitive capacity with information provided through IHD displays, energy bills or regarding temperature settings for energy efficient use of heating and cooling systems.

Findings show that carers played a key role in translating information to aged or intellectual disabled participants due to their familiarity and understanding of the householders' needs and capability.

The significant and important contribution that support organisations are able to make to energy efficiency programs included

- providing an established and trusted pathway to engaging with vulnerable households
- helping communicate and reinforce key messages
- providing ongoing support and advice that , together with the above, assist households to develop habits and practices that lead to lasting behaviour change

Apart from energy efficiency and thermal comfort, other reported benefits included positive changes in

- personal empowerment through greater awareness and increased billing and tariff literacy
- health and well-being
- ‘liveability’ of home
- aesthetics
- convenience
- privacy

1.5 Conclusion

Overall, the project aimed to understand the barriers and improve the adoption rates of energy efficiency measures within aged and disability pensioners’ households in Northern Grampians Shire, Victoria.

Motivations to join the project were primarily to reduce energy costs and to improve thermal comfort where previously this had been unaffordable – although some participants commented on altruistic motives also playing a part and acknowledged the wider benefit that might accrue from the project to others and/or the environment.

The home energy assessment undertaken at the start of the project showed that, participants were, in general, living in homes that had poor energy performance.

The poor energy performance of these homes contributed to these homes being very hot in summer and very cold in winter. Therefore, most retrofits installed by the project in participants’ homes were aimed at improving the home’s indoor temperatures to improve participants’ thermal comfort and wellbeing whilst reducing energy consumption – e.g. through the installation of window treatments, underfloor insulation, more efficient appliances.

Exceptions to the decrease in energy usage were particularly apparent in 4 houses where there was a replacement of wood fires with electric appliances. In these homes there was a large increase in electricity consumption but a reduced cost overall to the households – as well as a significant increase in convenience.

Thermal comfort is best achieved through a combination of actions (e.g. draught proofing, use of curtains and zoning together with efficient air-conditioning). Whether thermal comfort will be achieved through low-cost or high cost actions will depend on whether individuals have the competence and resources to perform such actions.

A tailored approach – as used in the project - facilitates this, allowing energy efficiency upgrades to be considered in context with personal priorities, circumstances and other home features.

Participants and carers reported being highly satisfied with the project and reported multiple benefits from their participation – particularly in relation to the installation of upgrades/retrofits, but also through undertaking more energy-saving behaviours and an improvement in their awareness and understanding of home energy use and ways to save energy.

Some participants reported a reduction in their energy bills. However, energy data collected through the project was not sufficient to allow an evaluation of actual energy reductions within the participating households.

It is therefore not possible to evaluate the effectiveness of the interventions delivered by the project in reducing household energy use.

The majority of participants reported that they experienced moderate to significant improvements in thermal comfort at home due to the energy efficient upgrades installed, which allowed them to engage in new energy efficient behaviour and improve their levels of control over energy usage.

At the commencement of the project, there was a low general awareness that heating and cooling devices consumed the most energy. However, the project made significant progress toward increasing participant's awareness of the proportion of their energy use attributable to heating and cooling systems.

This was commonly illustrated through usage information and graphs, and by discussing the issue at length.

There was also limited awareness of the recommended temperature settings for air conditioners in summer and winter (the project recommended 18 degrees for heating, and 24 degrees for cooling), as well as limited efforts to retain heated and cooled air. Providing advice on setting and using air-conditioners became a major focus of the project.

To begin, there was also a lower than expected use of heavy drapes to maintain heated or cooled air within the home. Many homes had ornamental or privacy curtains that did not provide a thermal benefit. Upgrading window treatments was a significant intervention that took place in the majority of households.

Most participants reported that window coverings and draught works as part of the project had made a significant difference to their thermal comfort in winter and/or summer.

Through the project, Interview responses indicate the project was successful in encouraging increased efforts to zone off rooms and use curtains/blinds to help regulate indoor temperature.

Participants reported that information received through the program either reinforced pre-existing energy-saving actions or encouraged new energy-saving actions, in particular in relation to heating and cooling.

On that regard, most participants reported some change in their cooling and/or heating practices regarding both the use of energy-consuming appliances (such as turning on heaters, air-conditioners, fans, electric blankets) or other measures (such as closing or opening blinds, windows or doors).

Overall, participants reported that by performing non-energy consuming approaches to achieve thermal comfort (such as zoning off rooms, using window treatments and blankets), they noticed that the need for use of energy consuming appliances such as air-conditioner was reduced.

Many participants also reported an increase in the frequency and duration of certain pre-existing energy-saving actions (apart from heating and cooling), such as turning off lights at the end of the program.

The use of appliances by the aged pensions tended to be modest.

A real strength of the project was the partnership with community support organisations that, through the established relationship they had with clients, were able to facilitate recruitment and engagement strategies, as well as provide ongoing support and advice to households in relation to energy efficiency.

Peer and family/carer support were major influences on decision-making choices and were used as a primary source of information and advice.

Other common information sources included TV, radio and newspapers but printed media – i.e. handouts, instruction booklets – were not as well accepted or utilised. There was mixed usage of internet.

All participants stated that they enjoyed the personal communication and face-to-face delivery of the program. It is clear from participants' responses that they appreciated and valued individually-tailored approach of interventions used to determine the new energy upgrades installed in each participating household, as well as to the tailored advice that directly met individual household needs.

Other benefits included an improvement in the health and wellbeing of those participants with summer heat-related health problems as a result of improved cooling.

Electricity bills were considered to be confusing and complex by participants. Many households welcomed assistance from the project to increase their billing and tariff literacy. As a result, many individuals felt more empowered, and more confident and assertive to discuss their bills and negotiate tariffs with providers.

They were also able to better understand their bills and the information contained within which gave them increased insight into their energy profile.

A summary of key issues that arose include the following:

- There were significant difficulties in collecting complete data sets on consumption (either through billing or interval data) for some households
- Sample size was statistically insignificant and so the qualitative, interview approach was preferred as the primary data collection source for analysis
- Dwellings within the project demographic were generally older housing stock with poor thermal qualities
- The region experiences cold winters and hot summers which, combined with dwelling condition, meant that residents relied heavily on heating and cooling devices to achieve comfort
- Capital cost was a greater factor in buying appliances than energy efficiency
- Only a minority of participants found the IHD a useful tool to understand energy use without the intervention of project staff who were able to create graphs which illustrated energy use patterns
- Some participants found it challenging to remember the suggestions and advice that were given to them at the start of the program either by the project coordinator or installers
- Impaired cognitive capacity of some participants presented significant barriers to fully engaging these participants – particularly in relation to information that was other than basic or straightforward – and there was a high reliance on

the support of their support workers and/or family members to translate and communicate key messages

- Health and physical conditions - many participants receiving either the disability or aged pensions had medical and pre-existing physical conditions that increased their dependency on the use of energy

A summary of barriers includes:

- Financial constraints and cost.
- Lack of information and knowledge
- Infrastructural barriers – e.g., not owning their own home
- Cultural attitudes/behaviours, prevailing attitudes, personal habits and preferences
 - stoicism and belief that they should accept the situation and just make the best of it
 - people believing they were already very frugal in their energy use and could not reduce it further without comprising their comfort
 - belief that advanced age made it pointless for them to undertake any major investment in energy efficiency, despite any benefit to their thermal comfort and health and well-being
 - ingrained belief that it was wasteful to upgrade older, inefficient items while they were still functional

Overall, the program has showed that a relatively low level of investment – properly targeted and coupled with tailored advice – can bring significant and multiple benefits to householders. However, tailoring programs to the particular needs of the household are essential to deliver the benefits intended.

1.6 Recommendations

1. Future programs should look to harness key personnel (i.e. support workers/carers) who are already in-situ.
2. Future programs should invest the appropriate level of resources and time into the capacity-building of key personnel (i.e. support workers/carers).
3. Future programs should fully exploit partnerships with existing services, organisations and intermediaries in the field who already have established links with potential target audiences.
4. Future programs should utilise a personalised face-to-face program delivery which provides tailored, targeted and actionable advice to households with aged or intellectually disabled residents
5. Future programs should focus on improving the quality of housing stock typical of this demographic which was generally found to be sub-standard in this region.
6. Future programs should provide financial subsidies to assist low income households implement energy efficient retrofits or upgrades
7. Future programs should allow sufficient time and resourcing for the proper implementation and evaluation of household curtailment behaviour (e.g., HVAC settings).
8. Future programs should consider the development of multiple or additional delivery and support arrangements to ensure the sustainability of the program
9. Future programs should specifically investigate the effectiveness of different displays and other visual tools.
10. Future programs should look to utilise/adapt studies and research from other fields (beyond energy efficiency) to trial new and innovative ways to engage and communicate energy efficiency to low income households
11. Future programs should have fully developed and agreed metrics that are able to properly measure and quantify indirect benefits.
12. Future programs should not be launched until the development and purpose of metrics and other evaluation criteria has been fully defined and articulated.
13. Future programs should include billing and tariff literacy as a key component.
14. Future policy should look at legislating a standardised format for energy billing that provided transparency and consistency.

2 Introduction

In 2014, the Northern Grampians Shire Council received funding under Round 2 from the Australian

Government's Low Income Energy Efficiency Program (LIEEP) for a project entitled, '*Innovation and Opportunities in Energy Efficiency for Disadvantaged Members of Our Community*'. This project aimed to understand the barriers (see below) and improve the adoption rates of energy efficiency measures within aged and disability pensioners' households.

As part of the program, forty aged and disability pensioners living in the Northern Grampians Shire were identified by the local shire council as significantly disadvantaged in terms of their involvement in energy efficiency initiatives in the region.

The program intervention included:

- An in-home energy assessment to:
 - explore current energy use and needs within aged and disability pensioners' households
 - recommend energy efficiency upgrades
- Installing specific energy efficiency upgrades (up to \$5,000 per household) as approved by householders
- Ongoing provision of tailored information, advice and feedback on household energy use

Engaging with vulnerable people (i.e. people with an intellectual or aged disability) requires trust and sensitivity and benefits from specialist advice and collaboration. The mix of consortium members who participated in the project include organisations that provide in-home support and have developed established relationships and built trust with their clients – e.g. Northern Grampians Home and Community Care services (HACCs); McCallum Disability Services; Grampians Community Health, Grampians Pyrenees Primary Care Partnership and Stawell Intertwine (later Pinnacle Inc).

They provided a trusted pathway for the project to approach and engage with households, which greatly facilitated recruitment. Later they were also valuable in helping maintain the awareness of participating households and in reinforcing key messages on energy efficiency to clients.

Recruitment of households commenced in May 2014.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) was contracted by the Northern Grampians Shire Council to conduct three rounds of face-to-face interviews with householders participating in the program as well as to analyse energy consumption data collected by the program coordinator.

The experiences and views of participants in the two separate groups of aged pension and disability pension recipients were combined and explored collectively.

The first round of interviews included questions covered a range of issues including participants' energy use habits, experience of the costs of energy, reasons for their behaviour and choice of appliances, knowledge of energy and climate-related policies, and engagement with energy providers.

The aim of the second round interviews was to investigate participants' experiences of the program to date, to explore potential benefits in terms of home thermal comfort, energy awareness, behavioural change in home energy use, and energy bills.

The third and final interview round report included:

1. Findings of the third and final round of interviews conducted with program participants, including four case studies that provide in-depth information about household energy within the program demographic.
2. Participants' responses to the required attitudinal LIEEP questions
3. Descriptive analysis of household demographic and electricity consumption data provided by the program coordinator
4. Summary of key findings and recommendations that could be used to inform future energy efficiency programmes and policies targeted at vulnerable and low income households.

3 Methodology

The project provided home energy efficiency interventions for up to 40 residents on an aged or disability pension in the Northern Grampians Shire, with the aim of assisting them to better manage their energy use and reduce energy costs.

The focus was to fulfil the aims of the LIEEP program, that is

- to assist low income and disadvantaged households overcome identified barriers to energy efficiency and to better manage their energy use
- to capture and analyse data and information to inform future energy efficiency policy and programs

In addition, Northern Grampians Shire looked to

- to find and test practical solutions that increased the access and participation of people who are aged or intellectually disabled to energy efficiency programs and actions
- To generate real lifestyle benefits for participants, including improved thermal comfort, improved liveability, improved health and well-being
- to build a body of knowledge that could be used nationally by the health and community care sector to support clients in being energy efficient

Aged and disability pensioners were identified by the local shire council as significantly disadvantaged in terms of their involvement in energy efficiency initiatives in the region.

The energy efficiency interventions in this project comprised three steps, namely:

- Undertaking an in-home energy assessment
- Installing energy efficiency upgrades including energy efficiency appliances, infrastructure or modification
- Providing tailored information and advice on home energy-saving measures.

As mentioned, the initial project cohort articulated in the original approved application was for 40 low income households whose residents received either an aged or disability pension, and who were also receiving some form of home care support from a health and community services organisation.

However - following preparation of the Data Collection and Reporting Plan and further discussion with the Department – the number of households was expanded

to include a control group of 20 demographically-matched houses for data comparison purposes.

The selection and recruitment process for both groups were the same – i.e. by referral from a home care or disability support organisation. These organisations were responsible for disseminating information about the project and the initial canvassing of potential clients.

It was not intended to publicise the opportunity through normal media unless there were real issues with getting sufficient participants – an issue which did not arise. It was thought that broad publicity would result in too many ineligible households applying and being disappointed.

The demographic, aged and disability pensioners, the project engaged are especially vulnerable and have very particular barriers that reduce their motivation and/or ability to uptake energy efficiency initiatives. These barriers include lack of knowledge and understanding around the issue, financial capacity, technological literacy and cultural behaviours.

Like many households on low, fixed and unreliable incomes who are affected by increases in retail energy prices, energy efficiency is a significant issue. This may also be exacerbated as a result of factors such as poor quality housing stock, health issues, limited ability to reduce energy use by replacing inefficient appliances, and the fact that, while these households tend to consume less energy than average households, they spend proportionally more of their income on this essential service.

The project aimed to examine these barriers and the dynamics around them, and through the use of innovative approaches (including tailored strategies, specialist tools and provision of incentives) determine what interventions lower barriers, increase the ability of this demographic to make informed choices and provide a greater degree of equity and access to the uptake of energy efficiency initiatives and/or behaviours.

It is important to note that the original approved submission was focused primarily on providing a qualitative, ethnographic analysis of households - rather than having an evaluation of the project based on a statistical analysis for which the cohort was too small to be meaningful, and for which there were too many confounding factors beyond the control of the project.

Despite the above comment, a primary objective of the project remained a proper evaluation of the effectiveness of interventions and initiatives through the variously collected data. This evaluation was clearly integral to key project/program outcomes such as transferability and informing Government policy and strategy.

As far as practicable, the project collected all data items as required under the LIEEP Funding Agreement. Baseline data included demographic data on households, dwelling and appliance information collected during the home energy assessments, and data on electricity and other energy use collected through billing information, interval data and also the in-home display downloads.

Semi-structured interviews were employed as the primary data-gathering method in this research. This method was chosen given the small cohort which in itself was probably a reflection on the fact that Northern Grampians is a small, regional Shire with a total population of fewer than 10,000 persons.

CSIRO was recruited as the research partner in the project with responsibility for conducting the interviews and providing analysis of the results. CSIRO also had access to the information collected and uploaded to the data portal, and conducted some analysis on energy use, demographics and dwelling characteristics. Their findings have been incorporated into that section of this report.

In relation to the qualitative data and information, a series of three interviews was conducted with each household –at the commencement of the project, mid-term and toward the end of the project.

Most disability pension recipients' interviews (9 out of 11) were conducted in the company of a support worker or family member, who was also encouraged to contribute to responses in order to ensure an appropriate understanding of the household energy needs.

Two aged pension recipients (out of 21) were also conducted in the company of family members. The interviews typically lasted 15 to 60 minutes and took place in participants' homes.

Table 1: Number of interviews conducted throughout the program

PARTICIPANTS	ROUND 1 INTERVIEWS (27 MAY TO 23 JUL 2014)	ROUND 2 INTERVIEWS (10 FEB TO 27 FEB 2015)	ROUND 3 INTERVIEWS (23 NOV TO 04 DEC 2015)
Aged pension	28	25	21
Intellectual disability	11	11	11
Total interviewed	39	36	32
Participant withdrawn			
Unavailable for interview	1		1
Deceased		2	2
Relocated		1	1
Total withdrawn	1	3	4

Ethics Clearance for conducting the interviews was granted by the CSIRO Social Science Human Research Ethics Committee. Interview quotes are included in this report when written consent was provided by the participant and/or legal guardian to disclose such data.

Interview questions aimed to investigate participants' perceptions at the end of the program.

Interview questions explored a range of topics including the following:

- Participants' perceptions of home thermal comfort, especially regarding cooling and heating practices and how this relates to participants' wellbeing
- Participants 'self-reported energy awareness and understanding such as:
 - Interest and use of the in home energy display (IHD)
 - Understanding of their energy bills
 - How existing appliances and householders' behaviour affects overall energy consumption
- Participants overall program feedback, including

- Main outcomes of program from participants' perspectives
 - Participants' views on program approach and preferred communication channels for receiving information about energy use and energy efficiency beyond the life of this program
 - Participants' views on potential future energy efficiency improvements to their homes and their capacity to undertake these improvements
- Participants' views about how best to disseminate energy efficiency information within their social networks and the broader community

The aim was to develop an understanding about energy use in the house and explore the ways in which participants have set about to be more efficient in their energy use given their personal circumstances.

With participants' consent, interviews were recorded using an audio device and were transcribed verbatim to enable thorough analysis and accurate quotation. To maintain anonymity and confidentiality, interview data was de-identified and a numerical code was assigned to each participant. Interview data from all three rounds was analysed thematically.

The analysis of the four case study participants in this report includes data provided during Round 1, 2 and 3 interviews.

The LIEEP attitudinal data required were drawn from the interview transcripts and recorded on an Excel spreadsheet.

These interviews have allowed a rich and in-depth experiential account of an issue to be obtained from each participating household. While individual interview participant's perspectives and insights may not necessarily be representative of their sector, it enabled a variety of community perspectives to be understood in order to provide the broadest possible picture of community acceptance of energy efficiency options.

Following recruitment of the households, each household was provided with a home energy assessment from trained project staff.

Training was provided prior to recruitment of the households through EcoMaster who ran face-to-face training in Standard Residential Home Assessment Training, and also access to a complete on-line record of the workshops and information.

The assessments looked at household behaviours, building characteristics and properties, appliances, energy use patterns and billing/tariff information.

Recommendations from the home energy assessments were made in consultation with the residents with households being able to access as much as \$5,000 worth of incentives aimed at improving household energy efficiency.

For each household, the chosen interventions took into account not only their energy efficiency value but also what residents considered being priority outcomes for them – whether it is an emissions reduction, 'liveability/comfort', financial or other benefit.

It was considered this would help draw conclusions about motivation.

Table 2: Household Interventions

Upgrades	Numbers of homes that received upgrade (total n=36)
Floor insulation	4
Ceiling Insulation	1
Curtains	17
Internal blinds	9
External blinds/awnings	22
Pelmets	10
Draught proofing works – windows and doors	15
Fridge upgrade	15
Freezer upgrade	1
RC Split System Inverter Air conditioner	12
Air Cooler	2
Energy Efficient Heater (Electric)	2
Energy Efficient Heater (Gas)	1
Heat Exchange Unit	3
Pergola installation (external wall protection)	2
Lighting upgrade	1
Carpet installation	1
IHD installation	36

Following implementation of the interventions, households received follow-up visits from project staff where additional data – mainly billing and interval data - was collected. Participants were also able to ask advice on a range of issues to do with energy efficiency, energy use and tariffs.

This included advice and support on understanding bills and tariffs, and whether their retailer was offering the best possible plan. This was a major concern for many households and was also an effective engagement tool.

The program installed In-Home Energy Display (IHD) to allow participants to monitor their energy consumption in all but one participant home (n=39). Face-to-face advice and support about how to use the IHD was provided by the program coordinator during the home visits.

Control houses weren't recruited till October 2015 when billing and tariff information from between 2013 and 2015 was collected. This meant that there was no prior intervention by project staff that may have influenced their behaviour.

Control houses received a \$200 cash incentive and a free home energy assessment as reward for their participation and agreement to provide the requested billing and interval data.

Main households also received a cash incentive of \$100 for each of the two years of the project. As part of the ethical guidelines, there could be no penalty directed toward a house for withdrawal from the project. The incentive was offered to encourage people to stay for the full term

In the end, seven of the forty houses who commenced the project did not remain for the full term (three deaths, one serious illness and three re-locations).

Collected data and information, including from the interviews has been used to evaluate project outcomes and to inform the project recommendations.

