Home Energy Efficiency Upgrade Program

FINAL REPORT

Australian Government
Department of Industry, Innovation and Science

Brotherhood of St Laurence
Working for an Australia free of poverty

The Brotherhood of St Laurence is a non-government, community-based organisation concerned with social justice. Based in Melbourne, but with programs and services throughout Australia, the Brotherhood is working for a better deal for disadvantaged people. It undertakes research, service development and delivery, and advocacy, with the objective of addressing unmet needs and translating learning into new policies, programs and practices for implementation by government and others. For more information, visit <www.bsl.org.au>.

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Section 2 and Appendix F:
Byrne, G, Jorgensen, B, Jungbluth, L & Smith, L 2016, 'What was the effect of the Home Energy Efficiency Upgrade Program (HEEUP) on household electricity and gas consumption?' in D Sullivan 2016, *Home Energy Efficiency Upgrade Program: final report*, Brotherhood of St Laurence, Fitzroy, Vic.

Section 3.2 and Appendix G:
Ward, M & Brent, D 2016, 'Discrete choice experiment, results and analysis for Home Energy Efficiency Upgrade Program (HEEUP)', in [as above]

Section 5.1 Research case studies:
Johnson, V & Sullivan, D 2016, 'Home Energy Efficiency Upgrade Program (HEEUP) research case studies', in [as above]

Section 6 and Appendix H:
O'Mullane, L & Hoch , L 2016, 'Home Energy Efficiency Upgrade Program (HEEUP) cost-effectiveness and cost-benefit analyses', in [as above]

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The photographs that complement the case studies were taken by Cara Bradley.

This report benefited from the contributions of Dr Victoria Johnson and Deborah Patterson (editor) and from review by HEEUP project staff.

A note on terminology

The term ‘participants’ (without qualifier) is used throughout this report to describe the households (or individuals in them) that proceeded to install a new hot water service during HEEUP. Where the people that expressed an interest in or received a home visit under HEEUP are also included, that is specified in the text.

Executive summary

The Home Energy Efficiency Upgrade Program (HEEUP) was a Low Income Energy Efficiency Program (LIEEP) trial funded by the Department of Industry, Innovation and Science, which assisted 793 households in greater Melbourne and regional Victoria to upgrade to more efficient hot water systems.

The objective of HEEUP was to assist low income households to overcome information, capital and trust barriers than might otherwise lead to less efficient hot water system purchases. Hot water was chosen because:

- it is one of the biggest energy users in the home accounting for around 20% of household energy use
- a new system has high up-front costs ranging from $1,000 to $5,500
- it is a complex purchase, with households having to calculate up-front costs and running costs, often with a great deal of uncertainty

As a result many households, particularly those on low incomes with capital constraints, choose a like-for-like replacement, which is often not the optimal upgrade for them or the environment.

This report outlines the delivery of HEEUP and the related research, which examined four distinct but interrelated aspects of the program: the actual energy savings from the different hot water systems; the level of incentive required to get low-income households to upgrade to a more efficient system; whether HEEUP changed purchasing decisions, and the key lessons from HEEUP for delivering similar types of programs.

The HEEUP research is important because there has been little study of programs designed to increase the uptake of more efficient hot water systems by low-income households.

HEEUP was funded by the Commonwealth Department of Industry, Innovation and Science (DIIS) and delivered by the Brotherhood of St Laurence, with a consortium that included Monash (University) Sustainability Institute (MSI), AGL, NSW Office of Environment and Heritage (NSW OEH), and the Alternative Technology Association (ATA).

HEEUP delivery outputs

Overall, 793 hot water systems were installed in HEEUP's main delivery period, which operated from April 2014 to January 2016. More than 600 of these systems were installed in 12 months from January 2015. Along with the hot water systems installed HEEUP undertook 1291 home visits to provide independent advice on hot water upgrades.

HEEUPs upgrades focused in two primary streams:

- low-income owner occupier households: where 71% (550) upgrades occurred
- community housing: where 22% (176) of the upgrades occurred with the benefits flowing to low income tenants.

A small number of emergency replacement upgrades (21, or 3%) and independent installations (46, or 6%) also occurred.

HEEUP participants were able to upgrade to:

- solar (with gas or electric boosters) (during all stages)
- heat pump (during selected stages)
- instant gas (during all stages) or
- gas storage (during selected stages).

Owner occupier participants in HEEUP received a home visit from a BSL staff member, who provided information on the best upgrade options, a subsidy and access to a no interest loan to help reduce the capital barrier. The subsidies were tiered with the highest cost systems (solar and heat pump) receiving the highest subsidy.

Of the 550 owner occupier participants who upgraded their system, 69% upgraded to one of the more efficient systems: a solar system (47%) or heat pump (22%).

Community housing upgrades were arranged and funded by the housing provider. Each housing provider received a flat rate $1,100 subsidy per upgrade. Tenants were approached to provide access to energy metering data; however, they were not required to contribute to the financing of the upgrade.

In the community housing stream, 28% of the 176 installations were either solar (5%) or heat pump (23%).

HEEUP research

The research components of HEEUP were undertaken by either Monash (University) Sustainability Institute (MSI) or the Brotherhood of St Laurence Research and Policy Centre (RPC). AGL played an important role facilitating access to data and assisting with data analysis.

The research questions were:

1 What change in household energy consumption (and energy expenditures) has occurred?
2 What is the optimal level of incentive?
3 Has HEEUP overcome the barriers to upgrades and generated 'additional' take up of efficient hot water systems?
4 What were the key lessons from the program in particular what enabled or impeded program goals?

1. What were the energy savings from the upgrades?

Monash University researchers assessed the changes in energy consumption in a sample of 339 households who installed hot water systems as part of HEEUP (see section 4, Byrne et al.). For all participants except those involving a fuel switch, they found:

- a statistically significant decrease in daily electricity consumption of 25% (2.09 kWh per day) and a statistically significant decrease in daily gas consumption of 7% (7.63 MJ per day)
- an annual reduction of 762 KWh ($213.46) for electricity consumption and 2,787 MJ ($55.64) for gas consumption.

They concluded that in overall terms the intervention was successful in producing energy savings.

The upgrade paths yielding significant decreases in daily electricity consumption were:

- electric storage to heat pump (29%)
- electric storage to gas instantaneous (42%)
- electric storage to gas solar (41%).

The significant electricity reductions were associated with annual financial saving equivalent to $244.14 (electric storage to heat pump), $303.89 (electric storage to gas instantaneous), and $295.65 (electric storage to gas solar). Increased gas consumption associated with upgrading from electric storage to gas instantaneous and to gas solar, was not statistically significant for either of these pathways.

The upgrade paths yielding significant decreases in daily gas consumption were:

- gas storage to gas instantaneous (15%) and
- gas storage to gas solar (13%).

These effects correspond to annual financial savings of $114.45 and $101.96 respectively.

2. What was the optimal subsidy level to encourage households to purchase a more efficient system?

Analysis of program data and a discrete choice experiment were undertaken to identify the optimal subsidy to encourage households to purchase a more efficient system.

Program delivery experience

Analysis of program data revealed:

- Conversion rates from a home visit to an installation were higher when the subsidy was higher and the out-of-pocket expense lower.
- Higher subsidies and the inclusion of heat pumps coincided with more energy efficient systems being installed.

- Upgrades to solar and heat pump systems could be achieved in 65% of participating households with the following subsidy mix:
    - $2,300 to $2,900 for upgrades to solar (with a householder contribution around $2,000)
    - $2,000 to $2,300 for upgrades to heat pumps (with a householder contribution between $1,600 and $1,800)

Discrete Choice Experiment

Ward and Brent (see Chapter 5) conducted a discrete choice experiment, which explored householders' preferences for hot water service upgrades.

Running costs had a larger impact on people's choices than upfront costs

For a generic hot water upgrade (when no technology is explicitly stated in the experiment), an extra dollar in annual running costs has around 7.6 times the impact of an extra dollar of upfront cost on people's choices. When the respondents were aware of the types of upgrade, annual running cost had even more influence on their preference.

3. Did HEEUP change purchasing decisions?

Participants' purchasing intentions and decisions were analysed to understand whether HEEUP shifted their purchasing behaviour.

HEEUP shifted hot water system upgrades to a planned decision

Without HEEUP, (73%) of participants would not have replaced their hot water system until it broke down. The program brought forward these households' upgrade decisions and made them a planned upgrade rather than an emergency decision. In doing so HEEUP was able to prevent ad-hoc decision making when there is limited opportunity for households to weigh up the relative costs and benefits of different hot water systems.

Participants upgraded to a more efficient system than they would have without HEEUP

HEEUP was also successful in shifting participants' upgrade choices to more efficient hot water systems. Only 19% said they would have upgraded to solar and 7% to heat pump without HEEUP. With HEEUP, participants opted for more efficient systems, with 47% purchasing solar and 27% purchasing heat pumps.

HEEUP also helped participants to achieve their ideal upgrade choice

Participants' final upgrades were more in line with their ideal upgrade than they would have been without HEEUP.

HEEUP case studies – Changing purchasing decisions

The research case studies illustrated ways the program assisted households' to make upgrades possible, brought forward upgrade decisions, shifted households towards more efficient upgrades and may influence future purchasing decisions.

4. What lessons were learnt from HEEUP service delivery?

Lessons about the service were identified from research case studies and the HEEUP reflective practice process.

Case studies

The eleven research case studies highlight factors influencing householders' decisions about upgrading their hot water services. They illustrate how HEEUP assisted some participants to overcome:

- capital barriers, through a combination of either rebates, loans or full funding
- information barriers, mostly through a combination of EEO and installer advice
- the tenancy barrier, through working with community housing providers.

Case study households reported achieving energy savings, bill savings, greener energy use and peace of mind. On the other hand, HEEUP did not overcome information asymmetry and trust barriers in at least one case study household.

Reflective practice process

The HEEUP staff's reflective practice process identified lessons from HEEUP including:

Low income home owners will upgrade to a more efficient hot water system when they are provided an **incentive** or **subsidy,** a **low interest loan** to cover the out of pocket expenses and **information** on upgrade options

Community housing providers are keen to participate and provide economies of scale.