4 Background Information

4.1 Participant characteristics

Most participants were aged pensioners (n=28) and 11 were disability pensioners. As shown in Table 3, most participants were above 70 years old (n=22) with 12 of participants aged above 80 years old.

Most participants live alone (n=27), 10 participants live in a two-people household and one participant live in a three-person household. The vast majority of participants (n=37) reported an annual household income between \$20,800 and \$31,199, with 2 participants reporting an annual household income between \$15,600 and \$20,799.

Table 3: Participants aged according to pension received

	AGED PENSION		DISABILITY PENSION		TOTAL	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
31 to 40	0	0	5	14	5	14
41 to 50	0	0	3	8	3	8
51 to 60	0	0	1	3	1	3
61 to 70	3	8	2	6	5	14
71 to 80	10	28	0	0	10	28
81 to 90	10	28	0	0	10	28
91 to 100	2	6	0	0	2	6
Total	25	69	11	31	36	100

4.2 Dwelling characteristics

Aged and disability pensioners, who participated in the program were, in general, living in homes that had poor energy performance. For example, at the time of the energy assessment, many participants were living in:

- Old homes: all homes were at least 20 years old with 77% of homes being at least 40 years old
- Poorly designed homes: only 28% of homes had a North Aspect and 44% of homes had minimal thermal mass

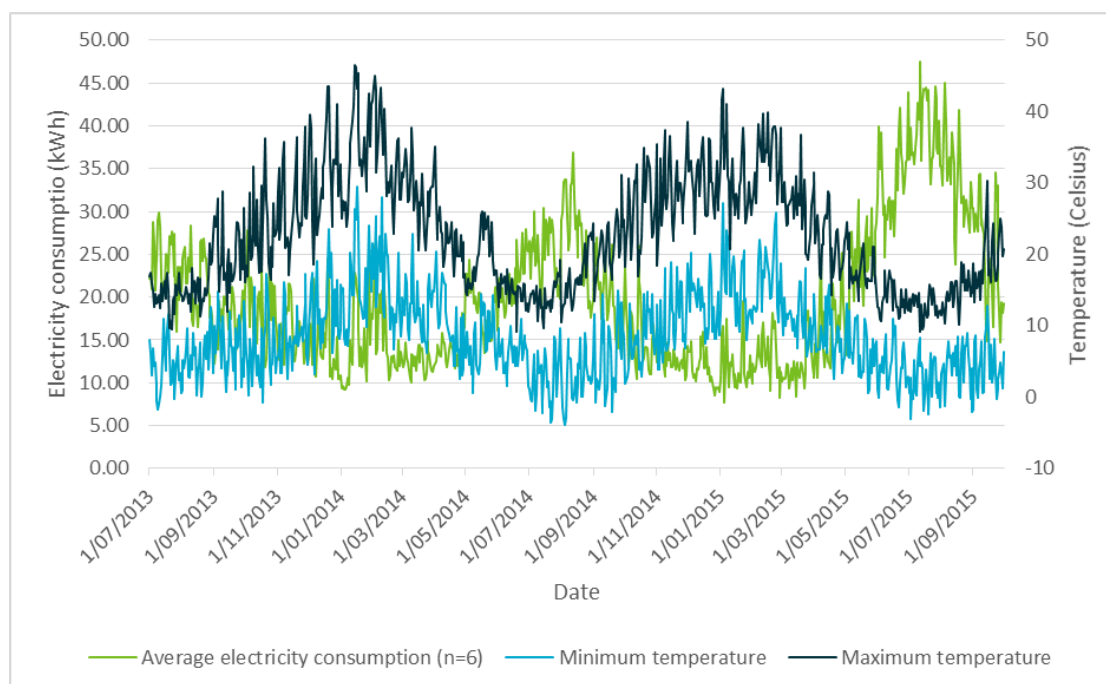
- Homes without EE features: 67% of homes did not have external shadings and none of the homes had double glazing windows.
- Homes with old cooling appliances: while all participants reported using air-conditioning for cooling, 25% of air-conditioner units reported were 30 years or older and only about half (52%) of air-conditioners were less than 10 years old.

The poor energy performance of these homes contributed to these homes being very hot in summer and very cold in winter. Therefore, despite the fact that aged participants were using a range of low cost strategies to manage their homes indoor temperature, very few participants were able to achieve thermal comfort without the use of heating and cooling devices to ensure wellbeing in very hot or cold days.

Therefore, results from the energy assessment conducted in participants' homes identified the need for more extensive retrofits to improve participants' capacity to reduce their energy consumption and/or improve wellbeing.

4.3 Households energy consumption

Electricity consumption data was available for a small number of participants (n=6) for a 24-month period. Descriptive analysis of this data presented in Figure 1 shows that electricity consumption of these households is higher in winter months, especially when maximum day temperatures falls below 15°C, suggesting heating appliances account for a large proportion of household energy consumption.



Note: Daily minimum and maximum temperatures retrieved from Climate Data Online (<http://www.bom.gov.au>)

Figure 1: Average electricity consumption of 6 program participants and daily minim and maximum temperatures

Data collected through the energy assessment, shows that the vast majority of participants relied on electricity for heating (95%); with participants also relying on wood (24%) and gas (21%) as fuel sources for heating. Analysis of energy data also shows that electricity peaks in winter especially amongst participants who do not rely in other energy sources for heating.

4.4 Barriers Identified During First Round Interviews (Pre-intervention)

Some of the barriers to future changes to improvements at home included:

- financial constraints and cost
- lack of knowledge or understanding, exacerbated by complexity of the energy market and a confusion of energy efficiency advice. This fostered lack of confidence amongst many householders to investigate their energy use and their capacity to make changes.
- the above view was further complicate by a culture of stoicism typical of the demographic and commonly found amongst the older generation – particularly in rural or regional areas
- cultural barriers also included:
 - ingrained habits, lifestyles and expenditure patterns
 - a view that it was wasteful to upgrade inefficient appliances while they were still functional
 - advanced the view that age meant they did not warrant any significant investment in appliance upgrades or improved thermal comfort
- satisfaction with their current level of comfort and energy use
- infrastructural barriers such as living as tenants in in older, inefficient homes

The main barrier was financial, with a lack of knowledge or understanding of what could be done next.

This suggests that participants might benefit from assistance, support and guidance on what energy improvements were available and best suited for their homes and ways to finance them (e.g. government grants or schemes).

Some participants who were tenants in a rental property (owned by social local service organisations or private individuals) mentioned that they could not undertake larger or structural improvements because they did not own the home and/or reported being unable or unwilling to approach landlords to request energy efficiency upgrades.

5 Findings

5.1 Communication Channels and Engagement Strategies

Based on participants' responses, it is clear that a key strength of this program is its personal and face-to-face delivery. Participants expressed their preference for receiving information and advice through face-to-face delivery from a dedicated professional and from someone they trusted. Most found information and advice more useful (and tend to remember it better) when it involves personal contact and a chance to discuss issues.

However, despite this personalised face-to-face approach, some participants found it challenging to understand and/or remember some suggestions and advice that were given to them and thus to act on them.

Another key strength was to utilise trusted pathways to initiate and maintain relationships with households, and to assist with the communication and reinforcement of key messages.

Positive changes experienced as a result of these approaches and an indication of their effectiveness included a reported increase in, or reinforcement of, energy awareness and increased understanding of their energy use and potential for saving energy by a majority of households (23 of the 32 interviewed in the third round).

Feedback from many participants indicates the advice and information they received through the project had been useful in helping them becoming more energy efficient in their homes. For example, one disability pension recipient reported feeling more efficient as a result of the project due to what he had learned and had implemented as a result. This suggests that this participation' sense of control of his energy use had increased as a result of being better able to manage his energy use.

It also indicated that participants now thought more about, and were paying more attention, to their energy actions in relation as a result of their participation in this project, the new energy upgrades installed in their home and/or to tailored advice they received from the project coordinator during the initial energy audit and/or his subsequent home visits.

Some participants reported that the project had helped them to better understand their energy use – achieved through the initial home energy audit, subsequent discussion on current energy use and potential improvements, examination and explanation of their energy bills and, in some cases, use of the in-home display.

Some reported that they had developed more awareness of their energy use as a result of their participation in the project. In some households, increased awareness has led to a conserving behavioural effect, i.e. led to participants changing their energy behaviours in some ways.

The remainder reported they were already aware of their energy use prior to the project and were generally conservative. Yet some reported that the awareness they already had was prompted or reinforced as a result of their participation in the project. In these instances, reinforced awareness did not lead to new energy actions but to participants being more diligent in taking existing actions.

Interestingly, some participants in this study were acutely aware prior to the project of the cost impacts of using old energy devices- yet they had no other choice because they lived in energy inefficient housing and relied on old energy inefficient appliances and heating/cooling systems.

This suggests that for these participants, the project has given them choice or some options that were not available to them before to assist them in better managing their

energy use and reducing costs. It seems that having the new energy upgrades installed and receiving advice on how to use them efficiently was making it easier for them to control their energy use.

Some participants reported undertaking more energy-saving actions following their involvement in the project while others reported no change. For those who reported they had made some changes, these included:

- Using items provided as part of the project (i.e., use of new heavy curtains, drapes or blinds to maintain cool air with the home / to reduce heat getting into the house).
- Using their existing cooling systems less as a result of improved home thermal comfort due to new energy upgrades installed (see previous section 3.2.1).
- Taking additional actions recommended by the program coordinator such as turning off lights and other appliances when not in use, taking shorter showers, decreased use of heating and cooling, and closing doors, curtains and blinds.
- Other additional actions such purchasing outdoor solar lights, power-saving board or installing insulation.

The most reported changes were the use of the newly installed upgrades.

Many households were unsure of how to set their air-conditioners and assisting people with information in this regard became a priority of the project with a handout being developed and circulated that included both a detailed explanation and a simple pictorial illustration. Most households reported benefiting from advice and information on optimising air-conditioner settings from project staff.

Changes in other habitual energy behaviours were also attributed by some participants to tailored advice they had received from project staff.

For some, this project seems to have triggered an interest in energy efficiency and a desire to learn more about ways they could control their energy use and reduce their bills.

There was a high level of interest from participants in receiving information, advice and assistance in relation to bills and tariffs. This was clearly evident in the control houses as well which further highlighted its effectiveness in engaging households in discussion on energy efficiency.

Although a minority of participants reported not talking about the program with others mainly because they feared it might generate some jealousy or because no one had asked them about it, there was significant degree of dissemination of program information beyond the participants to their social networks and broader community.

Understandably, much of this was biased more toward the upgrades that had been installed as part of the program rather than what they might have learnt from the program in terms of energy saving.

However, there has been considerable reinforcement of the key messages – particularly in relation to heating and cooling devices (e.g. AC settings) – as the project progressed. That reinforcement, coupled with a diminishing commentary on the upgrades will result in people helping advise their peers more on energy efficiency actions.

The unavoidable positive is that the project is being talked about within these peer groups. Overall, interview responses indicate that the word about the program had spread across the broader community when project participants lived. They also suggest that many people project participants knew - other residents on disability and aged pension who were not in the program - would be interested in participating in this

program or a similar program if given the opportunity in the future to receive assistance with the installation of energy-saving upgrades.

Some participants mentioned that they would like the program to reach more people in need and thus have wider benefits beyond their household to the broader community.

5.2 Reduced Energy Consumption and Cost

Although there is some indication from interval data and billing data that the project did have an effect on reducing consumption (and hence cost), it is virtually impossible to quantify this reduction and attribute an accurate figure to the project.

Similarly, while some participants felt that the program had a positive impact on their energy bills it was difficult for them to really know if this was the case or not.

The reasons for this were many including inconsistent billing cycles and difficulty comparing similar time periods. Also the fact that similar time periods had little correlation to actual temperatures and seasonal variations, or to the dynamic circumstances and situations of individual households during these periods – changes whose effect was likely to be more significant than changes brought about by the project. This view is substantiated by any quick look at the standard deviation in the data (see below).

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Table 4: Summary of Changes in Peak and Off-Peak Consumption for House with Useful Data

Control Household	%age change Peak	%age Change OP/DC	Main Household	%age change Peak	%age Change OP/DC
601	3.43	5.75	501	-10.71	
602	-19.24	12.11	502	-25.66	
603	11.17		503	-19.69	
604	10.07		504	-17.13	
605	28.25	9.64	505	-48.8	-17.33
606	5.36	27.71	507	1.6	
607	-9.5		509	-10.23	-15.92
608	-15.74		510	3.11	
609	-23	-6	512	142.72	-10.26
610	-14	2	514	11.08	
611			516	16.1	6.4
612			518	0.11	3.38
613	19	-51	519	1.67	-31.8
614	30	15	521	-22	
615	2		522	42.93	-8.5
616	-5	-7	523	-5.87	-16.63
617	20	21	524	-24.19	-18.51
618	-2	1	525	-8.23	
619	5	28	526	-43.12	
620	27	11	527	85.31	52.85
			531	-6.01	2.93
			532	10.28	-36.34
			533	-21.49	12.35
			534	60.14	1.99
			537	-19.96	4.11
			538	-14.96	
			539	-11.07	-3.15
			540	-4.42	33.01
			543	-71%	
			544	-35.87	

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Table 5: Summary Changes in Control House Consumption

%age change Peak Mean (Control)	4.044444	
Standard Deviation	16.54134	
%age change OP/DC Mean (Control)	5.323846	
Standard Deviation	20.2773	
No of control houses increasing Peak	11	61%
No of control houses decreasing Peak	7	39%
No of control houses not included Peak	2	
No of control houses increasing OP/DC	10	77%
No of control houses decreasing OP/DC	3	23%
No of control houses not included OP/DC	7	



Figure 2: Graph Showing Changes in Control House Consumption

Table 6: Summary Changes in Main Household Consumption

%age change Peak Mean (Main)	0.831	
Standard Deviation	38.55538	
%age change OP/DC Mean (Main)	-2.43647	
Standard Deviation	21.94942	
No of main houses increasing Peak	11	37%
No of main houses decreasing Peak	19	63%
No of main houses not included Peak	0	
No of main houses increasing OP/DC	8	47%
No of main houses decreasing OP/DC	9	53%
No of main houses not included OP/DC	13	

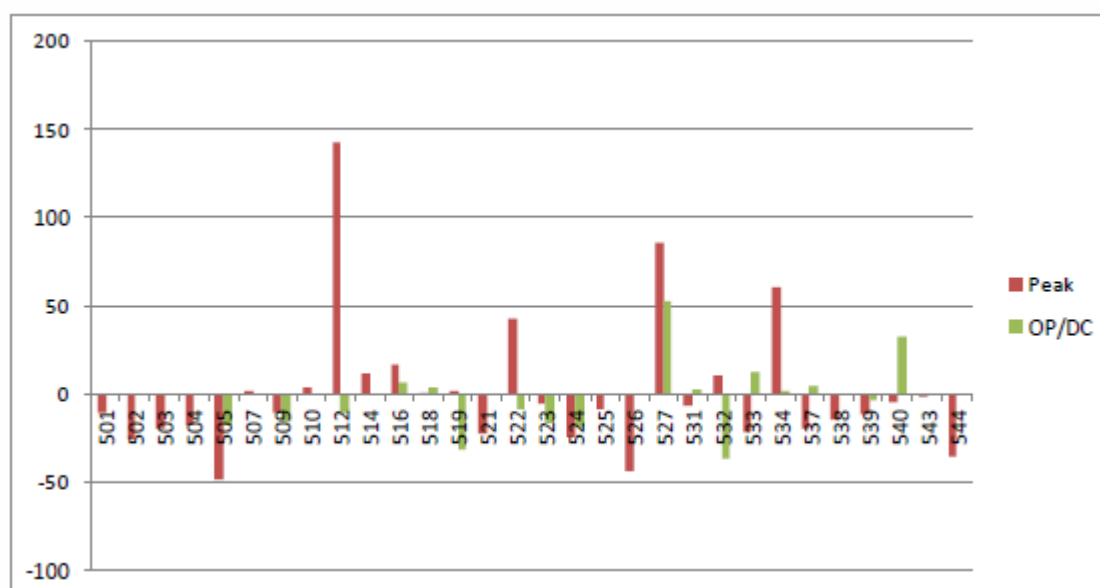


Figure 3: Graph Showing Changes in Main Household Consumption

What the project did do was look at bill and interval data from each households (both main households and the control households) over as long a period between June 2013 and post June 2015 as it was possible to gather (*note: despite repeated attempts and approaches to both households and retailers, there remained some gaps in data that further reduced the integrity of any analysis*).

Table 4 above was created using interval and billing data from houses where there was data available to compare over similar time periods (the 4 seasons pre-intervention

against same seasons post intervention). Table 5Table 6 combines and provides a basic analysis of the figures in Table 4.

The graphs provide a diagrammatic representation the changes in each group.

It is interesting to note that the four most significant increases in energy consumption are all for houses where wood heating has been replaced by electric heating and, so, it was inevitable that consumption would increase in these households.

Despite the likely error likely due to the small cohort there is a strong indication that overall the project has a positive effect on reducing household energy consumption.

The estimated reduction (percentage) calculated from a comparison of collected control and main households' consumption data in peak usage was 3.213%, and in off-peak usage of 8.712%. With average peak usage calculated at 9.103681kWh/day and off-peak at 7.522616kWh/day, the combined average savings per household are 345.973 kWh/yr per household.

At an average cost of \$0.26/kWh peak and \$0.14/kWh off=peak, the average savings are \$61.247 per household.

5.3 Tailored Energy Efficient Solutions

Satisfaction with the program was high. All participants expressed being very grateful for the new energy upgrades installed and the advice and support they had received/were receiving from the program coordinator. As a result, they were commonly eager to provide positive feedback.

All participants were thankful for the energy upgrades installed in their homes and commented on the fact that they could not have been able to afford these if it wasn't for this program. Many were positive about specific items they had received, most commonly items that had increased home thermal comfort this summer

The majority of participants (84.375%) felt that their homes were generally more comfortable and reported improvements in thermal comfort for themselves and/or a household member as a result of the project. Much of this was attributed to new home energy upgrades installed as part of the program.

Some of the neutral or negative responses in relation to improving home thermal comfort may be due to older housing stock. Temperature in weatherboard houses are notoriously difficult to regulate and may require more extensive and expensive retrofits.

Feedback about the effectiveness of any upgrades – whether appliances, HVAC units, window treatments, insulation, draught proofing etc. – has been overwhelmingly positive with a small number complaining that they were having trouble understanding how to use the settings on air-conditioners. These issues were addressed during follow up visits.

One house was unhappy with installation of exterior blinds and the contractor was called back to reinstall them.

Most participants (68.75%) reported changes in their cooling and/or heating practices, usually in relation to use of installed upgrades – e.g. new thermal curtains/blinds used to control sun exposure.

Participant's responses in relation to changes in thermal comfort often also referred to reduced energy use – e.g. blinds kept the house cooler and led to reduced use of the air-conditioner and so lower consumption and cost.

A few participants (18.75%) reported that the project motivated them to take additional actions involving the purchase of more energy-efficient products and doing a retrofit.

For example, one aged pension recipient stated that her energy awareness had increased as a result of her participation in the program and this led her to purchase energy efficient solar lights for her garden:

The family members of one aged pension recipient were installing insulation after learning during the initial energy audit that the ceiling was not insulated

Many houses were already extremely frugal in their use of electricity and did not feel they had done anything differently in their homes or could not think of specific energy action they had taken as a result of the project. They felt that they were already conservative with the way they used energy prior to joining the project primarily due to their upbringing and strong-held habits of minimise waste.

Some participants reported no actual changes to what they did prior to the project thus no new energy actions - but they often reported being 'more aware', 'more conscious' and more diligent in taking the energy actions they already took prior to the program or 'do a bit more' (n=23). Some reported that participating in the program had made them reinforce or re-affirm the need to take these energy saving actions.

Some participants who reported no or limited changes pointed to the challenges of breaking current day-to-day habitual energy actions and establishing new ones. Some participants found it difficult to change how they acted.

Some participants found it challenging to remember the suggestions and advice that were given to them at the start of the program either by the program coordinator or installers (e.g. instructions on how to use particular new items or ideas on how to save energy in the house) and thus to act on them.

When asked if they felt more energy efficient as a result of participation of the program, some participants talked about the new equipment (e.g. new fridge or AC using less energy than their old one) rather than their own energy actions – the belief shared by many was that the new equipment was more efficient and therefore by association making them and their household more energy efficient.

In addition, some participants described that although they were already conservative prior to the project, they might not have been as energy efficient as they were now with the new energy upgrades because they relied on old appliances that used a lot of power.

Here it is important to note that the belief of being more energy efficient because more efficient upgrades relied on the new upgrades being used efficiently as well as existing items.

While some had thought about future improvement and gave specific examples, others hadn't and thus were unsure about what else could be done. A small minority reported that they were satisfied with their current level of comfort and energy use, and planned no further changes.

Some reported that they would like to do more to improve their thermal comfort of their homes and improve energy efficiency. Some nominated smaller changes such as energy appliances they would like to purchase. Others expressed interest in larger changes included installing external shading, insulation and upgrading their heating and cooling systems. Some of the changes listed were inspired directly by the project and its recommendations.

In general, the in-home displays (IHD) were not well used or understood. Many households reported that they had a novelty factor to begin with but which soon wore off. Some people saw it technologically daunting. However, a minority (25%) found it useful or helped 'make visible' their energy usage and appreciation of what used energy in the home. One household described it as a 'real asset'.

For homes with a disability, the numerical display of the original IHDs made it difficult to understand. Late in the project these were changed for a dial display and the immediate feedback was that these were more use-friendly.

Many households thought the IHD was for use by project staff and not by them.

The most valuable use of the IHD was the graphic display they were able to generate which, together with graphs generated from billing or interval data, proved a useful tool in illustrating to householders their energy use patterns and helped support the advice and recommendations from project staff wanted to make,

The illustrations in the below examples show one a household where really high peaks coincided with periods when family visited and took over the bottom half of the house.

The next shows typical high winter peaks associated with lower summer peaks that related directly to heating and cooling impacts on energy use.

The third shows a household with summer peaks as the only heating in winter was a wood stove. The fourth shows off peak hot water use continuing to be a cost despite a period when the house was empty and the main electricity usage was near zero – maybe a fridge and clock radio.

These types of scenarios, when discussed with households, often made sense and increased the residents appreciation of what was happening in relation to their energy use.

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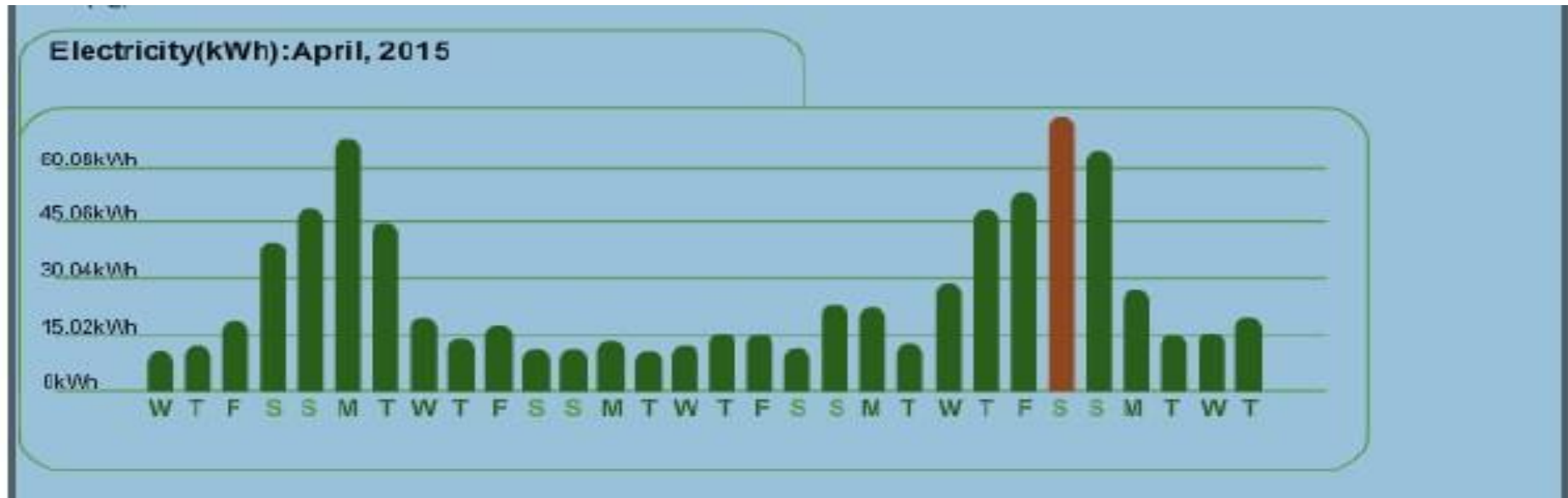


Figure 4: Household with Peaks Associated with 2 Family Visitations April 2015

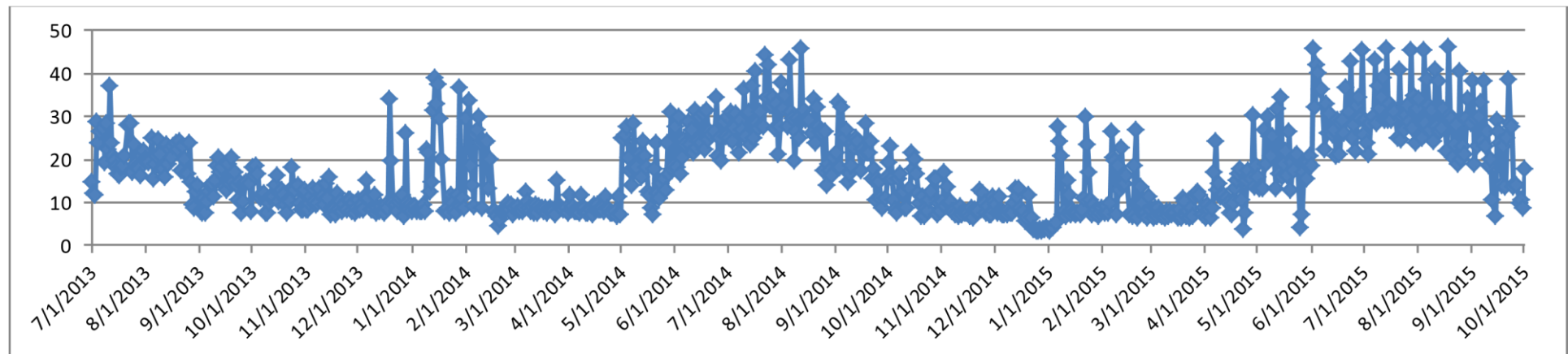


Figure 5: Household Heating and Cooling Peaks

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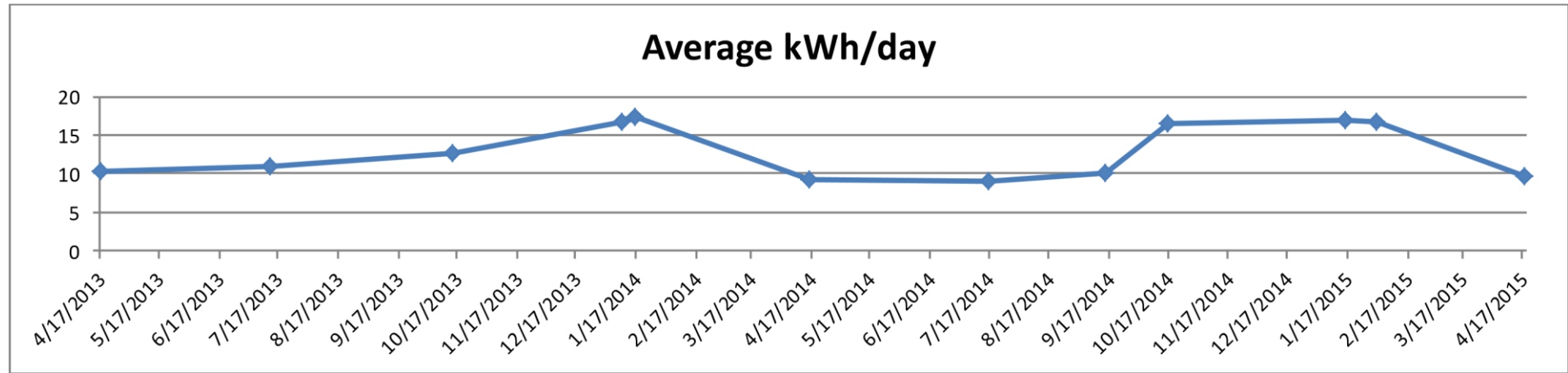
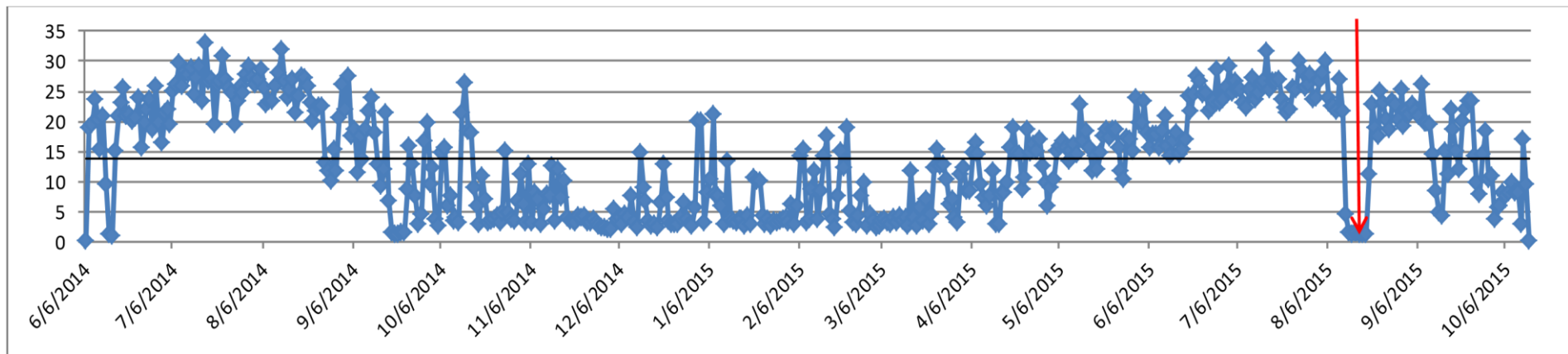


Figure 6: Household with Summer Peaks



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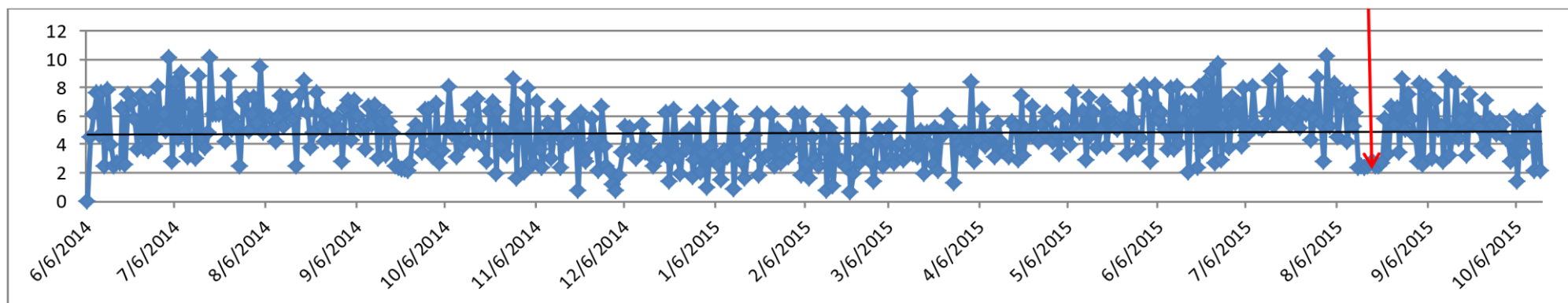


Figure 7: Household Showing HWS Usage when House has been Empty

In tailoring recommendations to households, some of the barriers to potential changes and improvements in energy efficiency were canvassed with participants as part of the round table discussion. These included:

- financial constraints and cost
- lack of knowledge or understanding, exacerbated by complexity of the energy market and a confusion of energy efficiency advice. This fostered lack of confidence amongst many householders to investigate their energy use and their capacity to make changes.
- the above view was further complicate by a culture of stoicism typical of the demographic and commonly found amongst the older generation – particularly in rural or regional areas – that what was, was what was and they just had to make the best of it
- cultural barriers also included
 - ingrained habits, lifestyles and expenditure patterns
 - a view that it was wasteful to upgrade inefficient appliances while they were still functional
 - advanced the view that age meant they did not warrant any significant investment in appliance upgrades or improved thermal comfort
- satisfaction with their current level of comfort and energy use
- infrastructural barriers such as living as tenants in in older, inefficient homes

The main barrier was financial, with a lack of knowledge or understanding of what could be done next. Some participants who were tenants in a rental property (owned by social local service organisations or private individuals) mentioned that they could not undertake larger or structural improvements because they did not own the home and/or reported being unable or unwilling to approach landlords to request energy efficiency upgrades.

5.4 Energy efficiency retrofits installed in homes

As shown in Table 7, most retrofits were aimed at improving the home's thermal efficiency.

Therefore, most participants had internal blinds (64%) ad/or external binds (56%) installed. In addition, 31% of participants had their air-conditioner upgraded, while 26% had pelmets installed.

Other retrofits aimed to improving thermal comfort provided include: provide alternative HVAC option (18%), draft-proofing doors (18%), installing floor insulation (10%), draft proof windows (8%), external shading or wall protection (5%) and installing ceiling insulation (3%).

Table 7: Energy efficiency retrofits installed as part of the project

Retrofit provided by the program	Frequency	Percentage
Install In Home Display	39	97.5%
Install internal blinds or drapes	25	64%
Install external blinds or awnings	22	56%
Upgrade fridge/freezer	15	38%
Upgrade HVAC unit	12	31%
Install pelmets	10	26%
Provide alternative HVAC option	7	18%
Draft proofing doors	7	18%
Install floor insulation	4	10%
Install door	4	10%
Draft proofing windows	3	8%
External shading/wall protection	2	5%
Install ceiling insulation	1	3%
Install improved energy efficient light	1	3%

5.4.1 Energy efficiency upgrades and patterns of electricity consumption

Electricity consumption is heavily influenced by heating sources used in the household. Figure 8 shows electricity consumption for a particular household, which reported using gas as the main energy source for heating in the home. Data shows electricity consumption for this household did not peak in winter months.

During Round 3 interviews, this household reported using the reverse cycle air-conditioner installed through the program for heating on occasions where they have problems with the supply of gas bottles. This might explain the greater variance in electricity consumption during the 2015 winter data.

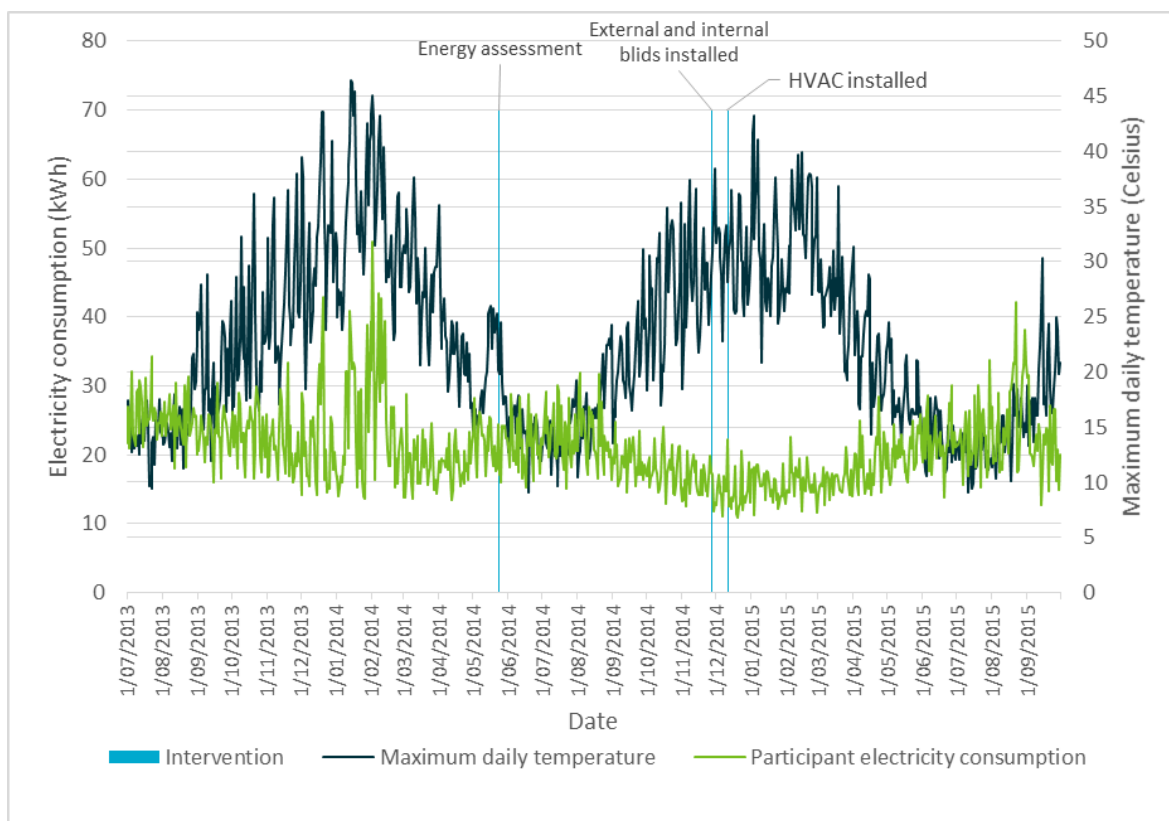


Figure 8: Electricity consumption of a program household who relies in gas as main energy source for heating

On the other hand, Figure 9, shows an example of a participant household who switched its main heating source from wood to electricity sources during the project. After the change in energy sources, there is a clear peak in electricity during winter months.

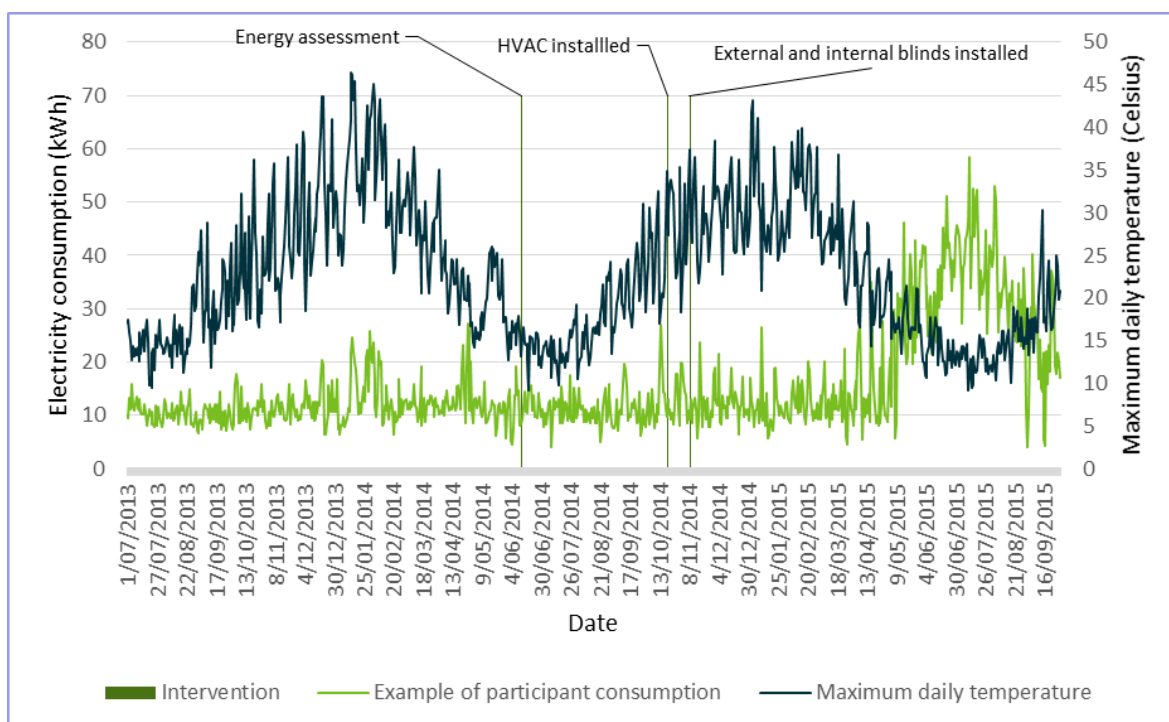


Figure 9: Electricity consumption of a program household who switched from wood to electricity heating

However, it should be pointed out that this household was paying around \$100-120 a fortnight for wood and so considered that they were far better off as a result of the switch and, apart from the great convenience, had significant health and well-being benefits related to issues such as arthritis, back ache, respiratory difficulty and pulmonary disease.

As previously shown in Figure 1, electricity usage in winter has increased for some participants after the program interventions.

However, Round 3 interview responses show these households have changed the energy sources used for heating.