Support should be provided to households on a graduated basis. Specifically:

- the **subsidy level should be higher for more expensive and efficient systems**: solar and heat pump
- provision should be made to **provide a higher level of financial support for those in energy hardship** or fuel poverty who cannot afford to co-contribute
- Independent, in-home advice, is very valuable for those who need it. However, many households have already decided on the upgrade they want and don't need detailed advice. In-home advice should therefore only be provided to households who need it. Other households should be provided with information and advice over the phone or via online channels.

Major recommendations

Recommendation 1: New program to address barriers to energy efficiency and energy savings in low-income households

HEEUP showed that:

- *with information, a subsidy and the option of a no interest loan, low-income home owners will switch to a more efficient hot water system;*
- *households have varying levels of need;*
- *high-needs households require greater support.*

The HEEUP This approach can be applied to other major energy efficiency upgrades.

Recommendation:

Introduce a program to assist low-income Australians improve the energy efficiency of their homes and so lower their energy bills. The program should:

1. Provide three critical enablers:
    - targeted information from trusted sources on energy efficiency upgrades and residential solar photovoltaics (solar pv)
    - subsidies for efficient hot water (solar, heat pump and instant gas), residential solar pv, and selected other upgrades (including insulation and highly efficient appliances such as refrigerators)
    - access to low-cost loans.
2. Provide graduated levels of support according to household need:
    - base level: all households should have access to relevant information on energy upgrades and this should be tailored for segments of the low-income population including pensioners and CALD communities
    - intermediate level: access a subsidy to reduce the up-front cost of an upgrade, a no interest loan to help manage the out-of-pocket expense, and the option of in-depth, independent decision support
    - high level: increased subsidies with minimal or no co-payments, where clear hardship can be established. This may be needed for households with high energy consumption relative to income, or in energy billing hardship, or with specific health or disabilities that may place them in energy hardship, or who are low income and have specific energy efficiency needs, such as a highly inefficient hot water system

Recommendation 2: Accelerate action in community housing

Community housing providers and tenants wanted energy efficiency upgrades and considerable scope exists to engage them further. Information and brokerage may be needed to do this.

Recommendation:

Introduce an incentive scheme to accelerate the uptake of energy efficiency upgrades in community housing. Funding could focus on the marginal additional cost of installing more efficient fixtures as part of regular maintenance.

Consideration should be given to identifying a broker to assist community housing providers plan a transition to efficiency upgrades of existing housing.

Other recommendations

Recommendation 3: Subsidise solar and heat pump to keep householder contributions low.

Upgrades to solar and heat pump systems were achieved in 65% of participating households with the following subsidy mix:

- *$2,300 to $2,900 for upgrades to solar (with a householder contribution around $2,000)*
- *$2,000 to $2,300 for upgrades to heat pumps (with a householder contribution between $1,600 and $1,800)*

Recommendation:

Provide subsidies of up to $2,900 to keep householder contributions for solar hot water below $2,000 and for heat pump below $1,800.

Recommendation 4: Widen the options available for improving energy productivity

Many HEEUP participants reported they were interested in upgrades other than hot water: rooftop solar photovoltaics (solar PV) was identified as a particular interest.

Recommendation:

Future policy and programs should facilitate householders' access to the most appropriate solutions for reducing their costs and improve energy efficiency including:

- energy efficiency upgrades in existing dwellings
- rooftop solar.

Recommendation 5: Facilitate low cost financing

Low cost financing through NILS was an important enabler for some HEEUP participants. Concessional loans are particularly suitable for low-income home owners when used in conjunction with a subsidy.

Recommendation:

Future programs or policy should fund concessional loans that enable low-income households to improve the efficiency of their homes. Consideration should be given to existing schemes such as the No Interest Loans Scheme (NILS) and council concessional loans (such as Darebin Solar Savers).

Recommendation 6: Quantify the multiple benefits of energy efficiency upgrades

HEEUP found participants had a range of motivations for improving energy efficiency. The program also contributed to a series of non-energy benefits including greenhouse gas emissions reductions, improved amenity, improvements and wellbeing and reduced stress; however, these were not quantified.

Further research should be funded to quantify the multiple benefits of residential energy efficiency upgrades and develop valid and reliable assessment tools. Specific attention should be given to the benefits for health, wellbeing, and reduced stress.

Recommendation 7: Partner with not for profits

The BSL was trusted by HEEUP participants because it is a known, not-for-profit community services provider. This had two benefits described by participants: a demonstrated capacity in engaging with low-income households and communities and a commitment to the best interests of the householder, unlike for-profit service providers.

Recommendation

Opportunities for not-for-profit organisations to provide energy efficiency services to low-income and vulnerable households should be developed. This will expand the reach of energy efficiency programs and address trust barriers.

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1 HEEUP overview

Introduction

The Home Energy Efficiency Upgrade Program (HEEUP) provided information, a subsidy and a no interest loan to low-income Victorian households in order to increase the uptake of highly efficient hot water systems. HEEUP sought to address capital barriers low-income households face through a no interest loan and a subsidy and to address information and trust barriers through the provision of independent hot water upgrade advice.

HEEUP was officially operational from June 2013 until June 2016. Engagement with households, home energy visits and installation of hot water systems occurred over 22 months between April 2014 and the end of January 2016.

The Brotherhood of St Laurence, a Melbourne-based community welfare organisation, led the HEEUP consortium, which delivered the program. Other members of the consortium were AGL, Monash Sustainability Institute (MSI), Alternative Technology Association (ATA), and the NSW Office of Environment and Heritage (NSW OEH).

Rationale for the Home Energy Efficiency Upgrade Program (HEEUP)

High energy bills remain one of the biggest cost of living concerns for Australian households. As bills increase so do cases of energy hardship and energy disconnections. Households living on a low-income are particularly vulnerable to high energy bills because they spend more of their weekly income on energy than wealthier households.

Improvements in residential energy efficiency can lower energy bills (see Reardon 2013). HEEUP sought to lower participating households' energy bills by assisting low-income participants to upgrade to more efficient hot water systems.

Hot water systems were chosen because they are one of the biggest energy users in most Australian's homes: on average, they account for 20–25% of the energy used in the home (Reardon 2013). The most efficient hot water systems can lead to big energy and cost savings.

Choosing the best hot water system is however a complex decision, with a host of technology choices. Householders have to consider the upfront cost of the system, which can range from $1,000 to $6,500, and then factor in different running costs. Often the information on running costs is not very transparent, or the householder is unsure who to trust. Householders are also largely dependent on plumbers or hot water system providers to advise them on the best upgrades. The plumber or advisor often has a specific interest and/or preference in the type of system installed.

As a result many households end up choosing a like-for-like replacement, or following the recommendation of their plumber. In many cases, this can be a sub-optimal choice for the household.

Funding and objectives of the LIEEP Program

HEEUP received $4.5 million in funding from the Commonwealth Government's Department of Energy Efficiency and Climate Change (DCCEE) Low Income Energy Efficiency Program (LIEEP). Following a series of departmental moves, the program was completed under the Commonwealth Government's Department of Industry, Innovation and Science. The objectives for the LIEEP program were outlined by DCCCEE (2012, pp. 6–7):

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

HEEUP research

HEEUP was run as a trial as part of the Low Income Energy Efficiency Program (LIEEP).

The HEEUP research focused on understanding three distinct but interrelated aspects of the program: the actual energy savings from the different hot water systems; the level of incentive required to get low-income households to upgrade to a more efficient system; and the key lessons for delivering similar types of programs.

The research is important because although hot water makes up a significant component of most households' energy usage there has been little study of programs designed to increase the uptake of more efficient hot water systems in low-income households.

A detailed Data, Collection and Reporting plan (DCRP) was developed by Monash Sustainability Institute and the Brotherhood of St Laurence prior to program delivery.

The research components of the HEEUP program were undertaken by either Monash Sustainability Institute (MSI) or the Brotherhood of St Laurence Research and Policy Centre (RPC). AGL played an important role facilitating access to data and assisting with data analysis.

The key research questions were:

1. What change in household energy consumption (also costs and greenhouse gas emissions) occurred?
2. What was the optimal level of incentive to facilitate a switch to more efficient systems?
3. Did HEEUP shift participants to purchase more efficient hot water systems?

4 What were the key lessons from the program? In particular, what enabled or impeded program goals?

Along with the HEEUP consortium research, the DIIS commissioned the CSIRO to undertake an study of all the LIEEP programs. Data from HEEUP was provided to the CSIRO in accordance with the terms of the BSL's contract with the DIIS.

Who was involved in implementing HEEUP?

Consortium members

HEEUP was delivered by the Brotherhood of St Laurence and a consortium of groups. The consortium members and their roles are outlined below.

Brotherhood of St Laurence	***The Brotherhood of St Laurence*** led the HEEUP program. The BSL Financial Inclusion team was responsible for all service delivery components, including participant management (recruitment, intake and loans), home visits and data collection, contract and delivery management. The BSL Research and Policy Centre (RPC) was responsible for aspects of the research, managing the relationship with MSI and writing the Annual and Final Reports. RPC also managed the data and transfer to MSI.
AGL Energy in action®	***AGL*** utilised its expertise in customer identification and recruitment and facilitated access to energy data (with full prior informed consent from participants). AGL's Smarter Living team were one of the project's preferred hot water system installers.
MONASH University Monash Sustainability Institute	***Monash Sustainability Institute*** led the analysis of energy bill savings from the hot water upgrades and provided advice and expertise on the data and evaluation components.
NSW GOVERNMENT Office of Environment & Heritage	***NSW Office of Environment and Heritage*** *(NSW OEH)* provided a customised version of their hot water assessment tool, which was used in the initial period of HEEUP to assess the optimal hot water upgrade during home visits with participants.
ATA	***ATA*** provided advice on technical aspects of hot water system upgrades and recruitment strategies.

HEEUP governance

HEEUP was managed by the Brotherhood of St Laurence and overseen by a steering committee made up of two Brotherhood of St Laurence representatives and a representative from each other consortium partner (see Appendix B for the steering committee guidelines). The committee met five times during the set-up and operation of the program.