For example, some participants who used to rely on firewood for heating at the start of the program have since switched to using reverse cycle air-conditioners.

Reasons for moving away from wood as a heating source provided by participants included cost (wood is expensive), health (indoor air quality) and wellbeing (i.e. physically challenging to chop and carry firewood).

While participants who moved away from wood as heat source saw an increase in electricity consumption, participants reported an increase in wellbeing as well as stated that the increase in electricity costs were offset by savings from wood purchase. For example,

The [reverse cycle] system, definitely [improved levels of comfort], because we haven't burned wood at all. (...) And we haven't got the ash of wood and fire ash. So it's definitely improved (...) the air quality. Elimination of the wood would be the best thing that happened for us [main outcome from program]. Really. (...) we are much better off. It was accosting about \$7.00, nearly eight bucks a day with wood, but it worked out to \$5.70 with the power, (...) but that's for everything. (...) So it was a hell of a saving. And my health, and I don't feel like [getting] wood in and stack wood and wheel it in from over here into the shed.

5.4.2 Energy efficiency upgrades and home thermal comfort

The majority of participants (90.625%) felt that one or several upgrades installed (often working together) had helped improve their thermal comfort. As one respondent explained:

The blind on lounge room window and above the front door have had an enormous impact on the temperature] of the living area. And, of course, the fans have made a difference. The blinds, the heavy drapes, it has just made this place so cosy, and insulation, of course ... The house temperature in general is better now. I think because the temperature in the house isn't going to those extremes any more so it's easier for her not to rely on that [existing air-conditioner] as heavily as she was.

Interviews responses show that participants were, in general, very appreciative of the upgrades received during the program.

As highlighted in Table 8, participants stated that the upgrades received provided them with additional measures to regulate their home indoor temperature and consequently manage their level of comfort and wellbeing. For example, prior to the program, when installed, curtains were often ornamental or for privacy only and did not provide thermal benefits.

Table 8: Participants' Perceptions about the Impact of Energy Efficiency Upgrades on their Thermal Comfort

UPGRADE	BENEFIT IDENTIFIED BY PARTICIPANT	ILLUSTRATIVE QUOTE
Blinds	Improvement in home indoor temperature	<i>There's been an improvement. The new blinds have been wonderful, mostly in winter. I like how they work. In winter they are keeping the heat in and We haven't had much of a summer yet but on the few hot days they certainly kept the heat out. They are good.</i>
		<i>The blinds in the front room installed through the project have made a difference, particularly when the weather is hot. I think the lounge has been a bit easier to keep warm and cool like I don't have to worry about the warmth too much in summer ... and with the real cold spell we had, it was a lot better.</i>
External blinds	Improvement in home indoor temperature and Reduced need for air-conditioner use	<i>Oh definitely the blinds [external blinds on northern face of house]. Well it keeps this room in particular – because it shades the veranda there and in the summer time this is just a hot box but I don't have as much – this on [existing air-conditioner] and I use the fan occasionally but it's made a big difference in the summer. I haven't noticed any changes in the winter</i>
Air-conditioners upgrade	Improvement in thermal in comfort due to more efficient HVAC unit	<i>When the day gets too hot then we have the coolers on and make the most of it. But if the weather is moderate, well we don't need it so much. It comes down.</i>
Combination of upgrades	Improvement in home indoor temperature and Reduced need for air-conditioner use	<i>The blind on lounge room window and above the front door have had an enormous impact on the temperature of the living area. And, of course, the fans have made a difference. The blinds, the heavy drapes, it has just made this place so cosy, and insulation, of course ... The house temperature in general is better now. I think because the temperature in the house isn't going to those extremes any more so it's easier for her not to rely on that [existing air-conditioner] as heavily as she was</i>

5.5 Home thermal comfort

5.5.1 Overall impact on home thermal comfort

Heating and cooling can account for more than 40% of a household's annual energy consumption (Australian Bureau of Statistics, 2009) and therefore understanding household thermal needs plays a key role towards assisting households to improve their energy efficiency.

When asked, the majority of participants reported that their homes were generally comfortable (87.5%) and that they perceived an improvement in thermal comfort (90.6%) for themselves and/or another household member in summer and/or winter.

As thermal comfort impacts directly on health and well-being, and on a person's quality of life, this represents a significant achievement of the project.

However, a minority of participants (12.5%) still reported thermal discomfort during Round 3 interviews, with one participating household reported no change in their thermal comfort as they felt their home was already quite comfortable prior to the project and declined the energy efficiency upgrade recommended through the project. Table 9 provides some illustrative quotes.

Table 9: Participants Perceptions of Thermal Comfort at the End of the Project

THERMAL COMFORT	ILLUSTRATIVE QUOTE
Improvement reported (n=29)	<i>The house has been much more comfortable this winter. It's warm and we haven't had to be freezing</i>
	<i>Oh yes, it's lovely to live in now ... it is a lot easier and a lot better and I can cope better</i>
Continued to report thermal discomfort (n=4)	<i>Well the thing is that it has improved because we've got the new shade cloth up. So that's improved but the house still gets really, really hot ... and in the winter, we only we do not have insulation in the walls because it's an older house so it gets very cold especially at the end of the house and insulation would help the heating situation</i>
No change in level of comfort reported (n=1)	-

5.5.2 Self-reported cooling and heating practices

As shown in Table 10, most participants (68.75%) reported changes in their cooling and/or heating practices, while others (31.25%) reported no change.

For the participants who reported changes, the most commonly reported changes were the use of installed upgrades in the home as part of the program, especially regarding the use of replaced or new thermal curtains/blinds to control sun exposure.

However, interview responses also show that participants perceived that changes in their own behaviour also contributed to the improvement of their thermal comfort at home.

Some participants who reported little or no change found it hard to establish new change existing habits, sometimes due to competing preferences (i.e. preference for natural light and/or outdoors views).

Findings also show that while some participants were already employing a range of low-cost adaptive measures (such as closing/opening doors, closing/opening curtains or putting on additional clothing to stay warm) prior to the project, these participants stated that the program helped reinforced such pre-existing energy-saving actions.

Participants also believe that such reinforcement helped them increase the frequency or extent to which these actions were performed, with some participants reporting 'paying more attention' to their home energy use.

In general, participants reported being more mindful of the need to balance lower-cost measures (such as dressing to the season; using blankets) with higher cost measures (such as energy efficient use of heating system).

Table 10: Heating and Cooling Practices being Performed at the End of the Project

	PRACTICE	ILLUSTRATIVE QUOTE
No changes reported by participants(=10)	Already employing a range of strategies to achieve thermal comfort prior to program	<i>Probably not [no change] because of my age, we've always been a bit conservative with power and I prefer to put a jumper on than turn on a heater, so it's probably hasn't made a big difference. I've always done those sorts of things, yeah ...</i>
		<i>Kevin suggested just the basic things. You know pull the curtains across, close the doors and just the – just what you would normally do ... it is common sense. I think they're things I've always done but I'm more conscious of it now, yes</i>
	Hard to change personal habits and preferences	-
Changes in cooling practices reported (n=22)	Increased efforts to use window covering, open/close windows and/or doors to establish a comfortable indoor temperature (often attributed to advice provided by program coordinator)	<i>Oh yes, I have [made changes]. Well, for a start, I pay much more attention to whether I've got doors and things open now and on those very hot days that we had in October I pulled the curtains [existing thermal curtains] closed and I shut the door, I shut everything off, except that bedroom because I need the cooler air to keep going in there because at night time it – that room is cooler then, and yeah, I've never pulled the curtains over before.... Kevin did explain that those long curtains help to keep the warmth in the room</i>
	Reduced use of their existing or new air-conditioner (often due to improved thermal efficiency through window coverings)	<i>Well, in the winter I put the blinds up, I've got new blinds on the front and the back, and I put them up in the winter time and that lets the sun in and that makes the house warmer. Now (summer), I've got them down and (...) I only have fans on. I don't use my [existing] air conditioner</i>
	Increased reliance of smaller cooling device (i.e. increased use of ceiling or pedestal fans rather than air-conditioner)	<i>On those warmer days because we've got the little evaporative cooler [installed as part of program] so he's had that going instead of the air conditioner (Disability pension recipient – carer)</i>
	Change in heating energy sources (i.e. switching from using firewood to reverse cycle air-conditioner)	<i>We haven't used any wood this winter. No, no wood at all. We've used the new split system. It's been quite – a fairly cold winter. It's been – done the job okay</i>
	Dressing to the season	-

5.5.3 Self-reported air-conditioners settings and use

During the program, it became clear that participants were not using their cooling and heating systems efficiently.

To improve the energy efficiency of cooling and heating systems, the program coordinator provided advice and suggestions on how to best use air-conditioner (both existing and installed as part of program), including optimal temperature settings in winter (18°C or lowest possible) and summer (24°C or highest possible), to achieve and maintain thermal comfort as efficiently as possible.

A handout (Figure 10) was provided to all households, that included the simple schematic below but also included more detailed information on setting air-conditioners and other behaviours and practices that would allow more effective use of the air-conditioner – this included things such as zoning, using window treatments, utilising ceiling or portable fans, dressing appropriately, using lap rugs etc.

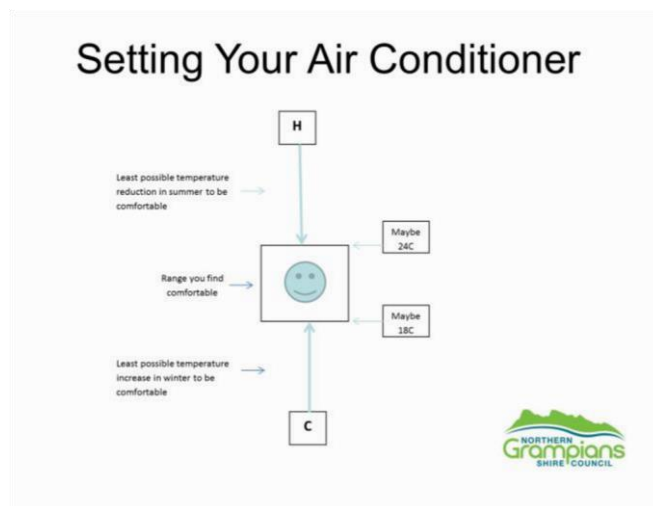


Figure 10: Setting Your Air-Conditioner Setting

The principle being communicated that the less work the unit had to do adjusting temperature, the less energy it will consume.

Round 3 (final) interview findings shows that while reported set temperatures of heating and cooling systems still ranged from 10°C to 25°C in summer and from 18°C to 30°C to in winter, advice regarding temperature settings was adopted by most participants, who reported using temperatures around 20°C to 22°C in winter and 24°C to 25°C in summer during Round 3 interviews.

Table 11: Participants Feedback on Air-conditioner Temperature Settings

ILLUSTRATIVE QUOTE		
Advice adopted	Finding optimal temperature settings.	<i>Because when it was installed, the guy that installed it really just switched it on and did not tell us what levels to use, what temperatures etc.... The manual does but Kevin explained a lot more ... He reckons to bring it down a bit [from 24C in winter] to 22C or something. You see the guy that installed it told us to blow real hard for half an hour on 30C to warm the room, but obviously it doesn't work that way. That's what Kevin said. So that's something we've learned</i>
	Avoid changes to the temperature settings during the day once comfortable temperature is set.	<i>Kevin talked to all us at length. Simply because that – it should be running on 23 as a maximum. You get your temperature there and just leave it there. Don't be upping and downing it all the time because that's just crazy, really ... She used to have it on 30, and flat out all the time. She could never get comfortable</i>
Barriers for energy efficient use of cooling and heating systems	Information about temperature settings still confusing	<i>Kevin's trying to teach me that at the moment. We're working on it. He even gave me a diagram the other day. Here it is. He gave me this diagram that says when it's cold you need the heat and if it's hot you don't need the heat. You need it cool when it's hot and cold, maybe 18 if it's a cold day with the sun and maybe 23 or 24 when it's hot to make it cool. One is with the sun and one is with the snow flake ... He's got me these pages to read but I have had the time yet</i>
		<i>This was in the box the other day [information leaflet from the program coordinator]. I do switch it on and off more than that advises. But about 24 I reckon was enough in winter ... In summer, well it says 18 but I think 18 is a bit low myself. For 18 you need a cardigan on [laughs]. I had it a bit higher, 20–22</i>
	Difficulty remembering advice	<i>(Interviewer) 'Did you have a conversation with the program coordinator on how best use your air con at the start of the program?' 'I guess so at the time but I wouldn't remember too much of that, would I?'</i>
Key role of carers for achieving energy efficiency use of cooling and heating systems	Important to involve and build capacity of carers	<i>I think Kevin's been really good in like assisting us as to what temperature to run it on because we're all – all the staff, all of us were ignorant of that and she [the participant] has got no idea. We were running the air conditioner way too high.</i>

In addition, interview findings show that support workers and/or family members played a key role in adjusting the temperature settings on the air-conditioner within several disability pension households.

Therefore, findings show that, while it is important to provide practical advice to householders on how to use heating and cooling systems efficiently, for participants with an intellectual disability or impaired cognitive capacity, it is essential to involve and build the capacity of support workers and family members so they can assist households to improve the energy efficiency use of their heating and cooling systems according to their health needs.

Self-reported change in other energy behaviours

While the focus of Round 3 interviews was on thermal comfort, a few participants (18.75%) also reported some change in other energy related behaviour. As shown in Table 12, participants reported turning off lights off and minimising appliances use at the end of the project.

Many also reported they were performing some actions more frequently, suggesting that the frequency and duration of certain energy behaviours were being performed more often at the end of the project.

Table 12: Additional energy related behaviour being performed at the end of the program

	PRACTICE	ILLUSTRATIVE QUOTE
No changes reported by participants (n=26)	Already conserving energy prior to the program	<i>Not really. I've always tried to be prudent with my use of electricity and really for me I've spent a lot of time outdoors, so there would only be washing once a week and cook two meals a day, so that was about all my needs part from the hot water [and heating and cooling]</i>
		<i>No I probably haven't done anything different. I was always conservative</i>
	Hard to change personal habits and preferences	-
	Difficulty remembering advice	-
Changes reported (n=6)	Minimising appliance use	<i>if I only wanted to wash six things I'd put the washing machine on and things like that so now I wait until I've got a full load. You know that sort of thing has changed for me ... I pay more attention</i>
	Turning off lights more often	<i>Oh yes. I make sure I've got all the lights turned off if it's not necessary to have them on, which I probably wouldn't have taken much notice of before ... I am more fussy about leaving things on</i>

5.6 Self-reported awareness and understanding of energy use

At the start of the program, participants reported a low level of awareness and understanding about energy use. Therefore, the program provided tailored information and support to participants including:

- How to use the IHD installed at home to monitor energy consumption
- How to read electricity bills
- How appliance use affects energy consumption

5.6.1 Understanding IHD information

The program installed In-Home Energy Display (IHD) to allow participants to monitor their energy consumption in all but one participant home (n=39). Face-to-face advice and support about how to use the IHD was provided by the project coordinator during the home visits.

When asked during Round 3 interviews, about half of participants (n=17) recalled having looked at the IHD readings with the project coordinator during a home visit but 14 other participants could not remember looking at the IHD.

Of those who remembered receiving advice about IHD use, most (76.47%) reported finding it useful when the project coordinator generated graphs from the IHD to illustrate their energy use.

Yet, overall the majority of participants (58.97%) tended to not actively look at the IHD without the project coordinator.

As shown in Table 13, participants reported a range of interactions with their IHD device from monitoring and prompting changes in energy use to no interaction at all.

Participants' feedback received during Round 2 interviews, suggested that the black and white numbers provided by the IHD installed at homes were hard to understand. As a result, three participants on disability pension had new IHD installed shortly before Round 3 interviews.

These new IHD displayed information through graphs and traffic lights (i.e. high (red), medium (orange) and low (green) periods of consumption).

Round 3 interview responses from these participants suggests that the information displayed by this new IHD was easier to understand, as illustrated by the following quote:

The other one had numbers and really that meant nothing to her but she can see on this one. It's got a little green light on it and when you use a lot of power, it goes red and like when you're just in the middle it's orange. I don't know if it's the colour but she can also see on the graph straight away, like you turned that light on and it shoots right up. So I think it's been really good. She likes this one and I believe she is understanding and is getting it. When she puts something on she'll 'Ooh it's changing' so that's a good thing for her rather than just reading

Table 13: Participants reported interactions with IHD device

INTERACTION	ILLUSTRATIVE QUOTE
Occasionally looks at the IHD but does not prompt changes energy usage (n=12)	<i>It just sits there on the bench and every time we turn the kettle on it goes from one up to three and you go "well" ... You can tell when the fridge comes on or when the washing machine is on, and all that sort of stuff</i> <i>(Interviewer) 'Do you act when you see a spike or higher number?'</i> <i>Well no those things have got to be done... We don't do anything unnecessarily and I can't do without my tea and coffee [laughs]</i>
Looks at IHD to monitor and prompts changes in daily energy use (n=8)	<i>It shows what energy I'm using and how much anything is using at a given time, so that, sort of, makes me adjust what I do to use less of it if I can ... It is useful because obviously you're not guessing you know. And you can make decisions based on facts rather than on unknowns</i>
	<i>Yes, I look at it every day and just make sure that it's not too high ... if it gets high, I just think "oh, why is it like that, have I got too many things on?" and usually I haven't got too many things on. It's just I need them</i>
Did not use IHD at all due to a lack of interest in the technology and/or no or limited understanding of the device (n=7)	<i>I wouldn't have a clue on the reading, see I wouldn't understand it anyway, it's still sitting up there on the thing there, ticking away, but I wouldn't understand it</i>

5.6.2 Understanding energy bill information

Round 1 and Round 2 interviews showed that participants found that electricity bills were confusing and too complex to understand. Therefore, the project coordinator provided support to participants about how to read their bills, including how to read actual energy consumption (in kWh) and tariff information so participants could better understand and monitor their actual energy use.

37.5% of participants reported that the support provided by the project coordinator had helped them better understand their energy bills and is fundamental to empowering people to take charge of their energy consumption and relationship with providers. However, 46.875% reported that no improvement on their capacity to read their energy bills while 2 participants were unsure. The reasons were as follows – 15.625% felt they always knew, while the remainder still found it too confusing or simply had no interest in finding out. In addition, 3

participants in the project do not receive and pay their energy bills directly and therefore such support was not provided to them.

A group of participants (21.875%) specifically expressed a gratitude to the CSIRO interviewer for the assistance provided by the project coordinator to ensure that their concessions were applied and/or to investigate the best energy plan for them by getting comparative quotes from different energy retailers. Interestingly, the control houses showed a great deal of interest in the support and advice provided by the project coordinator in relation to billing and tariff information – suggesting that this was a very effective engagement strategy.

Table 14: Reported reasons for improvement or lack of improvement in understanding energy bill information

ENERGY BILL AWARENESS	REASON	ILLUSTRATIVE QUOTE
No change reported (n=15)	Already read and understood the details on their bills prior to the program (n=5)	<i>No I've always scanned the bills. I've done it for years and I look at my usage on the graph and I go by this ... and I do compare them to see how I am tracking</i>
	Still do not understand the details on their energy bills or (n=10)	<i>I just look at the price. I couldn't tell you how much a kilowatt or whatever I pay or anything ... I just think look to me you've already used it, you've got to pay for it anyway so I just pay the bill and if it doesn't have anything funny on it, that's it. Different people say to me well what do you pay per kilo, I'd have no idea ... I'm just happy where it is</i>
	Lack of interest in engaging with the information: Energy savings is not a priority (as long as cost is reasonable) (n=10)	-
Improved understanding reported (n=12)	Increased understanding of energy bill due to support provided by program coordinator	<i>I think we are better educated on understanding bills and costs. Yeah. Much better ... we went through all of them with Kevin and he showed use a few things. Times, and when it's off peak and on peak and – the ratio, the zone one two and three, whatever they call them</i>
		<i>Oh yeah, it has. I thanked Kevin the other day because I said, "Well, now I understand more about the bill and what the usage is," after he explained it all to me. For example, the first stage, the second stage and all that, what it all meant, and how the price altered</i>
		<i>I think it has helped me a little bit because Kevin sort of says what's going on and it does help I think ... and I probably do [pay more attention] really. Because I just used to get them and just look and think 'oh well that's that' and pay. Now Kevin has spoken about different things you do take notice</i>
Improved level of interest reported (n=12)	Paying more attention to their energy bills and the details on them	<i>Well, I look at it before but I didn't really take a great deal of notice of it, just another bill that had to be paid ... so I'm probably taking more notice of it now, yes. I make a point of checking it out</i>
		<i>It's not my ability to read the energy bills, I could understand them before but I didn't bother, but now I bother [laughs]. I used to hate them. I'd only look at how much I paid to pay and paid it, I wouldn't go into the details, but I do now. See at the bottom it says average cost per day \$4.20, average daily usage 1539 kilowatts, same time last year 1056 kilowatts but then I think about the weather and what I was doing. I am a lot more interested. Now I look what the last one was at that time last year and I think of the weather and what I was doing ... It was this program which prompted my interest</i>

5.6.3 Understanding how appliance use affects energy consumption

The project coordinator used information and graphs from the IHD and energy bills to increase participants' awareness about the impact of appliances use on energy consumption, especially regarding heating and cooling systems.