Community partners and enabling organisations

Along with the consortium members, the HEEUP program engaged with many community partners and businesses. Significant program partners included:

- Good Shepherd Microfinance, which provided the loans oversight and facilitated BSL delivering no interest loans
- Hume City Council, which recruited community members
- Sanden (heat pump supplier), which partnered in community recruitment and supplied the preferred heat pump model
- Envirogroup (heat pump and hot water installer), which partnered in community recruitment and were a preferred heat pump installer
- Apricus (solar hot water installer), which partnered in community based recruitment activity and were a preferred solar and heat pump installer in the final period
- all Victorian energy distribution companies facilitated access to electricity (United Energy, Jemena, Ausnet, Powercor, Citipower) or gas data (Multinet, Envestra and AGP).

HEEUP delivery staff and their roles

The HEEUP delivery staff, located in the BSL financial inclusion team, and their roles are outlined below.

The Energy Engagement Officers (EEOs) visited clients and provided information including the costs and benefits of hot water upgrades and provide NILS financing. EEOs also ensured all the necessary documentation for participation in HEEUP was complete. The number of EEOs fluctuated between one and five according to demand for home visits.

The Intake Officer managed the participant intake process within BSL, responded to enquiries, managed the diaries of the EEOs and oversaw the flow of information between delivery partners. The intake officers also liaised with clients.

The Loans Officer's managed financial data, reporting and record management for the NILS component of the program.

The HEEUP Data Officer ensured the timely delivery of standardised data to MSI for analysis and upload to CSIRO.

The HEEUP Project Manager was responsible for coordination of project functions and components, including delivery staff management, installation partner management, secretariat for Steering Committee, and budget reporting.

What did the HEEUP trial involve?

The key features of the HEEUP trial are outlined below.

Eligibility and verification

Eligibility for HEEUP was broadly defined by the federal government's LIEEP program guidelines, which required a focus on low-income Australian households. Interventions could not be made in public housing. The Brotherhood of St Laurence refined the HEEUP eligibility to require *either* criterion 1 *or* criterion 2:

Criterion 1: Concession card (Pensioner, Health Care, Low Income Health Care or DVA Gold card)

1 Primary eligibility: energy bill holder has a concession card and lives in the house; verification required:

   i. the concession card (same address as the installation)

   ii. the bill from the house

2 Other eligibility: another person living in the home has a concession card (eg. a dependent, partner, housemate); verification required:

   i. the concession card (with the name and the same address where the installation is taking place)

   ii. the bill from the house

Criterion 2: Household income threshold

1 Household Income is below $47,000 (individual) or $87,000 (couple or dependent children); verification:

   i. most recent tax return(s) for an individual/couple

   ii. three months of bank statements

Installation streams

In practice, The HEEUP trial developed into two primary installation streams:

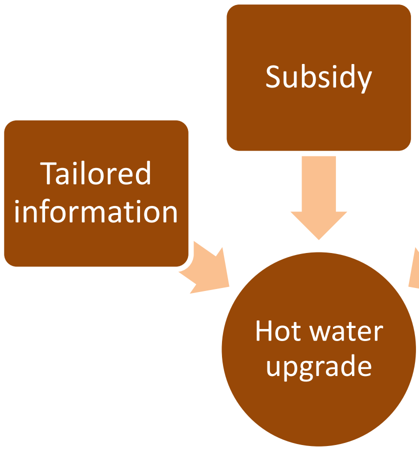
1 **Standard installations** offered to low-income owner occupier households (referred to as owner occupier installations)
2 Installations in rented properties managed by not-for-profit community housing providers (referred to as **community housing installations**).

In addition there was a limited offer of emergency upgrades to customers who called AGL's call centre needing an **emergency replacement**. Also, there was a small number of **independent installations** were included. In effect there were four installation streams.

The details of these groups are outlined in the following sections.

HEEUP for owner occupiers

One installation stream was targeted at low-income owner occupier households across greater Melbourne.

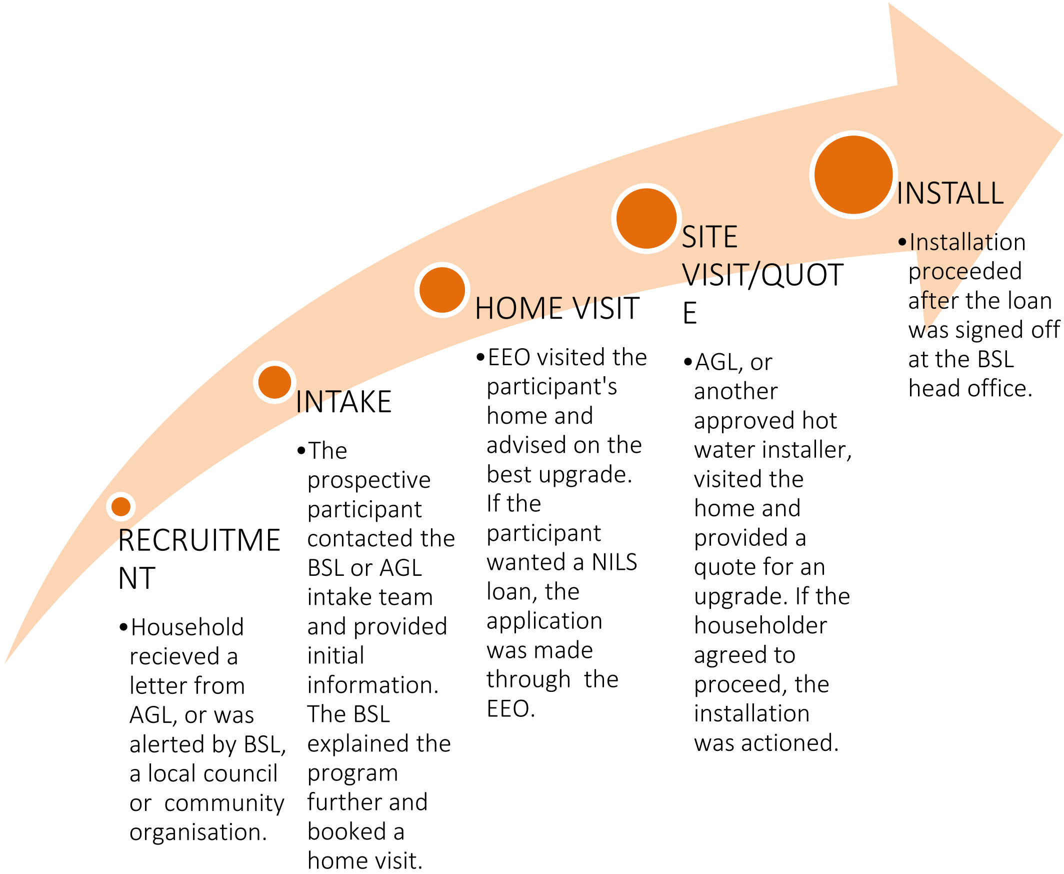


In this stream participating households were provided with:

1 **Information on different hot water upgrade options**, which was designed to assist them to assess the costs and benefits of different systems. The information was provided during a home visit from a HEEUP Energy Engagement Officer.
2 **Access to a No Interest Loan (NILS).** Participants were offered a NILS loan to cover the out-of-pocket express, thereby addressing a cost barrier of upgrading to a new, more efficient system. BSL negotiated a modified NILS loan with a limit of $2,000 rather than the usual $1,200.
3 **A subsidy towards the cost of the new hot water system.** The subsidy was tapered, with the highest support given to higher cost, more efficient upgrades: solar systems or heat pumps, followed by instantaneous gas, and the lowest subsidies given to gas storage systems. Details on the subsidy are provided in Table 1.

Box 1: HEEUP participant's journey

A simplified version of a HEEUP owner occupier participant's journey is outlined below. At each stage HEEUP or partner organisation staff would seek to engage HEEUP participants and streamline the process, while providing high quality and accurate information.



Information provided to participating households

The information in the home visit focused on upgrading to a more productive hot water system rather than behavioural advice on energy conservation. This reflected a program desire to isolate, as much as possible, the energy savings made from the hot water upgrade, rather than behavioural changes.

Hot water tool (HWT) advice

During the initial period (until February 2015) participants received advice based on a computerised hot water tool created by the NSW Office of Environment and Heritage. The tool used information on the household's appliances and water usage pattern, combined with algorithms around hot water consumption of different appliances, to provide a tailored set of recommendations on the costs and benefits of different upgrades. These recommendations were provided in a letter (see Appendix A), which in most cases was printed on the spot and given to the participant.

Energy engagement officers' verbal advice

Later in the program, to speed up the process, advice was provided by the EEOs without using the hot water tool. The EEOs provided direct, less formal advice on upgrades based on a short interview and the likely costs and benefits of the different options.

Hot water systems and subsidies on offer

HEEUP provided variable subsidies to assist households upgrade to their preferred more efficient hot water system. During the program there was a series of changes to the subsidies, including the types of hot water systems subsidised, the amount of the subsidy, and the nature of the subsidy (see Table 1). The primary differences were:

1. **Hot water systems on offer:** the inclusion of gas storage (4.3 star rating or better) from September 2014 and of heat pumps from February 2015. The addition of heat pumps reflected an interest in other efficient hot water products. Gas storage systems were added to provide some assistance to participants who were adamant a gas storage system was for them.
2. **Nature of the subsidy:** changes between a fixed out-of-pocket expense for the household (for example, $1,200 in the HESS period), to a fixed subsidy with a variable out-of-pocket expense (BSL 1 fixed subsidy and BSL 2 fixed subsidy), and finally a maximum out-of-pocket expense (BSL 3). Changes to the nature of the subsidy reflected both external factors (notably the closure of the HESS program) and the program management team's interest in trialling different approaches to increasing conversion rates.
3. **Changes to the amount of the subsidy:** Changes in the amount of the subsidy also reflected external factors and the program management team's interest in trialling different subsidy levels and approaches to increase the conversion rates.

Table 1: HEEUP program subsidies and out-of-pocket expenses, by date

Name	Period	Out-of-pocket	Subsidy
HESS program subsidy	1 Apr to 30 Jun 2014	Fixed amount	Variable
Solar gas boosted		$1,200	Variable
Solar electric boosted		$1,200	Variable
Instantaneous gas		$1,200	Variable
BSL 1 Fixed subsidy	1 Sep 2014 to 8 Feb 2015	Variable	Fixed
Solar gas boosted		Variable	$2,000
Solar electric boosted		Variable	$2,000

Instantaneous gas		Variable	$500
Gas storage		Variable	$150
BSL 2 Fixed subsidy	9 Feb to 30 Apr 2015	Variable	Fixed
Solar gas boosted		Variable	$2,500
Solar electric boosted		Variable	$2,500
Heat pump		Variable	$2,000
Instantaneous gas		Variable	$500
Gas storage		Variable	$350
BSL 3 Variable **subsidy**	1 May to 18 Dec 2015	Maximum	Variable
Solar gas boosted		$2,000	Variable
Solar electric boosted		$2,000	Variable
Heat pump		$1,800	Variable
Instantaneous gas		$2,000	Variable
Gas storage		$1,200	Variable

Recruitment

Recruitment for standard installations used a variety of methods. Table 2 shows the number of installations and the number of expressions of interest from each recruitment source. Over 70% of the households who installed a hot water system were recruited through AGL. The data comes from HEEUP administrative data.

Table 2: Primary recruitment channels, expressions of interest and installations

EOI source	Description	EoIs	Installations
AGL	Mail-outs to concession clients	1558	392
EnviroGroup	Solar installer contacts with clients	82	54
Word of mouth	Primarily referrals from other clients	54	29
Apricus	Regional visits	30	25
Hume City Council	Community based recruitment by council	67	19
New Gen Solar	Solar installers contacts with clients	10	10
Western Water	Water leaks identified in hot water systems	3	3
BSL	Inquiries direct to the BSL	3	1

No source recorded	Including Sanden recruitment	379	15
All owner occupiers		**2172**	**548**

Note: In addition, community housing providers yielded EoIs for 232 homes and 176 installations

AGL recruitment

AGL was the primary recruitment channel for the owner occupier participants in HEEUP. Their main recruitment method was a series of mail outs to their concession card holding clients. Mail out numbers and areas are detailed in Table 3. The approach letter (see Appendix A for an example) was designed collaboratively by AGL and the BSL.

Table 3: AGL mailouts, date, number and area

Date	Area	Number
Jul-14	Mornington Peninsula (including Frankston)	4000
Sep-14	Melbourne North West, North East	14000
Nov-14	Melbourne West, Outer East, South East	50000
Aug-15	Melbourne South, South East, North West, North East	55000
Total		123,000

Hume City Council

Hume City Council promoted HEEUP through mail-outs and stalls at community events. The mail outs included:

1. 10,000 letters from the Mayor of Hume to all ratepayers
2. Emails to Hume City Council environment lists

Sanden heat pumps

Sanden heat pump supplier and the BSL undertook recruitment via a series of local newspaper advertisements (see Appendix A).

Revisiting the HEEUP database – November 2015

As the program drew to a close, 1222 households that had expressed interest in the program (by phone, letter or email) following a letter from AGL but had not decided to install a system were recontacted. A follow-up letter from BSL, marked with the BSL and DIIS logos, was posted to all these households in early November 2015. The letter included a bold red circle advising that HEEUP was to close on 22 November, and that if they were interested in upgrading their hot water service they should contact BSL before then. This reminder letter to a 'warm' audience produced a response rate around 10%; and around 50% of the respondents progressed to installation.

Regional information seminars

In cooperation with Apricus and EnviroGroup, three information seminars were convened in regional Victoria (Shepparton, Bendigo and Castlemaine). The events featured the promotion of a special deal on Apricus solar systems. The third event in Castlemaine involved more advertising resources and attracted 15 participants, most of whom signed up on the day.

Word of mouth referrals were also generated from the Castlemaine information session and there was a good uptake in the Castlemaine area subsequently. The area may also have a higher general awareness of the benefits of solar.

Conversion rate of EoIs to hot water installations

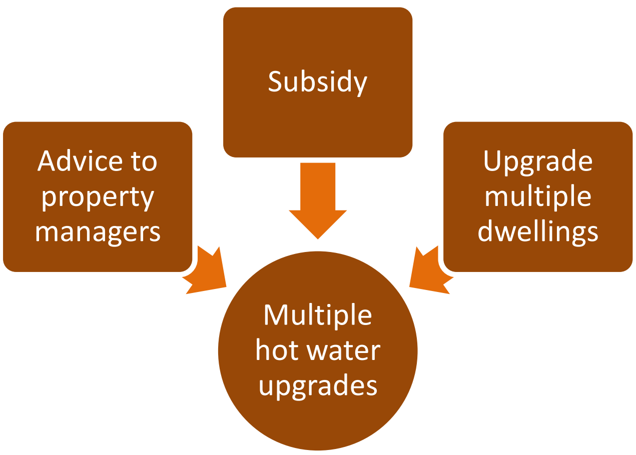
While a close analysis of the conversion rate of EoIs to installations for all sources listed above is not possible due to different approaches used in collecting data, the conversion rates of EoI into installations for the main channels that approach the BSL or AGL directly (AGL, Hume and word of mouth) are instructive:

- 25% of EoIs from AGL recruitment channels resulted in installations
- 28% of EoIs from Hume recruitment channels resulted in installations
- 54% of EoIs who approached the program as a result of word of mouth referrals resulted in installations

Community housing

The community housing stream begun in early 2015 had two main distinguishing features:

1 **Direct engagement with property managers**, which was focused on logistics rather than detailed energy efficiency advice
2 A fixed subsidy of $1100 for hot water upgrades



Engaging community housing providers

Email was the primary channel used to recruit community housing providers. Initial emails outlining a prospective partnership were followed by phone conversations and in person meetings.

By April 2015 preliminary agreements had been achieved with both Housing Choices Australia and Community Housing Limited, and both these resulted in installations commencing before 30 June 2015. In the second half of 2015 the BSL promoted the HEEUP opportunity to other community housing providers, again through email and telephone calls.

There was a consistent $1100 subsidy per installation. Limited verbal encouragement was given to the providers to upgrade to the most efficient hot water system possible.

Interest in partnering with BSL accelerated in late 2015. The Community Housing Federation of Victoria sent an email to all of their members and also word spread via the sector's networks.

By the closure of HEEUP, 11 community housing organisations had partnered with the BSL (Table 4. These partnerships resulted in 176 hot water upgrades. Five organisations installed systems in more than 10 dwellings and two organisations account for over 50% of all community housing installations.

Table 4: Community housing installations by provider

Community housing provider	Number of hot water installations
CH 1	61
CH 2	33
CH 3	21
CH 4	20
CH 5	14
CH 6	8
CH 7	7
CH 8	6
CH 9	3
CH 10	2
CH 11	1

Engaging community housing tenants

After the housing provider identified a property they wished to include in the HEEUP offer, the tenants would be asked if they wished to participate and informed of the conditions: that the housing provider paid for the upgrade, but that they would need to agree to an interview and share some data with the Commonwealth. All tenants were offered a $50 Coles Myer gift voucher for their interview. A BSL Energy Engagement Officer would subsequently contact the tenant and arrange a time to visit and conduct the interview. Where a tenant declined to participate, the provider would not nominate the property for an upgrade.

In some regional locations, to create efficiencies in delivery, BSL adopted a remote survey model: the community housing provider explained the purpose of the survey to the tenants and BSL then sent the survey by email or post.

Who HEEUP assisted, when and how

The HEEUP participants

This section provides key information on the households that installed hot water systems under HEEUP (owner occupiers and community housing tenants)[1]. Appendix E: Demographic and dwelling data provides full demographic, dwelling, energy and hot water information, as wells as disaggregated data for each of the main installation streams: standard, community housing, emergency replacements and independent installations).

Hot water system

- 81.5% had a hot water system over 9 years old (those with systems under 9 years old were often unhappy with its performance and seeking a change for financial or environmental benefits)
- 9.2% of households had a controlled load electric hot water system (that is, a system on a discrete circuit with a lower rate, sometimes called off-peak)

Energy source

- 85% had electricity and natural gas
- 11.6% were electricity only (no natural gas)
- 24% of homes had rooftop photo voltaic

Household income

- 72.2% of participating households had an income below $52,000 per annum
- 88.1% had an income below $78,000 per annum

[1] Data was missing for some households on some items (see details in Appendix E: Demographic and dwelling data)

Tenure

- 56.2% of participants owned their home outright
- 16.9% owned their home with a mortgage
- 21.7% rented their home; all of these were in community housing

Ages of homes

- 69% of homes were over 30 years old

Aboriginal and Torres Strait Islander participants

- 1.3% of participants (10) identified as Aboriginal or Torres Strait Islander people

Employment status

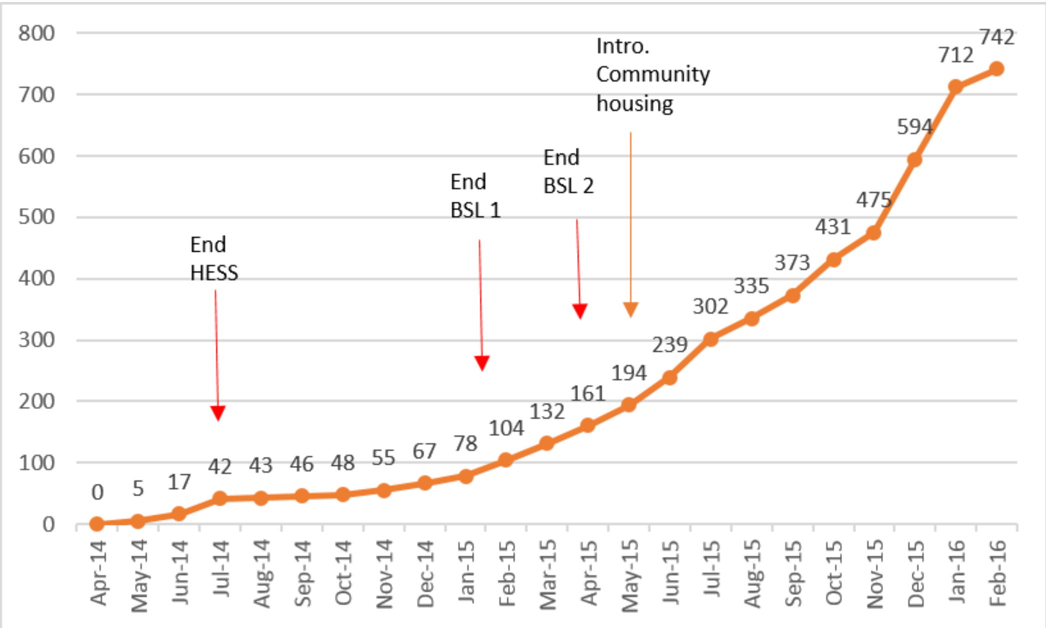
- 62% of HEEUP participants were not in the labour force
- 13% were employed working full time (3.1%) or part time (10.1%)
    - 9.6% were unable to work
    - 5% were engaged in unpaid work (care/home duties)

Timeline of HEEUP installations

Timeline of all installations

As shown in Figure 1, HEEUP program installations began slowly. A brief period of activity under the HESS subsidy (May – end June 2014) was followed by a three-month hiatus. By February 2015 installations had increased slightly, but numbered just 104. In the 12 months from February 2015 over 650 systems were installed.