There were two related areas of understanding that the project coordinator focused on here. The first was for households to gain a practical appreciation of what used the most energy in their households.

It was explained that energy consumption = power x time, so that the more power something needed to run and the longer it was on for, the more energy it would use and the more it would cost.

Practical examples using lights, kettles, ovens, air-conditioners and clock radios were commonly used to illustrate this principle.

The second was that saving energy is like saving rainwater – every drop counts. So that is why it is good to save on things like lighting and standby power and such where possible. However, they don't require a lot of power to run and, if you learn to turn them off as much as possible, their impact on your bill will be relatively small.

In general, things that need a lot of power are anything that heats or cools – real savings can be made by minimising the power they need to run (e.g. through purchasing energy efficient appliances with good star ratings, or appropriately sized appliances) and the time they are on or working at full power (e.g. thermostat settings, timers). The less power they need and the less time they are on, the less energy will be used - and the lower the energy bill will be.

During Round 3 interviews, a large number of participants (53.125%) indicated that information and advice received during the project had helped them improve their level of awareness and understanding about their home energy use.

Some of these participants reported changes in heating practices, such as discontinuing the use of an old heater or reducing heater use. A minority of participants (18.75%) reported no change as they felt they were already aware of and understood their energy use prior to the program. Several participants (31.25%) were unsure about whether the program has helped them had helped them improve their level of awareness and understanding about energy use.

Overall, participants were appreciative of the advice and help provided by the program coordinator to assist them with managing their energy use and home thermal comfort. Some carers (both professional and relative) also appreciated the fact that they were also able to improve their awareness about ways to save energy in order to assist participants in achieving thermal comfort.

While some felt that their control of energy use had increased, they attributed them to the upgrades installed and listed further upgrades as a barrier for an increase sense of control over energy consumption, as shown in the following quote:

We are in control of it by shutting and closing curtains and doors and things like that ... and by using the air-conditioner more efficiently because this is the only heating she has so she can't go without it ... but we are not in control of the lights and the doors. These need to be replaced

Table 15: Reported changes in awareness about home energy usage

ILLUSTRATIVE QUOTE	
Improved awareness and understanding about how appliance use affects energy consumption, in particular regarding heating and cooling practices (n=17)	<p><i>It has increased ... I mean, when I saw the amount of power that I use on a graph before, I was amazed. I just didn't realise ... I mean that's why the bills got so high because I'd leave it [old heater] on all the time and well now with my meter [IHD] I can see how – I didn't know it was – as I say, with that meter I can see what I'm using, so you make decisions based on fact rather than – as it were</i></p> <p><i>Well, as the program has gone on, we've realised that little things like that [turning off lights] add up ... We are a lot more aware of it now, more conscious</i></p>
Improved awareness and understanding of energy saving behaviour (n=23)	<p><i>Yes it has. As I said I'm more conscious of – well even turning on the fan I sort of think oh I'm getting a bit warm but I'm not really consciously doing it but I realise maybe I've waited an hour before I've turned it on because I wasn't overly hot. Whereas before all this started I'd flick it on and I'd be walking in and out. So it only goes on when I'm sitting here rather than put it on and forget about it</i></p> <p><i>The program probably made us more aware of power ... just aware of how to use things better, be aware of doors, just more aware because we understand how these things can make a hell of a difference</i></p>
Improved awareness and understanding of energy saving behaviour (carers)	<i>I think it's been excellent for her, and not just her, it's been good for us as a family and the staff ... We've learnt how to use the air conditioners more efficiently and like opening and closing the blinds</i>
No change reported energy saving behaviour (n=5)	-
Learned new energy saving behaviour	-

5.7 Participants' overall feedback

5.7.1 Main outcomes

During the interviews, participants were asked to identify the main project outcomes, if any, they experienced from participating in the project.

As shown in Table 16, the most reported outcome of the project was improved thermal comfort in the home (87.5%), which was attributed to both the installation of energy efficiency upgrades as well as to the energy advice received from the project coordinator.

As reported, improved thermal comfort also provides improved health and well-being and improved liveability as co-benefits. Unfortunately, beyond recording participant responses, there was no empirical measure to capture the extent of these co-benefits.

Other main outcomes specified by participants included reducing energy use (40.625%) and energy bills (28.125%), appliances upgrade such as the replacement of old fridges and freezers (18.75%), greater awareness and understanding of energy use (21.875%), improved health and well-being for themselves or another household member (12.5%) as well as building carers capacity to contribute to the household energy efficiency.

It should also be noted that just because a participant didn't list a particular outcome didn't mean that it was not experienced.

Overall, it became clear that participants perceived multiple program outcomes as illustrated by the comment below,

We're very power conscious now, after spending a lot of time with Kevin explaining everything to us now, and that's the main thing ... The house is more efficient, and it has been a win all around, and it has been a great project to have this for her, and from all of you, all of the money and everything to help her save money. And make her life more comfortable. It has made a massive difference... That's the most important thing, comfort

Feedback from some participants also showed that:

1. For some participants, high energy costs can lead to financial and emotional distress which negatively impacts on wellbeing.

An example of this was noted in a household during the program. On May 4th 2015, the participant (old) reverse cycle air-conditioner broke down and he reverted to using a 4kW wall heater. The participant immediately noticed the increase usage showing on the IHD and became concerned. This concern soon turned to genuine stress and agitation when he received a bill which was significantly higher than anything he had received before. He contacted his direct care worker who, in turn contacted the project coordinator. The IHD printout below shows the impact of the heater.



Figure 11: Change up in Electricity Consumption with Inefficient Heater

Through the LIEEP project, the project coordinator arranged for a new split system, reverse cycle air-conditioner to be installed which immediately reduced consumption.

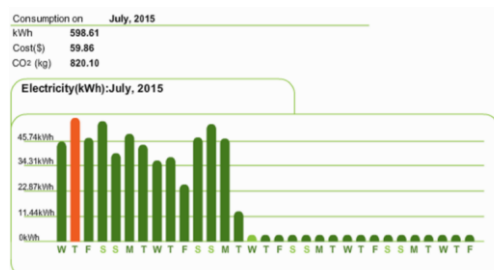


Figure 12: Change Down Following Installation of RC AC

2. Participants' quotes show the importance of home energy efficiency and related thermal comfort on household wellbeing. For example, one participant described how high energy bills led him to financial and emotional distress, while other participants and/or carers highlighted how improved energy efficiency and thermal comfort has improved wellbeing of households who have limited mobility and/or

specific health conditions (i.e. respiratory difficulties, summer heat-related illness and winter cold related illness).

It is important to build the capacity of support workers and family members so they can assist aged and intellectual disabled participants to improve their energy efficiency without compromising their wellbeing.

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Table 16: Main outcomes of program participation

OUTCOME IDENTIFIED	ILLUSTRATIVE QUOTE
Improved thermal comfort (n=27)	<i>Well almost everything ... Well to get doors, to get warmth from the gas heater, have your curtains that you can draw and yeah, lots of things. It's been wonderful</i>
(i.e. Energy efficiency upgrades related to thermal comfort and/or	<i>The main outcomes ... the heating and the cooling and particularly the elimination of the drafts, 'cause if the wind was coming from the north around the front door it used to just blow a gale because there was quite a gap there.. And I've got to be honest. This year I reckon the house has been more comfortable than it has been and I've been here for 42 years</i>
Greater control of indoor home temperature)	<i>The main ones were more comfort across all the seasons but especially in summer I find it better because of the outside blinds</i>
	<i>We can regulate it [indoor temperature]. That would be the main outcome. As I said, living in the country and just putting up with hot and cold it really didn't occur to me that you could regulate it. Now we can have it warm in the winter and cool in the summer ... we have the new curtains so it keeps the inside temperature pretty stable, it doesn't change much</i>
Other energy efficiency upgrades (i.e. new fridge/freezer) (n=6)	<i>We had a chest deep freeze, which was difficult for me to get anything out of because I've got a lot of stomach problems, and it was very old. And now we have this upright fridge freezer which is just fantastic... It's also made a difference to our power bill. I certainly think it's been a huge benefit medically for me, in addition to being a lot cheaper to run than the two old ones were. It's made a difference to our power bill</i>
Reducing energy use and related cost savings (n=13)	<i>Well I suppose the key outcome was a greater awareness of the power usage and the fact it certainly has improved the power bills</i>
	<i>You could tell straight away on her power bills that it came down with the new fridge and I felt that it's been coming down with all the other things we've been doing, especially over winter, like this is the only heating that [participant name]'s got. So you run it, you've got to run them or otherwise she's cold and you can't have her cold. So there is going to be cost involved but I just felt that how we've been doing it all [more efficient use of air-conditioners, using blinds], because like I was the same as everybody else, I'd shove it up to like 28 or something if I was cold but see now you can see it really didn't make much difference, it was only costing you money</i>
	<i>Helping me get my energy use and budget generally and most importantly 'peace of mind' back under control ... I'm very grateful for the involvement</i>
	<i>I would say it [new RC installed later in the program] has made a huge difference to my electricity bill. I have noticed a huge decrease. My big problem before was that heater. It was killing me financially and really getting me in an emotional mess. I was worried and tense and feeling haunted by it, I was living in a quiet desperation and in many ways I was just existing just to pay the electricity bill and well the weight has been lifted. Life has been so much different now I know I can use the air-conditioner and be warm and it won't financially ruin me ... Now with the anticipated reduction in the expense I can adequately budget and have money left over so it's been a god send</i>

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OUTCOME IDENTIFIED	ILLUSTRATIVE QUOTE
Improved awareness and understanding of energy use (n=7)	<i>Just to understand better for example keep the blinds down and the curtain closed when it's hot or when it's too cold</i>
Improved health and wellbeing (n=4)	<i>This place was so draughty. She could never get comfortable ... especially with her arthritis and everything, and poor circulation, and all that, she has got to be comfortable ... the program has made a massive difference with this house, with the heating and the cooling ... It has made a massive difference to make her life more comfortable. That's the most important thing</i>
	<i>The limitation of the wood would be the best things that happened to us really. The fireplace is nice, to look at the flames, but there's a lot of dust ... With the new air con, there is no ash or dust so it's definitely improved the air quality. Thus helped my health for sure because I haven't been to the doctor with my lungs this year. I get really short of breath in the winter. Well, this year I haven't been bad at all. I'm doing things that I couldn't – I still, I can't run, I can't do things quickly, and bending over, but I'm doing more things in the garden for example</i>
Outcomes for carers	<i>I think it's been excellent for her, and not just her, it's also been good for us as a family and the staff I believe because we've learnt how to use these air-conditioners and opening the blinds and the curtains. I think we're all doing a pretty good job thanks to Kevin's support ... It's a long term thing. We've got her a plan now and I've got it in a chart for staff, that is what you run the temperatures on, you've got to shut these doors, pull these blinds and that's actually how it's going to be done in the house and for her</i>

5.7.2 Program approach

Overall, participants were very appreciative of the expert energy advice and support they received from the project - especially the interaction with the project coordinator and the personalised face-to-face delivery.

Participants were, in general, appreciative of the advice, support and feedback provided, as well as the opportunities to ask questions. Table 17, shows participants' quotes about the benefits of the program personalised approach.

Responses also show that the program coordinator was key to the delivery of the program - with the vast majority of participants and carers commending the program coordinator for being personable, professional, trustworthy and knowledgeable.

This suggests that the success of this program relied primarily on the relationship and trust established between participants and the program coordinator.

Table 17: Strengths of program approach identified by participants

	ILLUSTRATIVE QUOTE
Tailored face-to-face advice	<i>It's worked well for me. The why is well self-explanatory; they came into the home, looked at it on-site, the problems specific to me and talked to me and helped me to deal with them. So the personalised touch is very good and useful. I think it's a wonderful service</i>
	<i>Just telling people – that's why I think it's been good that you've come into the house because just telling people you just draw your blinds and shut your doors, often people can't see it, but yeah, no, I think coming into the house has been good</i>
Delivered by a dedicated professional	<i>I suppose he takes the trouble to try and get the messages through to us. We're grateful for the information that he can give us</i>
	<i>Well I suppose when you're old, it's nice to have somebody come in respectfully and that's what Kevin did and he asked if I had any suggestions [at the start of the program] and he was always very helpful and he phones regularly</i>
	<i>Kevin was local. So that helped because if I had a problem I could either just ring him up or go to the shire office. You need that local person with local knowledge</i>

Overall, all participants were positive about their experiences of the overall project and satisfied with the way it had been run and most could not think about ways to improve it.

However, family members and support workers provided a few suggestions for improvement, including:

- Need to work with carers to simplify advice (including by developing non-verbal options) to make it easier for disability participants to understand and act on information provided.
- Work more closely with carers so they can better understand information and advice that needs to be communicated to participants so they can pass on the information on ways that make sense to their client.

Overall findings shows that carers could play an even greater role in personalising advice to each participant in their home and to improve the effectiveness of the messages being delivered by energy efficiency programs.

5.7.3 Further energy efficiency upgrades

While the project was able to offer a range of energy efficiency upgrades, feedback received from participants show that, in some cases, participants identified further energy retrofits needed to improve their home's energy performance and improve thermal comfort.

When participants were specifically asked about whether further improvements were needed, 17 participants outlined specific upgrades needed in their homes, while 15 participants could not think about any other improvements.

Of the participants (53.125%) who reported they would like to take further steps in their homes, these steps included a range of upgrades from new LED lights, ceiling fans, heat lamps to draught proof work on doors and windows, new doors, internal/external blinds, insulation (floor, roof or wall) and solar system.

Some of the upgrades listed by participants seem to have been inspired directly by the project (i.e. additional thermal blinds similar to the ones installed as part of the program) or recommended by the project coordinator.

While some felt they could afford the upgrades they listed, many participants reported that financial cost was a barrier – especially for larger (and more expensive) upgrades. A couple of participants also reported rental tenure as a barrier.

Among the participants who could not think about any other improvements (n=15), reasons included:

- being satisfied with their current level of comfort and energy use thus not planning any future upgrades (21.875%) as this participant described:
No, All I really needed were the curtains and an efficient but less expensive heater and I've been provided with that ... So fully satisfied, thank you very much
- not having thought about it or being unsure about what could be done (n=5) □ being too old to invest in energy efficiency (6.25%).
- lack of available finances preventing them from thinking about improvements (n=1)

5.8 Dissemination of information

5.8.1 Uptake of information and support post program

When asked who they thought could provide energy information and advice to them post project, responses from disability pension recipients included current support workers (n=5), support workers and family (9.375%) and family (6.25%). Two were unsure.

This should not be surprising as 10 disability pensioners reported already having conversation with their carers (professional or relatives) about the project and energy use.

All family members and support workers present during Round 3 interviews stated that they would be happy to continue providing support and reinforcement of key messages to participants and providing effective energy advice – following appropriate knowledge, understanding and skills development (see Section 3.4.2).

Responses from aged pension recipients in terms of who could provide them with information and advice beyond the project included family members (n=4), Home Help (n=3) and energy retailers (n=1). For example, this aged pensioner offered an example of the sort of interactions she had with the person from Home Help around thermal comfort and energy use.

I think my home help. She comes in four times a week and she knows to say, "will I close the curtains now or will I leave them open?" and things like that. She'll ask me and then she'll do it for me if I haven't done it myself

Indeed, some aged pensioners reported already talking to personnel from Home Help (n=4), family members (6.25%) and personnel from Meals on Wheels (3.125%) about the project, energy use and energy efficiency. Others (34.375%) could not think of anyone beside the current program coordinator.

However, two aged pensioners did not feel that they required further information or advice in the future, for example:

I don't think there's any more information that we could get ... I think, for the way we're setup, yeah, it's worked very well for us

5.8.2 Dissemination of information within social network

Most participants (68.75%) reported having talked about the project with others, mainly family, visitors to their home (show them upgrades), friends in town, neighbours and other participants in the program. Most reported mainly mentioning the existence of the project and/or their participation in it, as this participant described:

I have told people that I'm on it and that's all

However, a few discussed the project and what they gained or learned more depth, for example:

Oh yes I have. I've even brought them in, and showed them what has been done, and how it has helped me ... they're very grateful for every little bit of information that they can get.

(Carer) she has got a lot of elderly friends, and she conveys to them what has happened, and how it has improved, and everything, so that's your best weapon isn't it, word of mouth?

I've had discussions and a lot of people have said, "Oh, those blinds are nice, where did you get those?" And actually my case manager, she said, "Where did you get those blinds?"

Ten participants reported not having talked to people because they rarely went out of their home; did not socialise much; or simply did not bring up the topic with others.

Family members and support workers reported that they had implemented what they had learnt through the program in their own homes and in some instances in other 'clients' homes, as illustrated in these two comments:

Well, we've taken bits and pieces of information that we've gained with us into the renovation [of their own home] ... well, you just don't think about it until it's pointed out to you plus you see the practical uses of these things, that it, sort of, hits home, well, actually, that's what we should be doing, it works

I know we've implemented some bits out at our house and I know a couple of the support workers took some of the initiatives that they did here. One actually provides support at a community residential house with six men in the house and two or three staff and I know that she's taken bits, initiatives that were done here, she's taken them back to the house ... Another support worker, I know that she's taken a few of the initiatives home as well

Overall, responses indicate that members of the broader community where participants lived became aware and interest on the program, mainly through hearing from participants experiences. For example:

Yes, they want to know how we got on it

Absolutely, different people have said, "Oh, I wish I was in that." Or "how did you get those?" Oh no, I think it's made other people aware of what the Shire is doing

Participants' feedback (46.875%) suggests that other members of the community might be interested in energy efficiency programs even if it provided 'only' information and advice, for example:

I'm sure people would [be interested in an energy advice program], I'm sure, I'm sure. Well, we were, weren't we? We didn't know that they were going to do things for us. They never said to us 'oh you're going to get free things or anything'. We were quite amazed at that'

Furthermore, a few participants in this project expressed an interest in signing up again, for example:

If it was a similar program to what this one is and somebody's going to come and tell me how to do something extra well I'd say that would be fantastic

Overall, responses from Round 3 interviews suggest that the impacts and learnings from this project have gone beyond the participants themselves and spread to some of the people they were in contact with, i.e. primarily their direct carers (both professional and relative) and personnel from home services (home help, meals on wheels) but also to friends and neighbours.

A number of households encouraged friends to attend the second LIEEP forum in February 2015.

5.8.3 Promoting energy efficiency

As shown in Table 18, some participants and their carers offered their views about ways for and encouraging a greater participation among this demographic audience in energy efficiency programs, such as promoting energy efficiency programs through social networks, such as case workers, HACC, social workers and/or community groups.

Other cited channels for promoting energy efficiency information were the local newspaper and the Shire Council.

Table 18: Channels of information identified by participants

ILLUSTRATIVE QUOTE		
Support networks	Case or support worker	<i>The program was referred to me by my case worker ... she is the ideal person because she deals with invalid pensioners as a case worker around here</i>
	Personnel of Home and Community Care Program (HACC) - Home Help and Meals on Wheels	<i>In this community, well I still say the girls who do the home help, they are experienced girls, they know how we're living, they know how uncomfortable it is to some people. They say to me sometimes people are sitting there shivering because they can't afford the energy. So I think those girls would be the ones to do it</i>
Community groups and local newspaper		<i>(Participant) Oh yeah they would be interested [to attend a energy saving talk in the senior citizens club]</i> <i>(Family member) That can get the ball rolling and those people would go and tell other people as well and I'm sure it would multiply from there</i>
		<i>There's another thing that they have and there's two Probus groups around here. Now that would be if you had a guest speaker come along, you would capture a lot of people at that one or those two groups but I suppose you still need to have someone that they can follow up with, like say Kevin Spence that they could contact</i>

5.9 Data Capture and Analysis

It is probably fair to say that it is the area of data capture and analysis that the project had its most difficulty and where there is room for the greatest improvement.

This was true of the following aspect:

- utilisation of the data schema – mainly in terms of the level of detail required but also complicated in part by its ongoing development/refinement
- consistency in the format of interval data received from providers
- level of cooperation from providers
- consistency in the integrity and comprehensiveness of the data
- confounding factors that hid project outcomes

The original, approved submission had a very clear focus on a qualitative analysis based on semi structured face-to-face interviews which would then be supported/enriched by quantitative data on billing, demographic and other data.