Figure 1: Cumulative HEEUP installations, all types*



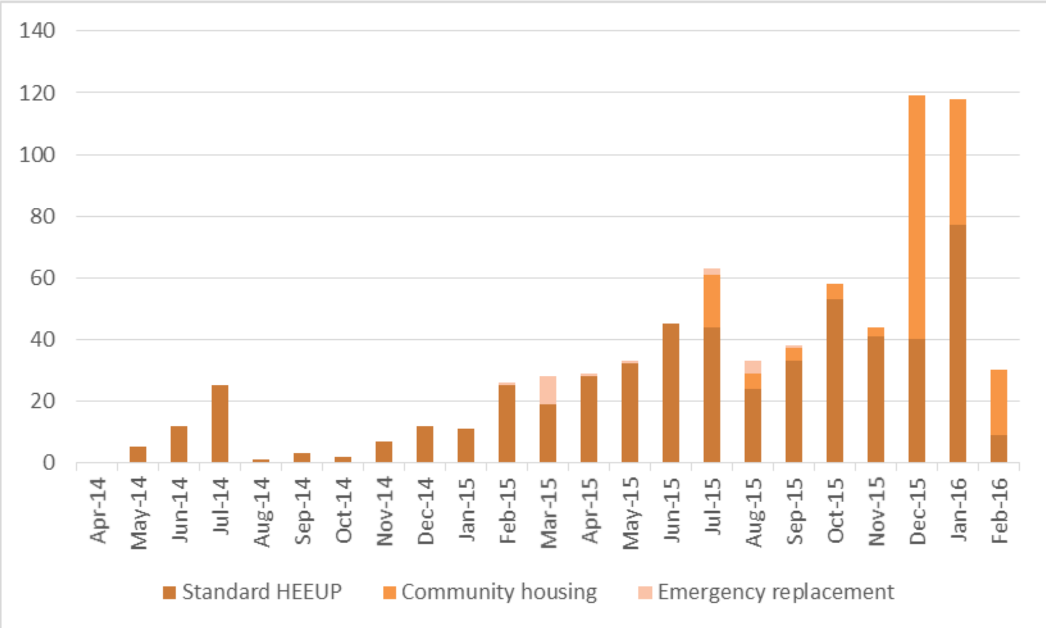
Notes: n=742. * Independent installations omitted due to a large number of unknown dates, other undated installs also omitted

The HEEUP installation timeline illustrates significant shifts in trajectory over the course of the program. Notable points from the trajectory include:

- acceleration over time
- changing momentum aligned with recruitment activity and changes in the subsidy mix and presentation
- increased activity later in the program with the introduction of the community housing recruitment channel and the final subsidy formulation.

Owner occupier HEEUP installations dominated the installation trajectory until November 2015 (Figure 2). Community housing installations came online from March 2015; however their monthly peaks were in December 2015 and January 2016 as providers sought to finalise their installation pledges before the closure of the program.

Figure 2: HEEUP installations by stream and per month



Notes: n=742. * Independent installations omitted due to a large number of unknown dates, other undated installs also omitted

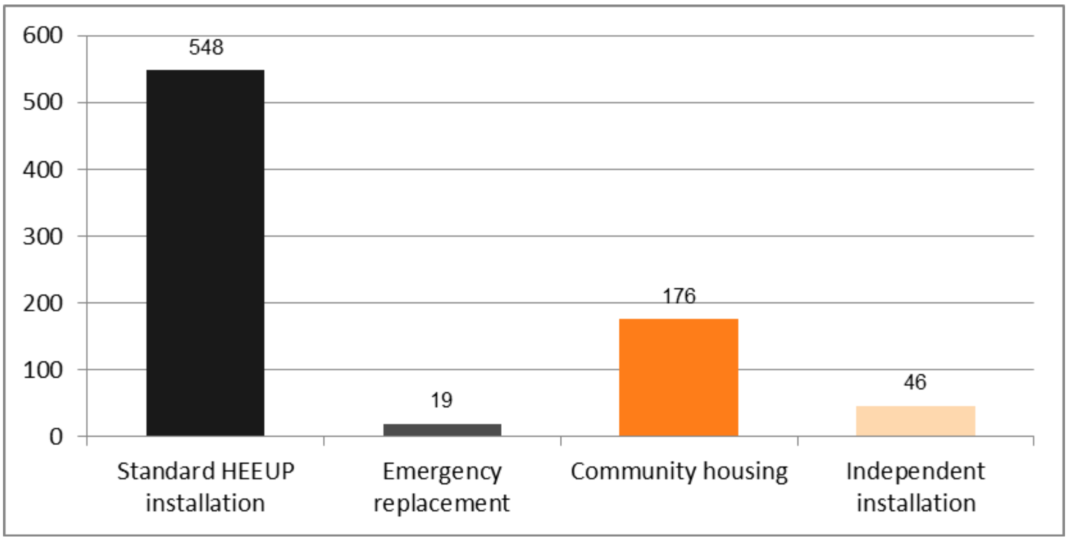
HEEUP's installation geography

HEEUP's standard installations were concentrated in Greater Melbourne and the Mornington Peninsula. A breakdown of all installations by postcode is provided in Appendix E.

HEEUP by installation stream

Installations for owner occupiers (standard HEEUP installations) were the primary HEEUP activity stream (70.71% of all installations). Community housing accounted for 22.71% of all installations under the program.

Figure 3: HEEUP installations by primary activity streams

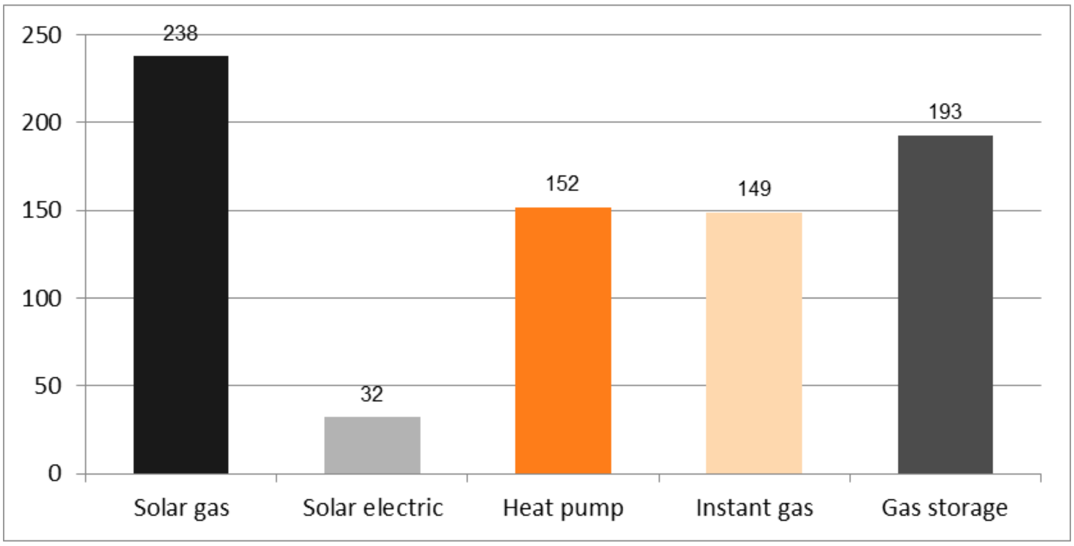


N=789

Types of installations

Solar with a gas booster was the predominant system installed (31%), followed by gas storage (25.3%), heat pump (19.9%), instant gas (19.5%) and solar electric (4.2%).

Figure 4: Types of hot water systems installed – all activity streams

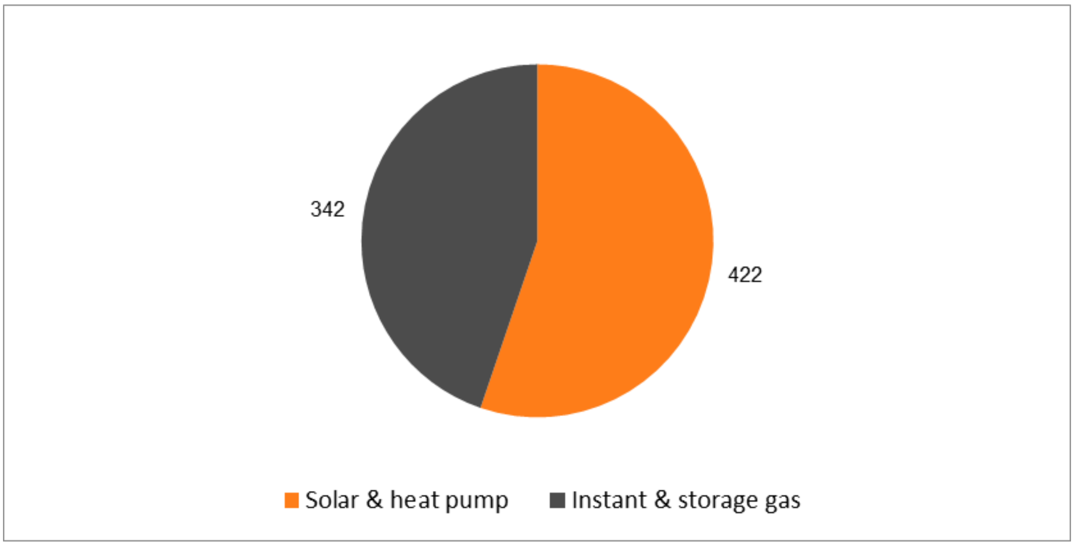


n=764 . Excludes missing data

When grouped together the more efficient systems – solar gas or electric and heat pump – make up 55% of all installations, while instant gas and gas storage make up 45%.

As shown below these figures mask substantial differences in installation types by activity stream.

Figure 5: Major installation groups



n=764

The type of hot water system installed varied across the installation groups as shown in Figure 6. The standard HEEUP installation group had the highest proportion of the highly efficient systems installed (69%), followed by community housing (29%). Table 5 provides details on the hot water systems installed.

Figure 6: Installation type by stream

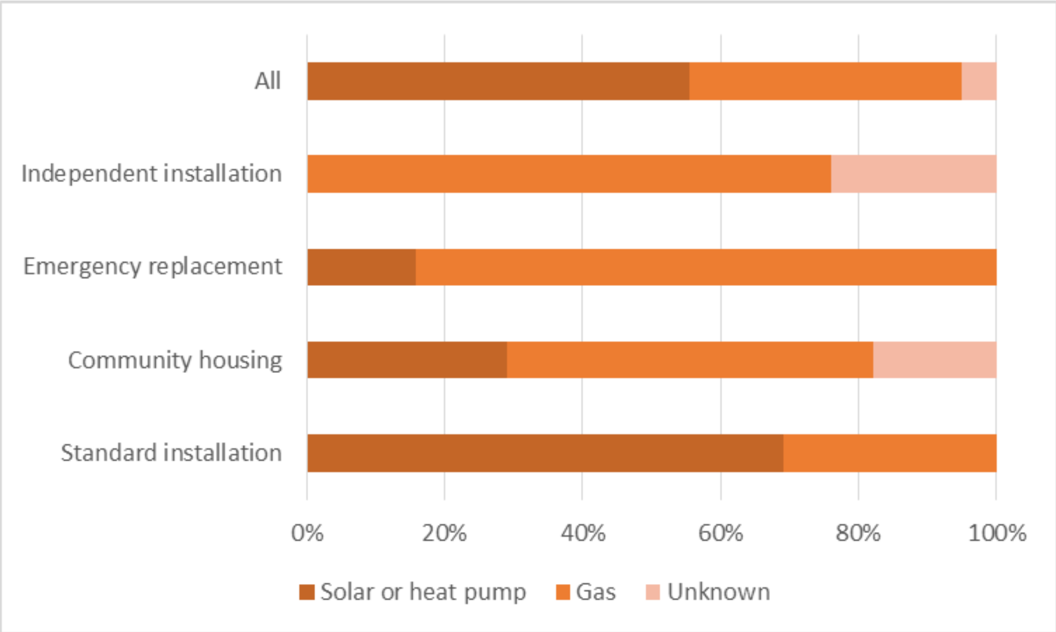


Table 5: Installed hot water systems by installation group – number and percentage

	Standard installation		Community housing		Emergency replacement		Independent installation	
	No.	%	No.	%	No.	%	No.	%
Solar gas or solar electric	251	47%	9	5%	3	16%	0	0%
Heat pump	120	22%	35	23%	0	0%	0	0%
Instant gas	104	19%	39	25%	5	26%	4	9%
Gas storage	61	11%	41	27%	11	58%	31	67%
Unknown	0	0%	27	17%	0	0%	11	24%
Total	536	100%	151	100%	19	100%	0	0%

Hot water systems and upgrade pathways

Natural gas storage was the most prevalent existing system across all participants and the major installation streams, followed by electric storage and natural gas instantaneous.

Figure 7: Existing hot water systems – prior to participation in HEEUP

	All participants		Standard HEEUP installations		Community housing	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Natural gas (storage tank)	430	56.3	306	57.6	80	46.8
Electric storage (off-peak tariff)	159	20.8	109	20.5	44	25.7
Natural gas (instantaneous)	85	11.1	47	8.9	32	18.7
Electric storage (continuous tariff)	22	2.9	16	3.0	7	2.3
Solar (electric boosted)	11	1.4	10	1.9	1	0.6
Gas unspecified	9	1.2	8	1.5	1	0
Solar (gas boosted)	9	1.2	7	1.3	1	0.6
LPG (instantaneous)	6	0.8	5	0.9	1	0.6
Electric (instantaneous)	4	0.5	3	0.6	0	0.6
Gas storage	3	0.4	3	0.6	0	0.0
Electric unspecified	2	0.3	2	0.4	0	0.0
Electric storage unspecified	2	0.3	2	0.4	0	0.0
Solar (wood boosted)	1	0.1	1	0.2	0	0.0
Missing	21	2.7	12	2.3	4	4.1
Total	764	100.0	531	100.0	171	100.0

Figure 8: Upgrade pathways – All participants (categories with 5 or more installs)

Old hot water system	Hot water system upgrade	Frequency	Percent
Natural gas (storage tank)	Solar gas	163	21.3
Natural gas (storage tank)	Gas storage	147	19.2
Electric Storage (off-peak tariff)	Heat pump	76	9.9
Natural gas (storage tank)	Instant gas	65	8.5
Natural gas (storage tank)	Heat pump	51	6.7
Natural gas (instantaneous)	Instant gas	41	5.4
Electric storage (off-peak tariff)	Instant gas	29	3.8
Natural gas (instantaneous)	Solar gas	25	3.3
Electric storage (off-peak tariff)	Solar gas	19	2.5
Electric Storage (off-peak tariff)	Solar electric	18	2.4
Electric Storage (off-peak tariff)	Gas storage	17	2.2
Natural gas (instantaneous)	Gas storage	11	1.4
Missing information on old system	Gas storage	8	1.0
Missing information on old system	Solar gas	8	1.0
Natural gas (instantaneous)	Heat pump	8	1.0
Solar (gas boosted)	Solar gas	7	0.9
Electric storage (continuous tariff)	Heat pump	6	0.8
Electric storage (continuous tariff)	Instant gas	6	0.8
Electric storage (continuous tariff)	Solar electric	5	0.7

Figure 9: Upgrade pathways – Owner occupier installations (5 or more installs)

Old hot water system	Hot water system upgrade	Frequency	Percent
Natural gas (storage tank)	Solar gas	157	29.6
Electric storage (off-peak tariff)	Heat pump	50	9.4
Natural gas (storage tank)	Gas storage	50	9.4
Natural gas (storage tank)	Instant gas	49	9.2
Natural gas (storage tank)	Heat pump	46	8.7
Electric storage (off-peak tariff)	Instant gas	25	4.7
Natural gas (instantaneous)	Solar gas	22	4.1
Electric storage (off-peak tariff)	Solar gas	18	3.4
Natural gas (instantaneous)	Instant gas	16	3.0
Electric storage (off-peak tariff)	Solar electric	14	2.6
Missing information on old system	Solar gas	8	1.5
Natural gas (instantaneous)	Heat pump	8	1.5
Solar (gas boosted)	Solar gas	7	1.3
Electric storage (continuous tariff)	Instant gas	5	0.9

Figure 10: Upgrade pathways – Community housing (5 or more installs)

Old hot water system	Hot water system upgrade	Frequency	Percent
Natural gas (storage tank)	Gas storage	54	31.6
Electric storage (off-peak tariff)	Heat pump	26	15.2
Natural gas (instantaneous)	Instant gas	21	12.3
Natural gas (storage tank)	Instant gas	16	9.4
Electric storage (off-peak tariff)	Gas storage	12	7.0
Natural gas (instantaneous)	Gas storage	9	5.3
Missing information on old hot water system	Gas storage	6	3.5
Natural gas (storage tank)	Heat pump	5	2.9
Natural gas (storage tank)	Solar gas	5	2.9

2 What was the effect of HEEUP on household electricity and gas consumption?

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Summary of results

The results of overall pre-post intervention comparisons for the daily electricity and gas consumption measures (not including pathways involving a fuel change) indicated a highly significant decrease in electricity and gas consumption. These decreases of 25% (2.09 kWh per day) and 7% (7.63 MJ per day) for electricity and gas respectively are of practical (as well as statistical) significance give an annual reduction of 762 KWh ($213.46) for electricity consumption and 2,787 MJ ($55.64) for gas consumption. That is, in overall terms the intervention was successful in producing energy savings.

The upgrade paths yielding significant decreases in daily *electricity consumption* were electric storage to heat pump (29%), electric storage to gas instantaneous (42%), and electric storage to gas solar (41%).

The significant electricity reductions were associated with financial saving equivalent to $244.14 (electric storage to heat pump), $303.89 (electric storage to gas instantaneous), and $295.65 (electric storage to gas solar).

Increased gas assumption associated with upgrading from electric storage to gas instantaneous and to gas solar, was not statistically significant for either of these pathways.

The upgrade paths yielding significant decreases in daily *gas consumption* were gas storage to gas instantaneous (15%) and gas storage to gas solar (13%). These effects correspond to financial savings of $114.45 and $101.96 respectively.