This focus was prompted by small cohort of participant houses originally proposed. It was considered that while the small sample number would provide sufficient data for a rich, ethnographic analysis, it was statistically insignificant, compromising the integrity of quantitative data. For this reason, a control group was not, at first, included.

However, during development of the Data Collection and Reporting Plan (DCRP) and following discussion with the Department, it was agreed to include of 20 demographically-matched households for comparison purposes.

Ongoing development of the data schema after approval of the DCRP and the complexity of the schema created some challenges for project staff, including some confusion on the level of detail they needed to go to collect data of value (e.g. a hairdryer appliance, including its age, make model and estimated usage/consumption) whilst not appearing too invasive during the home energy assessments.

Without diminishing the value of data, project staff sometimes felt that data collection overshadowed the provision of support and advice to households on energy efficiency. The cost of this has been estimated at over \$95,000 (see Level 4 costs in Section 9: Budget).

During the Third LIEEP Forum in August 2015 held at Newcastle, CSIRO advised the project coordinator that while the project should try to collect as much detail as possible, it should focus on what was really important to capture and report in terms of the project and program objectives. That is, while there was key data required by CSIRO and the Department to allow comparison across projects - e.g. core demographic, dwelling characteristic and metred energy consumption information – there was detail (e.g. on appliances) that, while potentially useful, was probably less important.

This suggests that there may be some scope to not only have an agreed schema before the launch of any program, but also to have a two-tiered one that had priority and non-priority data items that would simplify analysis.

The project also had some challenges in relation to the integrity and comprehensiveness of the data it was collecting.

In-home display data was useful – mainly in an illustrative context as described previously – but did not show any consumption prior to the project for comparison.

A great deal of effort was made by project staff, support workers and households to collect billing and interval data. Initially the project focus was primarily on billing data and the average daily consumption figure within a billing period.

In the first instance participants were asked to provide copies of their bills. Cooperation was not an issue with all households willing to cooperate as fully as possible. However discarded, lost or misplaced bills meant that complete data sets were not always available. This held true even as

the project progressed with some participants still failing to retain bills or forgetting what they had done with them.

The project sought to address this by working with households to contact retailers directly and request copies of bills extending from June 2013 to as close as possible to the date the request was being made.

This also was not fool proof with the issues including

- participants having changed accounts (e.g. through change of address) or providers in the period from June 2013
- participants not remembering previous account details
- retailers supplying data covering only part of the requested period
- retailers simply failing to supply the requested information despite repeated requests

After attending a number of LIEEP forums and participating in grant recipient networks, the project started collecting interval data in the hope this would provide a more consistent and comprehensive insight into energy usage.

Unfortunately, collection of the interval data had the same issues as that of collecting billing data, with the added complication that it was data that originated with the distributor and required a more complex process and longer timeframe to extract and forward.

Also, interval data is presented in a number of different templates or structures. Some also came in single spreadsheets that covered the requested period, others came in multiple spreadsheets. Some of the multiple spreadsheets were chronologically coherent and others had overlapping periods.

With many tens of thousands of individual tariff days to collate/assimilate, this became quite time consuming.

Also time consuming was chasing data gaps and going back repeatedly to households asking for data, waiting to see if it arrived and then waiting for a chance to re-schedule and repeat the process again.

A lack of sophisticated statistical analysis software also limited data interpretation. Nevertheless, using basic Excel, the project was able to generate a useful set of figures and graphs to assist in interpreting project outcomes and in communicating key messages.

The project has not expected as many issues with the data collection as were experienced - originally believing that it would be a fairly straightforward process given modern ICT technology.

The project's MERI response to these issues was to persevere as best as possible with retailers and households to obtain the data and extra project staff were allocated to assist with this process and the recording and uploading of data.

Having said all of the above, a highlight of the data collection and analysis was the series of interviews conducted by CSIRO with participating households and the findings that resulted which are included in this report.

During the interviews, participants were asked to identify the main program outcomes, if any, they experienced from participating in the program.

The most reported outcome of the program was improved thermal comfort in the home (n=27), which was attributed to both the installation of energy efficiency upgrades as well as to the energy advice received from the program coordinator. Other main outcomes specified by participants included reducing energy use (n=13) and energy bills (n=9), appliances upgrade such as the replacement of old fridges and freezers (n=6), greater awareness and understanding of energy use (n=7), improved health and well-being for themselves or another household member (n=4) as well as building carers capacity to contribute to the household energy efficiency.

Due largely to this trust and presence, the value and great weight that participants placed on the knowledge and guidance of support workers and carers became apparent through the project,

and made obvious the key role that they could play in developing the habits that could lead to long-term behaviour change – not least through the repetition, reminder and reinforcement of key energy efficiency messages.

Therefore, the project sought to increase the capacity of individuals and organisations providing direct care to vulnerable households. Initiatives and actions included

- inclusion of these organisations in the project consortia
- involving support staff and carers in the home energy assessments and ongoing follow-up visits where they were exposed to the concepts and principles of home energy efficiency
- providing basic information and instruction at staff meetings
- invitation to each of the two forums run by the project where the concepts, principles and key message of energy efficiency were once more discussed and explained
- offer of dedicated training of key personnel within support organisations

By far the most successful method of building capacity was by involving staff in home energy assessments and the follow up visits where they could see the practical application. This was reinforced in those households where upgrade/retrofits took place and participants' feedback and response was made.

The offer of dedicated training for carers was not taken up and remained a disappointing outcome. The reasons for this were mainly issues of timing and funding. Finding a suitable block of three or four days that suited a number of busy professional individuals who were also geographically separated proved difficult – despite the potential contractor contacted to provide the training willing to be reasonably flexible in its delivery (e.g. one day a week over four weeks, a block of four days, or something in between).

A number of attempts were made but, with other priorities (most particularly data collection) demanding attention, the opportunity eventually lapsed.

Training key personnel in energy efficiency within community support organisation should remain a key objective for future programs aimed at increasing the participation of vulnerable households in energy efficiency programs.

However, a problem with this will be the lack of flexibility in the terms of employment of support workers. Almost invariably they are linked with targeted government programs where limited funding is strictly governed by very specific guidelines. This can limit any professional development considered outside their core responsibilities (i.e. energy efficiency is not seen as core responsibility of support workers even though a very compelling argument can be made that it should be).

Interestingly, such a narrow focus also limits desirable ideals or principles such as a genuine whole-of-government, cross-silo approach to issues – perhaps an area for future development.

5.10 Project Delivery

The day-to-day management and conduct of the project was overseen through the Northern Grampians Shire's Community Protection and Environment Team within the Department of Infrastructure and Environment, and included the project manager, project coordinator and project staff as required.

Consortia members sat on a project steering committee and comprised the project manager and project coordinator, as well representatives from Northern Grampians Home and Community Care Services, McCallum Disability Services, Grampians Pyrenees Primary Care Partnership, Central Victorian Greenhouse Alliance, Sustainability Victoria, Grampians Community Health and Pinnacle (formerly Stawell Intertwine).

Early members of the committee that withdrew for resourcing limitations were La Trobe University and Sustainable Regional Australia.

Formal meetings of the Project Steering Committee were held inconsistently and infrequently and the active participation Grampians Community Health and Pinnacle may have waned as a result of this although they remained as part of the email communication and continued to receive milestone reports and the CSIRO interview reports, as well as participate in the first forum held in June 2015.

Part of this may have been due to the nature of working within small communities and networks, often within the same organisation and with multiple intersecting interests that means consultation on a number of unrelated issues takes place at one time.

This makes informal communication an easy and convenient form of communication – especially as everyone has busy schedules and expediency can be attractive.

The other consortia members, most particularly the HACCs personnel and McCallum remained actively involved and committed.

Sustainability Victoria were a later addition to the consortium and provided valuable input and advice. They participated actively in both forums and in wider communication to their networks. They also provided numerous handouts and give-aways that were distributed to households – these included thermometers, meters, shower timers, and information brochures.

Likewise, CVGA were also available to provide advice and help with communication and networking. Representatives presented at both forums.

McCallum and HACCS provided critical liaison with households and helped with the management of any expectations or issues that arose, and with data collection – including approaching the State Trustees on a number of occasions to obtain billing data for client households. – e.g. problems with installations, manage any issue that arose.

With the project expenditure tracking under budget and feedback from participants positive, the primary MERI or risk focus remained the integrity and quality of the data capture and analysis.

As described previously the small cohort meant that, from a statistical perspective, the project would probably not provide any meaningful data but that, despite this, the decision was made for the project to fulfil as best as it was able the requirements of the Department and CSIRO in relation to the data schema.

From the perspective of a MERI response this meant providing additional part-time staff to assist with data collection and collation, and to persevering with the collection of data from providers and ensuring as far as possible that gaps in data sets were filled.

There were no issues with arranging and conducting the interviews beyond the withdrawal of 7 households due to death (3), relocation (3) and serious illness (1).

There were no issues that arose from contracting CSIRO to conduct the interviews and subsequent analysis. The project committee considers the reports prepared by CSIRO in relation to their findings to be of a high standard and consistent with the terms and objects of the contract.

5.11 Other Benefits

Other benefits included improved 'liveability' of homes and access to areas (both interior and exterior) that were not previously used because they were too hot, too cold, or too draughty or exposed.

An example of this is a participant who was largely restricted to spending most of her waking hours in her lounge room, with a limited view out on the world. Watching TV occupied a major part of her day. As part of the project, ceiling insulation, external lounge room blinds (N facing) and external verandah blinds (W facing) were installed. Apart from the thermal improvements these interventions made, the participant was most excited about the external blinds. She never liked to sit out there as it was too hot and exposed. The new blinds changed this and made the area an attractive and comfortable place to sit. She bought an outdoor setting for just that

purpose and now regularly sits on her verandah, looking out on the main street and feeling much less isolated.

In addition, a number of participants reported improved aesthetics of their houses and one welcomed the increased privacy provided by the blinds.

Advice and support given through the project on billing and tariff literacy helped empower a number of households who felt more able to understand the charges they were being billed for, the way information was set out on their bill, and the key things they should be looking at and comparing from bill to bill and period to period.

Health and well-being improvements were also self-reported by participants during interviews. This was particularly relevant for those who suffered temperature-related discomfort and/or had limited mobility. Some aged pension recipients required heating for management of arthritis, diabetes, back aches, circulation problems and pulmonary disease. Other aged pension recipients required cooler weather for easier breathing and circulation.

Probably the most direct health and well-being benefit was reported by one participant who was suffering from financial stress and anxiety due to the high cost of heating his home. This anxiety and emotional despair was exacerbated by the severe restriction on his capacity to 'go out and treat himself every now and then'. The project replaced an old electric wall heater with a new split system, reverse cycle inverter air conditioner with a rated input almost a quarter of the old system. In July 2015, IHD data immediately showed a drop from an average of 36.5kWh/day to 11.8kWh/day. This represents a saving of over 2,200kWh over a three month winter period or almost \$600. During the round three interviews, the participant commented on the drop in his last bill and how he could not believe how lucky he was to part of the project.

There are numerous studies from Australia and internationally that show the importance of residential energy efficiency on household thermal comfort, health and wellbeing has been identified by numerous previous studies (e.g. Berry et al., 2014; Howden-Chapman and Chapman, 2012; Moore et al., 2016). Most particularly, householders in Howden-Chapman and Chapman (2012) study reported specific health benefits such as reduced hospitalisation for respiratory and coronary conditions due to retrofitted insulation in their New Zealand homes, while householders in Moore et al. (2016) study reported that the improved thermal performance of the housing project homes they moved in had contributed significantly to improving their health and comfort. Such studies support our findings that the benefits of energy efficiency upgrades go much beyond energy and related cost savings, and include social outcomes such as improvements in occupants' thermal comfort, health and wellbeing.*

A report by the Energy Efficiency and Environment (Climate) division of the International Energy Agency (IEA) reports that studies show a clear link has been established between energy efficiency and health and well-being impacts. They also show four dollars can be saved in public health costs for every dollar spent on energy efficiency. There is also a growing body of evidence that mental health benefits (reduced stress, anxiety, depression) are equal to or greater than physical benefits.

The IEA also reports that significant benefits in health and well-being emerge particularly when targeting vulnerable groups.

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<http://www.iea.org/topics/energyefficiency/energyefficiencyiea/multiplebenefitsofenergyefficiency>

6 Case Studies

In this section, two brief case studies are presented both from aged pension recipients. These are intended to provide a more complete picture of these participants¹ through profiling their experiences of the program, perceived outcomes of their participation and remaining obstacles to improve home energy efficiency. To safeguard privacy and ensure anonymity, pseudonyms are used and any other identifying details have been removed to prevent identification of participants. Additional consent was secured from them to feature in this section.

6.1 Case study 1: Maude

When we first met Maude, she lived in a very draughty rented house that got very hot in summer and cold in winter. During the Round 3 interview, she reported that her house was now comfortable, mostly due to reduction of draughts through the program intervention and the new external blinds and awnings which were effective in minimizing sun exposure on the northern face of the house.

She thought that the external blinds had been effective in minimizing sun exposure on the northern face of the house thereby keeping the living room cooler this summer. She reported that she had used her AC less as a result.

Well it [external blind] keeps this room [lounge room] in particular – because it shades the veranda there and in the summer time this is just a hot box but I don't have as much – this [existing AC] on and I use the fan occasionally but it's made a big difference.

In the winter, she continued using the wood heater as primary source of heating.

That goes for 24 hours a day when I start it up in the winter. If I'm – if it goes out or I am away for a day or something like that and it's freezing cold well I'll use that one [existing AC]

There was some confusion expressed in terms of recommended temperature settings for AC making it difficult to know exactly what temperatures she usually set her AC on in winter and summer.

Now I've got to try and remember that because one goes up and one goes down. I think – this is where I get confused. It must be for – one is 18 and the other is 24. So 18 – no [laughs] isn't it awful. 24 must be cool and – no, the lower you get isn't it. The higher you go is the heat. So I've got that back to front. I'll soon – isn't it awful, I'll soon tell you. It's right here. This tells me [referring to leaflet provided by the program coordinator] – well I've had it on 27. So that's the cooling ... you come down yes, 27/24 is cool. And the winter you go 27 to 30. I don't think I've ever had it on 30 so it would be 28 in winter.

When trying to clarify temperature settings she used in winter and summer, Maude reported 24C in the summer (although she reported only using the AC on exceptionally hot days now) and up to 28 in winter (although she only had the AC occasionally in winter)

Yes I have – well it's actually what it says on here [referring to leaflet provide by the program coordinator] it's 24 in the summer or 24 or 25. Which is – I usually run it on 24 and I leave it on all the time until I feel that I don't need it.

It would have to be really, really cold and as I said if I'm coming home – if it's late and I think oh God I only want to watch a couple of hours of telly and its freezing cold you might put it up to 28. Because you are only going to run it for a short amount of time and then it get switched off. Well I switch it off because then it's usually going to bed ... But in the winter I don't really have to use that much because I've got the fire here.

¹ Refer to Milestone Report for details on how these four participants were identified and selected as case studies.

(Note: the handout recommends a winter setting of 18C)

She reported that she already did prior to the program the actions suggested by the program coordinator to improve thermal comfort. Yet, she reported taking these with more frequency as the program had increased her energy awareness:

Just the basic things. You know pull the curtains across, close the doors and just the – just what you would normally do. They're things I've always done ... well I'm more conscious of it now

Indeed, Maude reported that as a result of participating in the program, she had become more interested in and conscious about her energy use. For example, she reported reducing the frequency of her washing, turning off more lights and not purchasing a dryer.

Interested yes. More so than I used to be before... I'd leave lights on, I wouldn't – if I only wanted to wash six things I'd put the washing machine on and things like that so now I wait until I've got a full load. You know that sort of thing has changed for me. And I don't have a dryer. I was going to buy one and then I thought oh what the heck. So I use the clothes horse more than I ever did.

She reported a greater awareness and understanding of what used energy in her home and her own energy behaviours.

Yeah. As I said I'm more conscious of – well even turning on the fan I sort of think oh I'm getting a bit warm but I'm not really consciously doing it but I realise maybe I've waited an hour before I've turned it on because I wasn't overly hot. Whereas before all this started I'd flick it on and I'd be walking in and out. So it only goes on when I'm sitting here.

She still did not use the IHD and she continued to paying her energy bills without engaging with the details on them. She stated that she was not interested in learning how to read the details, expressing that bills had to be paid.

I just look at the price. I couldn't tell you how much a kilowatt or whatever I pay or anything ... No because I just think look to me you've already used it, you've got to pay for it anyway so – I mean if I saw something that said \$40 for hot water or something I would question that because I'd think now that's a bit silly but no. Different people say to me well what do you pay per kilos, I'd have no idea. So I just pay the bill and if it doesn't have anything funny on it, that's it ... I'm just happy where it is because you can chop and change what you – to me what you win on one bill you lose on another and I think they're all pretty much the same.

Upon calling the energy retailer she subscribes to, it was realised that Maude's pension details had not been added to her account, therefore no pension discount had been received since beginning with the company. This was rectified, and she received to a credit from the company.

So I knew nothing about it. I didn't know the pension – it's not a great deal of money but any little helps

The main outcomes of the program for her were her fridge (saving money as eliminated food waste), new blinds (improved thermal efficiency and comfort) and increase awareness of energy use.

The fridge [saving money] and the extra blinds have made a big difference to particularly the summer, you know the warmer days. I think it's just made things more comfortable ... And to be a bit more observant. As I said don't put the fan on at 10 o'clock in the morning and you walk – you're working outside until 12 o'clock in the afternoon. Put it on to cool off in other words and that sort of thing ... The program's made you more conscious of how you live actually.

Maude expressed the desire to sign up for a similar program the future to learn more about home energy efficiency:

If it was a similar program to what this one is and somebody's going to come and tell me how to do something extra. Well yes, I would say that would be fantastic.

While she could think of future improvements to the house, the barrier to undertaking them was not owning the house she lived in:

I'd have insulation in the roof and different – and sort of a – probably more blinds put round the other side. But no, any improvements if it was my home, yes. But no because it's rented I know they [landlords] wouldn't do anything anyway.

In Maude's case, it seems that she became more 'observant' or conscious of her day-to-day energy use and her own energy behaviours as a result of the program leading to some changes. For example, she had reduced the frequency of her washing, turned lights and other appliances off when not required more often. The main outcomes of the program for Maude were saving money (attributed to her new fridge) and increased thermal comfort in summer. Maude reported that she was not interested in understanding the details on her energy bills. Based on Round 3 insights, the next step for Maude could be to clarify recommended temperature settings on AC and provide support to use her AC more efficiently. The barrier of rental tenure also needs to be addressed to improve both thermal and energy efficiency of the house and thus liveability and comfort for Maude.

6.2 Case study 2: Bert and Samantha

When we first met Bert and Samantha, they lived in a very old draughty weatherboard house. This negatively affected them as both had cold related medical conditions. In the Round 3 interview, Samantha felt that the house was comfortable yet still draughty in winter.

Yes except for in winter there's a draft everywhere underneath the door things and yeah. Yeah, they were going to do it but, yeah, I don't know whether there's any money left by now, I mean. We've done very well.

Samantha noted that the curtains have made a huge difference in maintaining a comfortable temperature, especially in the back bedroom that used to be unbearably cold. She also reported that her thermal comfort has improved in the kitchen as a result of the blind. This was important to her as she was an avid cook and used the kitchen in all seasons.

Yes that blind comes down when I'm over there getting tea. Sun shines in your eyes, it's beautiful you can pull that down so far.

Samantha reported making changes to the way they cooled/warmed the house as a result of their involvement in the program. According to her, the program coordinator had suggested helpful strategies on how best to achieve and maintain a comfortable temperature in the home (particularly the two main living areas- kitchen and lounge) which they followed. For example, in the summer, they put the existing AC before the house heated up, and zoning off parts of the house accordingly. As a result, their house felt much more comfortable on hot days.

Kevin said, pull the blind, put this on high for a start. And then he said, that one in there should be enough to do the two rooms which it is. I do turn this one on to cool things down and then turn it off. Bert's got his going all the time ... He also mentioned pull the blind down and close the doors

She could not think of she had done differently in the ways she used energy in the home (apart from heating and cooling) since the start of the program

Not – I haven't done anything different much at all

She did not feel that awareness and understanding of what used the most energy in the home and ways to save energy had changed as a result of the program. She felt they were in control of their energy use as *'we only use what we have to use'* yet the fact that the house was still

draughty at the close of the program suggests that this limited their ability to reduce heat loss and thus energy use for heating.

According to Samantha, the IHD had not been working for a few months so she had not used it since the start of the program. She also could not answer questions related to energy bills as Bert was the one who paid these (and he was available for the interview).