Introduction

The adoption of energy-saving technologies by households is an important part of achieving energy conservation and greenhouse gas targets in Australia. Despite the opportunity to realise significant energy savings, however, oftentimes homeowners are reluctant to take on cost intensive energy efficiency investments, such as purchasing a more efficient hot water service (Frondel & Vance, 2013). With this in mind, the National Strategy for Energy Efficiency (Council of Australian Governments, 2010) seeks to increase the up-take of low emission hot water services in Australian households through public education, financial incentives and reducing barriers that may hinder households buying and installing these technologies. Steps toward this end are described in the commissioned report entitled *Investigation of Deemed Savings for Residential Activities in a Possible National Energy Savings Initiative* (EnergyConsult, 2012) which details the expected energy savings from a range of technology upgrades. Further, over the last 10 years, the Australian Government has funded the trial and evaluation of energy-saving interventions using a range of approaches including replacing inefficient water heaters with new, energy efficient solar or heat pump models (e.g. Alice Solar City, 2013; Lynch et al., 2013; 2013; Perth Solar City, 2012; Solar City Adelaide, 2013).

One of the barriers to household investments in energy efficiency has been the financial cost of energy saving technologies especially for low-income households. The HEEUP project was designed to address this significant barrier head on by providing households with tailored information and advice on the financial costs and benefits of a hot water upgrade and by providing households with access to funds through a number of financial mechanisms. Therefore, the behaviour change focus of HEEUP was primarily on energy consumers' decisions to purchase and install a new, energy efficient hot water service. From this strategy of persuading householders to upgrade their inefficient water heating systems, energy savings should result from the improved efficiency of new, replacement technology.[2]

Research aims and research questions

The objectives of this section of the report is to assess the magnitude of any change in household energy consumption that is attributable to the hot water service upgrades, and to identify specific types of hot water service upgrades that contribute to energy savings. The following sections describe the evaluation methodology employed to assess the change in energy consumption in HEEUP and the data analysis strategy employed to test for significant decreases in energy consumption over time as a function of the intervention. The results of the data analysis are discussed in the final section of the report. This analysis addresses the following questions:

[2] This report details an evaluation of the effect of the hot water service installations on household energy consumption and not the effectiveness of the program on consumer decision-making regarding the purchase and installation of new, energy efficient water heating technology.

1. What, if any, change in household energy consumption results from the hot water service upgrades?
2. What, if any, change in household energy consumption results from specific types of hot water service upgrades?
3. What variables explain any change from pre-intervention consumption to post-intervention consumption?

Selected previous research

Installing technology upgrades in households to produce energy conservation has been trialled in other contexts (see Abrahamse et al., 2005, for a review of these studies). However, there have not been a large number of experimental trials in the behavioural sciences that evaluate the effectiveness of replacing inefficient hot water services with more efficient technologies. Rather, research employing regression techniques has identified various technologies as more or less consequential for energy demand. For example, one recent study on the drivers of household energy consumption in NSW identified technologies such as pool pumps, moderate to high use of clothes dryers, and the use of ducted air conditioning as significant contributors to average daily electricity demand (Fan, MacGill & Sproul, 2015). Having a gas hot water service, on the other hand, was associated with significantly lower demand for electricity, even after controlling for the presence of a gas connection in the household.

Other examples of research focused on the impact of water heating on consumption and conservation have studied the potential savings that might accrue from energy efficient water heating technologies but without much attention afforded human factors in the use of these innovations (DEDJTR, 2015; EnergyConsult, 2012; Huang & Lee, 2004; Moreland Energy Foundation Limited, 2010; Nekså et al. 1998). These documents tend to identify heat pumps and solar (gas and electric boosted) solutions as the technology producing the biggest energy savings, especially when replacing electric storage units or inefficient gas systems (i.e. below 5 star). These replacement options can save around 30 to 35 MJ per day on average.

The Australian Government has funded a number of energy efficiency trials, some of which included installation of solar hot water systems and/or heat pumps (DERT, 2013; Sayeef et al., 2013). A number of these programs demonstrated significant energy savings. For example, in their report of the Solar Cities program, the CSIRO cites average daily savings of 0.7 (3.2%) and 1.7kWh (7%) following solar water heating installations in Perth and Alice Springs respectively (Sayeefet al., 2013). However, these results seem to ignore the type of existing technology in place.

The Perth Solar City (2012) project installed mostly electric boosted solar hot water systems in 1151 households (having a modal income of between $50,000 and $100,000 per year). In 911 households, solar systems were installed to replace existing water heating devices and the largest percentage of these was gas storage systems (45%). In other households, the existing systems were electric storage (32%), gas instantaneous

(17%), and electric instantaneous (6%). The evaluation for the effect of the solar water heating replacements was conducted on 235 households that had an existing storage or instantaneous electric system. In their report, Perth Solar City (2012) stated that, where an electric storage or instantaneous system was replaced with a solar water heating system (with electric booster), households decreased their electricity consumption by an average of 18.2% per day compared with a comparison group of households.[3] Analyses involving other combinations of existing systems were not reported and therefore it is not possible to know what, if any, statistically significant gas savings were associated with shifting from gas systems to solar hot water.

The Alice Springs Solar City report (Alice Solar City, 2013) installed solar hot water systems (mostly electric boosted) and heat pumps over a four year period. The majority (61.9%) of installations replaced existing solar systems, while electric storage (23.0%), gas storage (10.6%) and gas instantaneous (4.5%) made up the remainder of systems already in place. The authors of the report observed energy savings that varied with the type of existing technology that was replaced by the new solar water heater. There figures (based on a subsample of 504 owner occupiers) suggested an annual saving of 16.7% (4.27kWh/day on average) and 11.1% (3.01 kWh) depending upon whether an electric storage system was replaced or an existing solar system.[4]

Lynch et al. (2013) evaluated the Central Victorian Solar Cities energy efficiency program in which some households were fitted with 1.5kW solar hot water systems while other households received one of a number of alternatives (e.g. a home energy audit, retrofits such as curtains and pelmets, photovoltaics, in-home display). The combination of interventions resulted in a 13% reduction in average daily energy consumption when compared with a matched control. However, the solar water heater replacement intervention involving 65 households resulted in the greatest savings. The researchers reported that shifting to solar decreased electricity consumption by 22% (or 4.84 kWh/day on average) relative to a matched control group. In 77% of these households, the solar systems replaced electric hot water systems.

The brief overview of selected energy efficiency trials in Australia above brings to the fore the conclusion that technology upgrades will not produce the same outcomes for energy efficiency in all applications. The type of existing technology being replaced, the magnitude of pre-intervention daily consumption, how energy is used in households across different regions and population, the type of data management and analysis procedures brought to bear, can all have a bearing on the savings observed. In trials were water heating technology has been used in everyday situations suggest that program induced savings can range from anywhere from between 3% and 18% depending upon a range of study-specific factors.

[3] Levels of statistical significance were not reported.
[4] Levels of statistical significance were not reported.

There are also factors that can limit the optimal performance of water heating technologies. These are described in the following section.

Limits to technology-driven efficiency

Rebound effects

It was reported by the Department of Climate Change and Energy Efficiency that households with a modern solar hot water system generally save 1.5–2 kilowatt-hours (kWh) per day on hot water-related energy costs when compared with traditional hot water systems. However, the preceding discussion illustrates that savings are variable, which may be partly due to the different analyses undertaken by each solar city and the CSIRO.

Furthermore, it turns out that the introduction of energy saving technology into a household can change energy consumption behaviours in unintended ways that serve to limit the potential savings that might be expected from the upgrade. The dependency between the performance of water heating technologies and how they are used in households explains the gap between their performance 'on paper' and their usually less than expected performance in-situ. The reason for this gap is usually attributed to the operation of 'rebound' or 'takeback' effects by which the introduction of energy efficient technologies results in a cost reduction and an associated increase in consumption (Berkhout et al. 2000; Greening, Greene, & Difiglio, 2000). Put another way, individuals 'spend' the savings resulting from the installation of an energy efficient water heater. Rebound effects can take the following form in households:

- Direct rebound effects whereby the use of energy increases as a result of increases in efficiency (e.g. installing an energy efficient hot water service, but using more hot water).
- Indirect rebound effects whereby the decrease in the cost of energy services means that households have more money to spend on other energy consuming goods and services (e.g. installing an energy efficient hot water service, but running space heating at a higher temperature).

Research on the existence and size of rebound effects is contested, but most studies suggest that some degree of takeback is likely to occur. Some researchers have concluded that the size of the effect can constitute up to 30% of the achievable energy savings (Chitnis et al., 2014; Dimitropoulos, 2007). For heating and hot water services, there is evidence that the direct effect may be much larger, especially for households that have electricity as their only source of energy (Gálvez et al., 2015). Furthermore, current evidence indicates that the largest rebound effects are associated with activities undertaken by low-income households (Milne & Boardman, 2000; Chitnis et al., 2014).

Installation, operation and breakdowns

The Alice Solar City project discovered a faulty valve in the Over Temperature Protection system resulting in the over use of the electric booster. The fault was estimated to exist in 230 systems after installation. A faulty electric boost solar hot water system can have similar energy use to an electric storage system. One of the 'transferable lessons' arising from the Alice Springs Solar Cities (2013) project was that 'Pilot installations of new technologies with careful monitoring is therefore worth considering in similar programs, even for modifications to well understood products' (p.54) . (The DCCEE (2010) describe a number of other operating and installation issues that can reduce the efficiency of solar water heating systems.)

The quality of the installation of energy efficiency technologies also influences their performance. According to Sayeef et al. (2013) solar water heating systems have variable performance because they depend upon exposure to sunlight. The installation of energy efficient technologies such as solar water heating systems and heat pumps is critical to their performance. For example, the orientation of the roof of the dwelling determines the direction in which the solar collectors should face. When incorrectly installed the overnight booster will be over-used to compensate for cooler afternoon solar heating.

The correct operation of energy efficiency can also be important to optimal performance. Where solar systems are concerned, hot water is best used in the morning hours so that water can be heated during the day and stored overnight. Inefficiencies occur if water is being used in the late afternoon and evening because the booster will be required to heat the water rather than the sun.