I don't take much notice to the energy bills. I pay the rates he pays the electricity.

Samantha mentioned draught proofing on doors and windows (which were scheduled to be installed as part of this program). She stated that they would not be able to fund these improvements themselves (i.e. without the support of a program) as Bert was incapacitated and as thus they would have to pay a builder to undertake installation.

The main outcomes of the program according to Samantha were the new upgrades installed:

Oh well we did excellent out of, you know, the drapes, the fridge. What else they do – the drapes and the fridge, gosh and that blind there, yeah. No I was all very thankful for everything that they did, yes. I think it was a good idea.

In the case of Bert and Samantha, the key outcome was increased thermal comfort. Much of this was attributed to the new window coverings and following advice from the program coordinator on how to best cool or warm the kitchen and the lounge. However, they reported that the house was still draughty especially in winter. Draught and heat loss limited to some extent their ability to reduce energy use for heating and associated costs. This indicates that for these pensioners who require large amount of energy for heating due to their medical conditions, while the energy advice provided has had positive impacts, it is essential to improve physical measures and offer adequate funding or financial assistance. Indeed, Bert and Samantha reported that they could not afford energy improvements as pensioners.

7 Conclusion

Overall, the project aimed to understand the barriers and improve the adoption rates of energy efficiency measures within aged and disability pensioners' households in Northern Grampians Shire Victoria.

Motivations to join the project were primarily to reduce energy costs and to improve thermal comfort where previously the cost of retrofits/upgrades had been prohibitive – although some households were also keen to express more altruistic motives as well and acknowledged to possible benefit to other low income households and/or the environment.

Qualitative interviews were a primary data-gathering method with the interview approach emphasising non-prompted, open-ended, semi-structured conversations between interviewer and interviewees. This was considered optimal for capturing the maximum number of potential issues pertinent to participants.

While the interview participants' perspectives and insights were not necessarily representative of their sector, this approach allowed a rich and in-depth experiential account of an issue to be obtained. It also enabled a variety of community perspectives to be understood in order to provide the broadest possible picture of community acceptance of energy efficiency options.

Participants reported being highly satisfied with the project and reported multiple benefits from their participation – particularly in relation to the installation of upgrades/retrofits. Most specifically, both participants and carers reported improvement in their awareness and understanding of home energy use and ways to save energy. Some participants reported

- a reduction in their energy bills - although the majority of participants did not or were unsure
- undertaking more energy-saving behaviours as a result of participating in the program
- greater energy awareness and understanding of their energy use.

The majority of participants reported that they experienced moderate to significant improvements in thermal comfort at home due to the energy efficient upgrades installed, which allowed them to engage in new energy efficient behaviour and improve their levels of control over energy usage.

Participants reported that information received through the program either reinforced pre-existing energy-saving actions or encouraged new energy-saving actions, in particular in relation to heating and cooling.

On that regard, most participants reported some change in their cooling and/or heating practices regarding both the use of energy-consuming appliances (such as turning on heaters, air conditioners, fans, electric blankets) or other measures (such as closing or opening blinds, windows or doors).

Overall, participants reported that by performing non-energy consuming approaches to achieve thermal comfort (such as zoning off rooms, using window treatments and blankets), they noticed that the need for use of energy consuming appliances such as air-conditioner was reduced.

Many participants also reported an increase in the frequency and duration of certain pre-existing energy-saving actions (apart from heating and cooling), such as turning off lights at the end of the program.

Another strength was the partnership with community support organisations who, through the established relationship they had with clients, were able to facilitate recruitment and engagement strategies, as well as provide ongoing support and advice to households in relation to energy efficiency.

Peer and family/carers support were major influences on decision-making choices and were used as a primary source of information and advice. Other information sources included TV, radio and newspapers.

Other printed media – i.e. handouts, instruction booklets - were not as well accepted or utilised to convey energy efficient information. There was mixed usage of internet to get information or advice that might influence decision making.

All participants stated that they enjoyed the personal communication and face-to-face delivery of the project. It is clear from participants' responses that a key strength of this project was the individually-tailored approach of interventions used to determine the new energy upgrades installed in each participating household as well as to tailor advice that directly met individual household needs.

Participants with summer heat-related health problems also reported that they believed their health and well-being improved as a result of improved cooling.

The project was also able to increase billing and tariff literacy amongst many participants - empowering householders and facilitating the renegotiation or transfer to lower rates/increased discounts of 8 contracts.

A summary of key issues that arose include the following:

- There were significant difficulties in collecting complete data sets on consumption (either through billing or interval data) for some households
- Sample size was statistically insignificant and so the qualitative, interview approach was preferred as the primary data collection source for analysis
- Dwellings within the project demographic were generally older housing stock with poor thermal qualities
- The region experiences cold winters and hot summers which, combined with dwelling condition, meant that residents relied heavily on heating and cooling devices to achieve comfort.
- Capital cost was a greater factor in buying appliances than energy efficiency
- Only a minority of participants found the IHD a useful tool to understand energy use without the intervention of project staff who were able to create graphs which illustrated energy use patterns
- some participants found it challenging to remember the suggestions and advice that were given to them at the start of the program either by the program coordinator Kevin or installers
- Health and physical conditions - many participants receiving either the disability or aged pensions had medical and pre-existing physical conditions that increased their dependency on the use of energy

A summary of barriers includes:

- Financial constraints and cost.
- Lack of information and knowledge
- Infrastructural barriers – e.g., not owning their own home
- Cultural attitudes/behaviours, prevailing attitudes, personal habits and preferences
 - stoicism and belief that they should accept the situation and just make the best of it
 - people believing they were already very frugal in their energy use and could not reduce it further without comprising their comfort
 - belief that advanced age made it pointless for them to undertake any major investment in energy efficiency, despite any benefit to their thermal comfort and health and well-being
 - ingrained belief that it was wasteful to upgrade older, inefficient items while they were still functional

A summary of key findings includes:

- There was a low general awareness that heating and cooling devices consumed the most energy to begin but the project has made significant effort in increasing people's awareness of how much of their energy use was attributable to heating and cooling systems by showing them usage information and graphs and discussing the issue at length. This was evident in some participants' responses.
- There was a lower than expected use of heavy drapes to maintain heated or cooled air within the home. Many homes had ornamental or privacy curtains that did not provide a thermal benefit.
- However, there were increased efforts to zone off rooms and use curtains/blinds to help regulate indoor temperature on hot and cold days. Most participants reported that window coverings and draught works as part of the program had made a significant difference to their thermal comfort in winter and/or summer.
- There was limited awareness of the recommended temperature settings for air conditioners in summer and winter (The project recommended 18 degrees for heating, and 24 degrees for cooling), as well as limited efforts to retain heated and cooled air. Providing advice on setting and using air-conditioners became a major focus of the project.
- Once habits have been established for many, but not all, disability pension recipients, they can be embedded and practiced long term.
- Electricity bills were considered to be confusing and complex by participants from both groups.
- The use of appliances by the aged pensions tended to be modest
- Findings suggest that the program was also able to provide valuable advice on additional upgrades participants could consider which would provide maximum benefits.
- Overall, the program has showed that a relatively low level of investment (i.e. draught proofing works, internal/external window coverings) properly targeted and coupled with tailored advice can bring significant and multiple benefits to householders (i.e. increased thermal comfort, improved health and well-being and reduced use/reliance on high energy consumption appliances such as AC thereby reduced energy consumption).

8 Recommendations

Recommendation	Rationale
1: Future programs should look to harness key personnel (i.e. support workers/carers) who are already in-situ	Support workers, carers and interested members invariably have a lot of trust invested in them by participants and provide a cost-effective avenue to effective engagement and communication.
2: Future programs should invest the appropriate level of resources and time into the capacity building of key personnel (i.e. support workers/carers).	<p>Once behaviour change and new energy-saving habits have been established they can be embedded and practiced long term. It is essential that future programs allow for appropriate follow-up action and support to ensure that advice is understood and remembered by participants, and to ensure that newly installed upgrades and existing energy use devices are working properly and being used efficiently – particularly in relation to heating and cooling devices.</p> <p>Training will ensure key personnel are better able to assist in communicating key energy efficiency messages and model energy-saving actions that encourage long-term behaviour change from participants</p>
3: Future programs should fully exploit partnerships with existing services, organisations and intermediaries in the field who already have established links with potential target audiences,	There are opportunities to strengthen the delivery of energy efficiency programs through these partnerships. This would require investment in these organisations and individuals (e.g., by giving assistance and training to agency staff in this area). It may also require increased funding and a revision of (their) program guidelines so that energy efficiency could be integrated into their core responsibilities
4: Future programs should focus on improving the quality of housing stock typical of this demographic which was generally found to be sub-standard in this region.	The majority condition of housing indicates that future energy efficiency programs delivered to similar low-income vulnerable households could focus on the improvement of the energy efficiency of current and future housing stock - especially as these households generally face financial constraints and have limited capacity for energy efficient retrofits.

Recommendation	Rationale
5: Future programs should provide financial subsidies to assist low income households implement energy efficient retrofits or upgrades	<p>Findings show that, in general, this demographic requires financial support to afford the up-front cost of many upgrades – especially when high-cost investments are needed to improve the energy performance of energy inefficient homes.</p> <p>Effective energy efficiency programs should focus on the need to balance energy efficiency and reduced energy costs with the need for thermal comfort in the home. Within this context, they should provide households with both the materials and competence needed to perform adaptive measures that reduce the need for, or reliance on, high energy demanding appliances.</p>
6: Future programs should allow sufficient time and resourcing for the proper implementation and evaluation of household curtailment behaviour (e.g., HVAC settings).	Realising the full capacity of energy efficient retrofits for energy reduction depends also on household curtailment behaviour and this component should be included and resourced.
7: Future programs should consider the development of multiple or additional delivery and support arrangements to ensure the sustainability of the program	<p>Importantly, results show that a key strength of this project is the coordinator. While the personalised face-to-face program delivery would appear to be the ideal approach for these participants, it is important to note that such an approach is time-intensive and relies heavily on personal relationships and trust between participants and the project coordinator.</p> <p>Such additional arrangements may not only help diffuse the heavy reliance on the program Co-ordinator but also help maintain the positive effects of the program (i.e. maintain behavioural changes and create new energy-saving habits) beyond the life of the project. Again, the use of existing community support organisations could have a role here.</p>

Recommendation	Rationale
8: Future programs should specifically investigate the effectiveness of different displays and other visual tools.	<p>Use of tools such as thermal imaging cameras, graphic representations of energy use linked to real life events (e.g. family visits, absences etc.), simple pictorial representations of zoning, setting HVAC units, thermal leakage were effective in assisting households 'see' their energy use and understand why recommendations were being made. Providing- and developing further - these visual tools will help participants remember to take specific energy-saving actions and help these actions become automatic.</p> <p>Less effective in a direct sense were the in-home displays. A choice of device appropriate to the cognitive capacity of individual participants, and education in its use and function, should be included as part of the installation.</p>
9 Future programs should look to utilise/adapt studies and research from other fields (beyond energy efficiency) to trial new and innovative ways to engage and communicate energy efficiency to low income households	While providing education and advice to participants should be included in any program aimed at increasing understanding of energy use and energy-saving behaviours, it is also important to consider alternative strategies that are less education-intensive like setting new defaults, automation, implementation plans, and simple prompts and attentional cues. These will help cater to different learning styles and capacities.
10: Future programs should have fully developed and agreed metrics that are able to properly measure and quantify indirect benefits.	As the benefits of energy efficient retrofits go beyond energy and related cost savings, future programs should also develop metrics that can quantify indirect benefits – particularly those relating to health and well-being – so that evaluation of energy efficiency programs can better incorporate the benefits of such programs.
11: Future programs should not be launched until the development and purpose of metrics and other evaluation criteria has been fully defined and articulated.	

Recommendation	Rationale
12: Future programs should include billing and tariff literacy as a key component	<p>Electricity bills were considered to be confusing and complex by participants and independent advice and support about bill and tariff information should be available to households through accessible, user-friendly channels that take into account all abilities.</p> <p>Some individuals did not have access to their bills (e.g., those with the State Trustee, Religious Orders) and this needs to be addressed.</p> <p>Access to bill information is a key step to empowering people to understand and act on their energy use and is an effective engagement tool.</p>
13: Future policy should look at legislating a standardised format for energy billing that provided transparency and consistency	<p>In view that energy is an essential service , key information relating to billing and interval data should be presented in a prescribed and standardised format to facilitate interpretation and analysis. It should be as simple and straightforward as possible so that lay persons are able to get value from the information and feel able to discuss and/or make comparisons competently and comfortably</p>

The findings from the interviews and CSIRO's analysis point to some key issues pertinent to improving energy efficiency in low-income homes and the development of future programs and policy targeted at this demographics. Table 19 below summarises the key findings and opportunities emerging from this report under six main categories:

- Targeted advice and assistance to inform energy efficiency practices
- Communication of key energy efficiency messages
- Individual tailoring of energy efficiency interventions
- Communication channels for improving energy efficiency and for recruitment/ participation in energy efficiency programs □
Practical technical solutions
- Policy Settings

Table 19: Key Findings and opportunities to improve Energy Efficiency

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
Targeted advice and assistance to inform energy efficiency practices		
Responses suggest the program coordinator had some success in promoting a more efficient use of AC and optimal temperature settings as most households seemed to have settled on temperatures around 20-22C in winter and 24-25 C in summer. Yet, reported set temperatures of AC (when known) ranged from 10C to 25C in summer and from 18C to 30C to in winter indicating that in some households some prevailing habits regarding the use of AC remained. Responses suggest that the advice provided by program coordinator about temperature settings and efficient use AC efficiently was followed by some participants. Others, however, still found it hard to grasp and/or to remember the advice and thus to act on it or chose to disregard the advice based on personal preferences and perceived thermal needs.	<p>This highlights the importance of providing practical advice on how to use heating and cooling systems and controls to help participants achieve optimal efficiency both in terms of energy saving and thermal comfort in their homes. This require, however, follow-up to ensure understanding, repetition, reinforcement and feedback.</p> <p>While providing <i>more</i> education and advice to participants may be useful, it is also important to consider alternative strategies that are less-education intensive such as setting new defaults, automation, implementation plans and simple prompts and attentional cues for some participants (see Section on Communication of Energy Efficiency Message and Section on Technical Solutions).</p>	Northern Grampians Shire Council; future programs.
Some participants did not set the temperatures on their ACs , their direct carers (professional and/or relative) did. Participants just turned the device on and off when they felt it was required. In these instances, the primary concern of the carers was to ensure the welfare of participants as they were often sensitive to ambient temperature due to medical conditions and required adequate cooling and/or heating.	Building understanding and capacity of direct carers to use AC efficiently in order assist householders in achieving thermal comfort while minimizing energy use and associated costs.	Future programs.
There were increased efforts to zone off rooms and use curtains/blinds to help regulate indoor temperature on hot and cold days. Most participants reported that window coverings and draught works as part of the program had made a significant difference to their thermal comfort in winter and/or summer.	Installation of new window treatments (thermal curtains, internal/external blinds and awnings) and draught works could help maximize home thermal efficiency and reduce the reliance and/or load on energy-consuming heating and cooling systems. Assisting and encouraging participants to consider and implement	Northern Grampians Shire Council; future programs.

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
	alternative ways to achieve thermal comfort that do not involve high energy consumption appliances such as air conditioners, for example, window coverings, draught stoppers, blankets and additional clothing to stay warm could bring multiple benefits.	
The project has made significant effort in increasing people's awareness of how much of their energy use was attributable to heating and cooling systems by showing them usage information and graphs and discussing the issue at length. This was evident in some participants' responses.	This suggests that visual aids (i.e. graphical depictions) may be more useful to help these participants better understand the proportion of their energy use that is dedicated to heating and cooling (i.e. scale and timing of usage, use patterns). This may help make them more aware of their own behaviours and influence more efficient energy behaviours when combined with appropriate advice and support.	Northern Grampians Shire Council; future programs.
The majority of participants did not actively engage with their In-Home Energy Display (IHD) , seemingly due to limited understanding of the device and how to use it (i.e. they did not know how to interpret the numbers on the screen and unsure about how to respond to feedback) and a lack of interest in the technology. For a minority, it was a useful tool as it acted as an attentional cue that prompted them to investigate level of energy use/what was switched on at a given time.	This suggests that for most participants , the black and white number display is not an effective tool to provide feedback on their energy usage and invoke the desired energy reduction response. For a minority, it can be a useful tool to better understand energy use and prompt a response. Here, it is important to note that not all participants are interested in the technology . Thus, we recommend that the participants themselves should decide if they consider using the IHD appealing or feasible once they have a basic understanding of how it works. Suggestive evidence in this study suggests that different type of IHD with graphs and traffic light display to show energy use may be more engaging and effective to better communicate what uses the most energy.	Northern Grampians Shire Council; future programs using IHD
Some participants reported a better understanding of their energy bills as the program coordinator had explained how to read and interpret the details of energy consumption and tariff information. As a result, they now looked at the details on	This suggests that assistance with how to read and understanding the details on their energy bills , i.e. understanding actual energy consumption (in kWh for electricity) rather than only looking at the dollar amount;	Northern Grampians Shire Council; future programs.

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
<p>energy use (the kWh they have used during the billing cycle; average daily usage) to monitor their energy use. Others reported paying more attention to their energy bills (energy usage) as a result of the program. Some participants still considered that information on their energy bills was confusing and complex; and others were not interested in looking at the details on their energy bills closely. As a result, they continued to look at the total charge to be paid rather than the actual energy use (i.e., kWh consumption) printed on their bills as a way to gauge energy usage. The program coordinator provided assistance to some participants to ensure that their concessions were applied and/or to investigate the best energy plan for them by getting comparative quotes from different energy retailers.</p>	<p>and how energy usage compares to the same time last year / from year-to-year, could assist some participants in better understanding and monitoring their energy use.</p> <p>It is important to note that the level of interest in the details on energy bills (satisfied with 'just' paying the bills) and/or cognitive capacity of some participants (in terms of their ability to grasp, remember, and then act on these complex aspects of energy bills) may mean that trying to explain things to them in more detail will not be highly impactful.</p> <p>Providing assistance in getting the best energy plan for each participant and to ensure that concessions are applied could be beneficial to assist participants in reducing energy costs.</p>	
<p>Communication of key energy efficiency messages</p>		
<p>Based on participants' responses, it is clear that a key strength of this program is its personal and face-to-face delivery.</p> <p>Participants expressed their preference for receiving information and advice through face-to-face delivery from someone they trusted. Most found information and advice more useful (and tend to remember it better) when it involves personal contact and a chance to discuss issues</p>	<p>For these participants and others in a similar situation, personalised face-to-face program delivery would appear to be the ideal approach for maximum benefit.</p> <p>Here it is important to note that personalised face-to-face program delivery is time-intensive and relies heavily on personal relationships and trust between participants and the program coordinator. The development of additional support arrangements – such as the involvement of carers and family members – should be considered to provide targeted advice and information. This recommendation is also relevant to ensure that a program outcomes continue beyond the life of a program. Written material could be used as a back up to face-to-face interaction but not as a primary means of helping participants. It is important here to note that face-to-face delivery is crucial for participants with limited cognitive ability and literacy level.</p>	<p>Government programs (any level).</p>

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
Despite this personalised face-to-face approach, some participants found it challenging to understand and/or remember some suggestions and advice that were given to them and thus to act on them.	<p>This suggests that it is crucial to ensure that participants fully understand the advice and how to act on it. This may require demonstrating new behaviours, ongoing reinforcement and support. Frequent feedback and follow-up are also important when trying to establish new habitual behaviours.</p> <p>Simple ‘action’ prompts and visual cues around the home may also be effective to help participants remember to take specific energy- saving actions as often people simply forget even if they know what they ‘ought’ to do.</p>	Northern Grampians Shire Council; future programs.
Support workers and carers play an important role in supporting participants in their day-to-day lives. There is great trust invested in support workers and carers by both groups of participants. This may be due to long established relationships that result from working together, and the personal nature of the role of the carers. Due to this trust and presence, many participants value their knowledge and guidance.	<p>Given this access, trust and presence, there is potential to further involve support workers and willing/available family members in a program by enhancing their understanding of energy use in the home and ways to improve energy. This includes what the most practical and effective actions are to achieve the greatest savings of energy at home and how to use energy devices efficiently. This will allow carers to assist participants in their efforts to become more energy efficient by communicating and reinforcing key energy efficiency messages; providing encouragement, prompts and feedback in their day-to-day activities; and modelling energy-saving actions.</p>	Northern Grampians Shire Council; future programs; Government programs (any level).
Individual tailoring of energy efficiency interventions		
Based on participants’ responses, a key strength of this program is the individually tailored approach of initiatives for specific situations – therefore directly meeting individual needs.	<p>For these participants and others in a similar situation, individual tailoring of initiatives would appear to be the ideal approach for maximum benefit. Providing tailored energy efficiency advice and assistance that takes into account the context and individual circumstances of the household is crucial to assist in improving home energy</p>	Government programs (any level).

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
	efficiency. Energy advice programs should be based on close attention to the circumstances of each participant (i.e. lifestyles, routines, medical conditions, thermal needs and preferences, use of space within the home) and carried out people with good technical knowledge and communication skills	
Results clearly demonstrate that all participants (aged and disability pension recipients) are unique and while some of their needs, interests and barriers they face in improving their home energy efficiency might be similar, there is a high degree of variability in abilities, technical skills, energy awareness, understanding, motivation, interest and goals around energy use and energy efficiency.	This result reinforces the need for individual tailoring of initiatives as ' one size does not fit all '. This statement applies to all recommendations presented in this table.	Future programs; Government programs (any level).
Participants reported a range of thermal experiences and preferences based on specific needs, medical conditions, vulnerabilities to hot/cold, lifestyles, different dwellings, preferred thermal environment/space in their homes and other considerations. This was reflected in a range of cooling and heating technologies, practices and 'comfortable' temperature settings in winter and summer.	This result reinforces the need to better understand comfort in order to appropriately tailor measures and advice aimed at reduced energy consumption and policy.	Northern Grampians Shire Council; future programs; Government departments and programs (any level).
Communication channels for improving energy efficiency and for recruitment/ participation in energy efficiency programs		
Findings suggest that carers (professional and relative) and Home and Community Care program (HACC) is most effective pathway to continue providing advice (following appropriate skills development of these individuals) beyond the life of this program and reinforcement/repetition of key messages that will assist in entrenching some habits and build long-term energy-saving behaviours.	This indicates a need for government (any level) to invest more resources into appropriate knowledge and skills development of carers (professional and relative) and HACC personnel so they can provide effective energy advice and support.	Government programs (any level).

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
A few participants felt that local and peer group networks could play a role in helping disseminate information about ways to become more energy efficient and to encourage greater participation among their demographic in future energy efficiency programs	Accessing these networks could assist in helping disseminate information about ways to become more energy efficient and to encourage greater participation among this demographic in energy efficiency programs.	Northern Grampians Shire Council; future programs.
Some participants and their carers reported interest from others in the community who had heard about the program and that interest could extend even to just receiving advice on how to save energy and associated costs.	This suggests that there is a genuine need/ demand for having readily accessible energy efficiency information and advice at the community level and for future energy advice programs.	
Practical technical solutions		
Results indicate that some participants struggle to use their heating and cooling systems efficiently.	In addition to providing specific advice (see Section above), two alternative solutions could be (1) to change the default settings of participants' ACs (after experimentation to determine the lowest temperature comfortable for them in winter and the highest in summer) and/or (2) to make use of automated devices like direct load control . Simply switching the default settings and/or setting the device so it switches on/off at certain times would 'make it simple' for participants to perform the desired behaviour (i.e., they simply stick with the default, thus alleviating the cognitive burden of having to remember what to do, and when, where, how, etc.).	
IHD	Developing and testing new feedback devices that have been designed with user engagement in mind	
Policy settings		
The State Trustee does not provide billing information to clients, thus preventing indirect feedback on energy consumption.	Engagement with the State Trustee could discuss the options for providing billing information for the client.	State Trustee/

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
		Public Guardian.
Overall, findings suggest that the program was also able to provide valuable advice on additional upgrades participants could consider which would provide maximum benefits. Yet the primary barrier for considering/ undertaking some energy efficiency improvements was financial.	This suggest that program participants require support and guidance on financial support available (i.e. government grants or schemes) to help with upfront costs of energy efficiency upgrades. Additional funding for larger energy efficient retrofits could be provided for larger upgrades such as insulation in energy efficiency programs. Additional funding could also be provided for targeted retrofits for the worst performing homes (coldest/warmest homes) and highest risk households (require large amounts of energy for heating and/or cooling due to medical conditions)	Northern Grampians Shire Council; future programs; Government departments and programs (any level).
Findings in Round 3 suggest that the program has showed that a relatively low level of investment (i.e. draught proofing works, internal/external window coverings) properly targeted and coupled with tailored advice can bring significant and multiple benefits to householders (i.e. increased thermal comfort, improved health and well-being and reduced use/reliance on high energy-consumption appliances such as AC thereby reduced energy consumption).	Additional funding or financial assistance to undertake these relatively low level investment and increase the capacity of participants for adaptive strategies for coping with hot and cold days.	
An additional barrier to further home energy improvements was tenancy – some participants who were tenants in a rental property (owned by social local service organisations or private individuals) mentioned that they could not undertake larger or structural improvements because they did not own the home and/or reported being unable or unwilling to approach landlords to request energy efficiency upgrades.	Providing incentives to landlords to improve energy efficiency could potentially increase the liveability and comfort for tenants and possibly also increase the value of their home.	Federal and state governments.
Both residents on aged and disability pension who participate in this program are involved in the community service system.	This suggests that there are opportunities to strengthen the delivery of future energy programs	Northern Grampians Shire Council; future programs;

KEY FINDING	OPPORTUNITY TO IMPROVE ENERGY EFFICIENCY	RELEVANT ORGANISATION OR JURISDICTION
	through existing services and intermediaries. This may involve developing and strengthening links between the program coordinator and agencies who are responsible for visiting participants in their homes in order (1) to increase awareness of future energy efficiency programs (and recruit participants) and (2) to discuss how to improve energy efficiency (following appropriate knowledge and skills development of these personnel) – in relation to thermal comfort, health and wellbeing, energy saving, reduction in costs – could be included in all discussions. This would require giving assistance and training to agency staff in this area.	Various agencies dealing with vulnerable and low income households

9 Project Budget

NGSC LIEEP Final Report Budget

Annual FY Income		2013/14	2014/15	2015/16	
Income	\$50,000; \$104,667.01; \$111,267; \$100,000	\$ 365,934.00	\$ 109,866.00	\$ 20,000.00	\$ 495,800.00
In-kind contributions:					
<i>Household Identification and recruitment</i>	Est 80 hours total @ \$45/hr	\$ 2,600.00		\$ 1,000.00	\$ 3,600.00
<i>Travel Costs</i>	Pool cars	\$ 8,000.00	\$ 13,950.00	\$ 8,000.00	\$ 29,950.00
<i>Office and ICT</i>	Per budget	\$ 4,000.00	\$ 5,800.00	\$ 5,800.00	\$ 15,600.00
<i>Project staff supervision and payroll</i>	Per budget	\$ 3,000.00	\$ 4,220.00	\$ 4,220.00	\$ 11,440.00
<i>Other Shire Officer time - e.g., communications IT support, finance</i>	Est 100 hours total @ \$45/hr	\$ 1,500.00	\$ 1,500.00	\$ 1,500.00	\$ 4,500.00
<i>Other consortia time -e.g., communication and promotion, participation on PSC, household support, professional advice to project and project staff</i>	Est 700 hours total @ \$45/hr	\$ 13,500.00	\$ 9,000.00	\$ 9,000.00	\$ 31,500.00
					\$ 592,390.00
In Kind Breakdown for Level Analysis					
	Level 1	Level 2	Level 3	Level 4	Totals
		\$ 3,600.00			\$ 3,600.00
	\$ 19,950.00	\$ 10,000.00			\$ 29,950.00
			\$ 15,600.00		\$ 15,600.00
			\$ 8,580.00	\$ 2,860.00	\$ 11,440.00
			\$ 2,000.00	\$ 2,500.00	\$ 4,500.00
			\$ 28,500.00	\$ 3,000.00	\$ 31,500.00
	\$ 19,950.00	\$ 13,600.00	\$ 54,680.00	\$ 8,360.00	\$ 96,590.00

Actual FY Expenditure					
Ordinary Hours	\$ 23,049.98	\$ 34,844.57	\$ 54,037.52		
WC		\$ 894.88			
Super			\$ 5,831.02		
Total Salary	\$ 23,049.98	\$ 42,775.61	\$ 59,868.54	\$ 125,694.13	
Contract Employees		\$ 25,350.02	\$ 9,271.20	\$ 34,621.22	
Loyalty		\$ 3,300.00	\$ 7,400.00	\$ 10,700.00	
Training HEA	\$ 9,316.00			\$ 9,316.00	
Contractors		\$ 2,116.49		\$ 2,116.49	
Materials and Services	\$ 7,659.76	\$ 139,749.75	\$ 10,905.92	\$ 158,315.40	
Consortia Costs	\$ 1,271.00			\$ 1,271.00	
Meeting Costs	\$ 871.72	\$ 1,406.96	\$ 1,044.20	\$ 3,322.88	
CSIRO (Research)		\$ 88,000.00	\$ 44,897.00	\$ 132,897.00	
Audit		\$ 210.00	\$ 350.00	\$ 560.00	
	\$ 42,168.46	\$ 302,908.83	\$ 133,736.86	\$ 478,814.15	
In-Kind	\$ 32,600.00	\$ 34,470.00	\$ 29,520.00	\$ 96,590.00	
	\$ 74,768.46	\$ 337,378.83	\$ 163,256.86	\$ 575,404.15	
Level Breakdown for use in Cost Effectiveness Calculations					
Item	Level 1	Level 2	Level 3	Level 4	
Salary	\$ 62,850.00			\$ 62,844.13	\$ 125,694.13
Contract Employees				\$ 34,621.22	\$ 34,621.22
Loyalty		\$ 10,700.00			\$ 10,700.00
Training HEA	\$ 9,316.00				\$ 9,316.00
Contractors		\$ 2,116.49			\$ 2,116.49
Materials and Services	\$ 158,315.43				\$ 158,315.43
Consortia Costs		\$ 1,271.00			\$ 1,271.00
Meeting Costs	\$ 1,000.00		\$ 2,322.88		\$ 3,322.88
CSIRO (Research)			\$ 132,897.00		\$ 132,897.00
Audit				\$ 560.00	\$ 560.00
In Kind	\$ 19,950.00	\$ 13,600.00	\$ 56,130.00	\$ 6,910.00	\$ 96,590.00
	\$ 251,431.43	\$ 27,687.49	\$ 191,349.88	\$ 104,935.35	\$ 575,404.15
		\$ 279,118.92	\$ 470,468.80	\$ 575,404.15	

Direct Households Costs

Loyalty (Main Households)	\$6,700.00
Materials, Services and Contractors	\$160,431.92

Other Project Costs

Control House Loyalty	\$4,000.00
Salary and Contract Employees	\$160,315.35
Training HEA	\$9,316.00
Consortia	\$1,271.00
Meeting Costs	\$3,322.88
CSIRO	\$132,897.00
Audit	\$560.00
In Kind	\$96,590.00

\$167,131.92

\$408,272.23

Combined

\$575,404.15

Average Cost per household **\$4,178.30**

Average Cost per household **\$4,178.30**

Actual Income Received \$495,800.00

Actual expenditure \$478,814.15

Unspent Funds **\$16,985.85**

10 Cost Effectiveness

10.1 Supporting Information

Note:

- a. Face to face approach means that cost: benefit ratio will always be high*
- b. Low cohort numbers mean any quantitative analysis is likely to have significant error attached*
- c. Standard deviation in data is greater than mean values which may also reduce value of findings, and which indicate the influence of confounding factors that are greater than the influence of project initiatives.*

LEVELS OF ANALYSIS

Please also refer to budget section breaking costs down to each level

Note that costs include in-kind

Level 1 - cost of delivering trial to participants (retrofit, home energy assessment and coaching cost/support) = \$251,431.43/40 households = \$6,285.79 per household

Level 2 – Level 1 costs plus cost of recruitment and maintenance of participants
= \$ 279,118.92/60 households = \$4,651.98 per household

Level 3 – Level 2 costs plus the cost of running the organisation to do the above
= \$470,468.80/60 households = \$7,841.15 per household

Level 4 – All above plus administrative and compliance costs, including preparation of milestone reports, financial reports and working with the Department to meet Funding Agreement Milestones = \$575,404.15/60 households = \$ 9,590.07 per household

INFORMATION USED TO CALCULATE THE CONVERSION FACTORS IN TABLE 20

1. Average consumption per house (all households based on collected consumption data)
Peak Usage 9.103681 kWh/day (cost used in calculation \$0.26/kWh)
Off-peak Usage 7.522616 kWh/day (cost used in calculation \$0.14/kWh)
2. Estimated reduction (%age) calculated from comparison of collected control and main households consumption data (*note comments above re small cohort and large margin of error*) as reported previously in report
Peak reduction 3.213%
Off-peak reduction 8.712%
3. Percentage Changes

Main Households:
Percentage of Households decreasing peak 19 (63%)
Percentage of households increasing peak 11 (37%)

(Note; if 4 anomalies where wood was replaced with electricity are taken out, percentages are 73.1% and 26.9% respectively)

Percentage of households decreasing off-peak 9 (47%)

Percentage of households increasing off-peak 8 (53%)

Control Households:

Percentage of Households decreasing peak 7 (39%)

Percentage of households increasing peak 11 (61%)

Percentage of Households decreasing off-peak 3 (21%)

Percentage of households increasing off-peak 11 (79%)

Assumption is that project had a positive impact ratio on decreasing peak usage of 63/39 or 1.615 to one. Or a positive impact of 61.76% of houses (63/102)

Also that it had a positive impact ratio on decreasing off-peak usage of 47/21 or 2.238 to one. Or a positive impact on 69.12% of houses (47/61).

4. Over 12 month period (365days)

Average peak savings = $9.103681 \text{ kWh/day} \times 365 \text{ days} \times 3.213\% \times \$0.26/\text{kWh} = \$27.758 \text{ per annum}$

Average off-peak savings = $7.522616 \text{ kWh/day} \times 365 \text{ days} \times 8.712\% \times \$0.14/\text{kWh} = \$33.489 \text{ per annum}$

Average total savings \$61.25 per year per household

5. Estimated energy savings Average peak savings = $9.103681 \text{ kWh/day} \times 365 \text{ days} \times 3.213\% = 106.763 \text{ kWh/yr}$

Average off-peak savings = $7.522616 \text{ kWh/day} \times 365 \text{ days} \times 8.712\% \times \$0.14/\text{kWh} = 239.21 \text{ kWh/yr}$

Average total savings 345.973 kWh/yr per household

6. From interview responses, n=28/32 reported improvement in thermal comfort (87.5%)

7. From interview responses, n=29/32 that one or several upgrades installed improved their home indoor temperature, potentially reducing the need for AC use (90.62%).

8. From interview responses, n=22/32 reported changes in the EE practices. 10/32 no change, however these also reported that the extent or frequency of some actions had improved. i.e. 100% report that project had positively influenced their EE behaviour.

9. From interview responses, 6/32 reported additional energy related information being performed at the end of the program (18.75%)

10. From interview responses, 15/32 no change in their understanding of energy bill information – either always knew (5); still don't understand (10); no interest (10)

11. From interview responses, 12/32 reported improved understanding of energy bill information and paying more attention to the details on them

12. From interview responses, 17/32 reported improved level of awareness and understanding on appliance energy consumption – particularly in relation to heating and cooling devices. 10 unsure. 5 no change.
13. From interview responses, 23/32 reported increased awareness and understanding of energy saving behaviour
14. From interview responses, 26/32 felt in control of their energy use at the end of the program with 10 saying their level of control had increased.
15. From interview responses, 13/32 reported that they thought the program had helped reduce their energy use
16. From interview responses, 17/32 identified further EE upgrades they are interested in pursuing
17. From interview responses, 32/32 thought the face to face approach - using someone local and trusted - worked well for them
18. From interview responses, 22/32 talked about or showed the program upgrades to others
19. From interview responses, 21/32 reported that they now regularly use their window treatments to help regulate the temperature inside their home

Table 20: Cost Effectiveness Calculations

Detail	Cost	Conversion factor	Total Attributable Cost	Unit description	Unit Qty	Cost Effectiveness (project period only)	Comments
Cost Effectiveness of project in:							
1. Reducing peak usage per household per percentage point	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	1	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	Percentage Point	3.213	L1: 1956 L2: 1448 L3: 2440 L4: 2985	Combined cost effectiveness of reducing consumption per household per percentage point
2. Reducing off-peak usage per household per percentage point	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	1	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	Percentage Point	8.712	L1: 722 L2: 534 L3: 900 L4: 1100	L1: 1339 L2: 991 L3: 1670 L4: 2042
3. Reducing consumption per kWh per household	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	0.6176	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	kWh	345.973	L1: 18 L2: 13 L3: 23 L4: 28	At \$0.26/kWh peak and \$0.14 kWh off-peak, investment in reduced consumption (and cost) for these households is a long-term investment
4. Reducing peak usage per household	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	0.6912	L1: \$9,385.12 L2: \$6,761.82 L3: \$11,230.25 L4: \$12,943.81	Households	1.00	L1: 10178 L2: 7532 L3: 12696 L4: 15528	Combined cost effectiveness of reducing consumption per household
5. Reducing off-peak usage per household	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	0.875	L1: \$8,385.78 L2: \$6,041.81 L3: \$10034.43 L4: \$11565.54	Households	1.00	L1: 9094 L2: 6730 L3: 11344 L4: 13875	L1: 9636 L2: 7131 L3: 12020 L4: 14701
6. Improving thermal comfort per household	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	0.9062	L1: \$6,624.29 L2: \$4,772.69 L3: \$7,926.63 L4: \$9,136.11	Households	1.00	L1: 7184 L2: 5317 L3: 8961 L4: 10960	Investment resulted in improved thermal comfort in the majority of houses
7. Improving temperature regulation per households achieved through upgrade/retrofit	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15 L4: \$9,590.07	1	L1: \$6,396.21 L2: \$4,608.36 L3: \$7,653.72 L4: \$8,821.56	Households	1.00	L1: 6936 L2: 5133 L3: 8653 L4: 10583	
8. Impacting positively on EE behaviour per household	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15	1	L1: \$6,285.79 L2: \$4,651.98 L3: \$7,841.15	Households	1.00	L1: 6286 L2: 4652 L3: 7841	Project had a positive impact on all households - see item 8 above

L4: \$9,590.07

L4: \$9,590.07

L4: 9590

Please note with the above

- 1) Time period is spread out only over the period of the project. Over longer periods, benefits and savings will accrue without any additional cost to project
- 2) each level of cost achieves multiple benefits which, in reality improve the cost effectiveness but the project wasn't able to separate out the separate costs

Also, below are additional outcomes and the percentage of households that achieved them

9. Encouraging additional energy actions (end of project) performed per households	18.75%	Indicates that without project incentives and/or support significant barriers may still exist to adoption of additional EE actions.
10. Improving understanding of energy bill information	37.50%	
11. Improving level of awareness on appliance energy consumption (incl HVAC units)	53.13%	
12. Increasing awareness and understanding of energy saving behaviour	71.88%	
13. Empowering householders to be in more control of their energy saving behaviour	81.25%	
14. Encouraging discussion about EE amongst peer groups	68.75%	
15. Using IHDs to prompt changes	25.00%	
Using IHDs to provide useful information to households	53.13%	IHDs had a mixed and relatively poor reception from householders but remain a fairly low cost intervention that does have some value within a program

10.2 Cost Benefit

- 1) With average total energy savings (benefit) of \$61.25/yr and project costs per household at each level

Level 1: \$6,285.79

Level 2: \$4,651.98

Level 3: \$7,841.15

Level 4: \$9,590.07

Cost benefits:

Level 1: $\$6,285.79 / 61.25 = 102.63$

Level 2: $\$4,651.98 / 61.25 = 75.95$

Level 3: $\$7,841.15 / 61.25 = 128.02$

Level 4: $\$9,590.07 / 61.25 = 156.57$

- 2) With average total energy savings (benefit) of \$61.25/yr and an average upgrade/retrofit cost of \$4,178.30 per year per household

Cost benefit = $4178.3 / 61.25 = 68.22$

(Note: the above does not reflect value of capital improvement, value to household of other benefits such as well-being and thermal comfort. Also, it is unlikely to be a direct linear relationship between the cost of intervention and the level of energy savings, especially where there is also changes in practice and behaviour which may be less expensive to initiate)

11 CEO or Senior Officer Endorsement

On behalf of Northern Grampians Shire Council, I approve the *NGSC LIEEP Final Evaluation Report 2016* and submit the report to the Australian Government's *Low Income Energy Efficiency Program* as required under Milestone 8 of the Funding Agreement.

Name of Authorised Person: Daryl Schuyler

Position/Title: Acting Manager Environment and Regulatory services.

Signature: 

Date: 16-06-2016