Environmental factors

The context in which new energy efficient technologies operate has an influence on the optimal performance. Heat pumps, solar hot water systems and storage systems are all sensitive to some extent to factors such as climate. For example, the DCCEE (2010) advise that the performance of heat pumps is best when used in areas having suitable climate conditions:

Heat pumps work most efficiently in warm, humid climates. They are not suited for installation outdoors in cold climates and where regular freezing or very cold and dry conditions are experienced. Some heat pumps are manufactured to work more effectively during brief frost conditions but they will cost more to run in these conditions and are not recommended for use in prolonged cold periods. Note that some heat pumps may require an electric booster element if operated in regions where it is cold. The cost of running a heat pump may increase if it is required to boost during the day when electricity tariffs may be high. (DCCEE, 2010, p.198)

The fact that the performance of energy technologies cannot be generalised in a straightforward manner means that evaluations of their effectiveness must take into account where the evaluation was done and during what time of the year. Therefore, generalising energy efficiency results from trials conducted in northern Australia to the south-eastern part of the country may be misleading.

Methodology

Study participants

Selection

The data for this study comes from a sample of participants in the HEEUP. The 339 households in this study were all the participants with data available up to the 31 October 2015. The entire program delivered a total of 792 hot water upgrades.

Participants were selected to participant in HEEUP using an opt-in process whereby concession card households were approached by mail and invited to receive a subsidised hot water system. A number of strategies were employed to recruit participants for a hot water upgrade. For example, AGL Energy mailed out to concession card-holding customers in selected suburbs having adequate proportions of low-income, owner-occupied households. A small number of participants were also recruited from referrals provided by community service organisations operating in selected communities.

The data for this study was collected from 339 households within the postal areas shown on the map in Figure 11. The postal areas were initially selected using socio-economic indicators for low-income regions in Melbourne however this was subsequently expanded to include higher income regions. The numbers on the map show the number of households sampled within each postal area with darker shades indicating larger samples. Participants resided in areas from across the Melbourne region with larger numbers recruited from areas around Frankston, Chelsea and Mornington in the southeast, Sunbury and Craigieburn in the outer north, and near Glenroy, Coburg and Reservoir in the inner north.

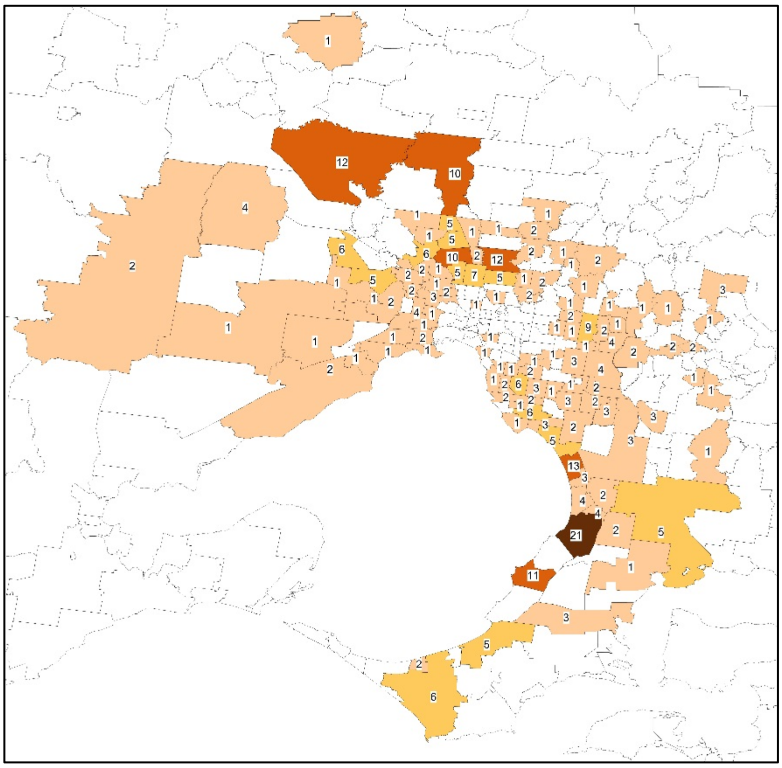

Figure 11: Location and number of intervention households

Household, behavioural, employment and income characteristics

A number of household, appliance, behavioural and demographic variables were collected during the survey stage of the study and these are listed in the tables in Appendix F1 along with their categories, counts and percentages. This data was collected by HEEUP project staff. Behavioural data concerning how hot water is used in the household was collected by the project staff using the hot water tool developed for this project. Not all variables are used in the modelling analysis but they are presented here to more fully characterize the sample profile. A summary of the data relevant to the analyses of 339 households described in this report appears in the following section.

Household characteristics (HHC)

- **Dwelling type (HC_1)**: The majority (75.5%) of dwellings were either detached or semi-detached houses with the remainder being units of varying types. An issue with this factor is that 56% of values are missing which makes it problematic to include in the main analysis as this would severely limit the model's ability to estimate other factor effects.
- **Home ownership (HC_2)**: The majority (95.5%) of homes are owned outright or owned with a mortgage with the remainder being community housing.
- **Home age (HC_3)**: 16.9% of homes were under 20 years old with a significant minority (17.5%) being 60 years or older.

- **Number of residents (HC_4)**: 31.5% of homes were single person households with the majority of homes (90.5%) having 4 or less persons resident.
- **Number of bathrooms (HC_5)**: The majority of households (61.5%) had a single bathroom with the remainder having two or more two bathrooms.
- **Existing household energy source (HC_6):** The great majority (94.5%) of homes were supplied with electricity and natural gas. Only 5% were electricity only households, and a couple of households had LPG gas in addition to electricity and natural gas.
- **Wood energy source (HC_7)**: Only 3.3% of households used wood as an energy source.
- Controlled load electricity (HC_8)

The household component equation for household i is a linear combination of the above items.

$$HHC_i = \sum_{j=1}^{8} h_j HC_{ij}$$

Appliance characteristics (HAC)

- **Existing hot water service tank size (AC_1):** The majority of households (69%) reported a small (160L) tank, 18.6% reported a medium (250L) tank and 12.4% reported having tanks larger than 250L.
- **Age of existing hot water service (AC_2):** Only 10.4% of households reported a HWS less than nine years old with the majority of HWS being much older than this.
- **Washing machine size (AC_3):** Most households (97.7%) have washing machines with capacity of 5kg or more.
- **Rooftop photovoltaics (AC_4)**: 26.5% of dwellings have rooftop PV with the majority (76%) being attached to houses rather than units.

The household component equation for household i is a linear combination of the above items.

$$HAC_i = \sum_{j=1}^{4} a_j AC_{ij}$$

Behavioral characteristics (HBC)

- **Number of weeks unoccupied per year (BC_1)**: Most households (77.8%) reported zero weeks unoccupied with the remainder being typically unoccupied one to four weeks. (No information on when these absences occur)
- **Number of clothes washes per week (BC_2):** Most households (76.3%)) do between 3 and 6 washes per week.

- **Number of showers per week (BC_3):** The most common numbers were 7 (18.7%) and 14 (20.7%) corresponding to one and two person households. I assume households reporting less than 7 shower per week are using alternative bathing regimes. The correlation between number of residents and number of showers is fairly high ($r = 0.7$) which is to be expected.
- **Average shower time (BC_4):** The majority (52.7%) of households reported showers lasting six minutes or less and a significant minority (33.7%) reported showering for between seven and ten minutes. The remaining 13.6% reported showering for ten of more minutes.

The household component equation for household i is a linear combination of the above items.

$$HBC_i = \sum_{j=1}^{4} b_j AC_{ij}$$

Demographic characteristics (HDC)

- **Employment status (DC_1)**: The majority of households (52.4%) answered 'retired' and just 15.9% of households reported at least one employed person.
- **Household income (DC_2)**: The majority of household incomes (68.7%) fall between $400 and $999 per week, which places them lower, and in many cases, much lower than the average disposable household income in 2013–14 of $998 per week reported bythe Australian Bureau of Statistics (2015).
- **Highest education level (DC_3)**: 5.6% of households reported primary, 21.2% reported year 10, 17.1% reported year 12 and the remaining 54.4% reported TAFE or Tertiary as the highest household education level.

The household component equation for household i is a linear combination of the above items.

$$HDC_i = \sum_{j=1}^{4} d_j DC_{ij}$$

Intervention

The home hot water service (HWS) is a major source of household energy consumption. Many households have older inefficient HWS and as such could benefit from upgrading to a more energy efficient appliance. The intervention in this study is some form of HWS upgrade (see later for details of various upgrade paths undertaken).

Project staff engaged with potential participants and, using either the hot water tool or via direct advice, provided participants with tailored information about the financial costs and benefits associated with purchasing and installing a hot water upgrade. The hot water tool, or a survey, enabled the collection of specific information about the participant, the dwelling, the existing hot water service, and how hot water was used in the household. This data was collected by energy engagement officers via personal interview and physical inspection of properties.

Based on the information garnered from the hot water tool, or later in the program from the experience of the EEOs, households were recommended a particular upgrade that best suited their circumstances. However, the upgrade ultimately installed was the option householders preferred irrespective of the output from the hot water tool.

Recruited participants were provided with access to a subsidy to contribute to a proportion of the costs of the hot water upgrade. In addition, participants were offered an interest-free loan through the No Interest Loan Scheme (NILS). These financial services covered the purchase and installation costs of the upgrade they had chosen.

Study design

A stepped wedge design was implemented by which participants are assigned to different intervention times (see the following section for more on this design). In this way, participants who get an intervention later in the study can serve as controls for participants who experienced the intervention earlier. This avoids the need for a separate traditional control group.

Participant data was collected prior to the intervention including variables such as individual resident demographic such as the number of residents (e.g. age, beliefs about energy efficiency) and household variables (e.g. number of residents, age of dwelling). This data was examined to identify individual and household level factors associated with energy consumption over time.

The response data

Gas and electricity energy consumption data was collected at the household level for the period March 2012 to December 2015. The start and finish dates varied somewhat by household but this did not affect the analysis since there was sufficient data pre- and post-intervention for almost all households. Consistent with Rickwood et al. (2012) accumulation energy data obtained from an ongoing meter readings schedule of intervals greater than one month were binned (standardised) to months so as to enable comparisons among households. Smart meter electricity data was also standardised to monthly intervals.

The response data for each household forms a seasonal time series with summer and winter peaks corresponding to changing cooling, heating and lighting requirements of households. As can be seen in the charts in Figure 12 the seasonal variation is quite pronounced during the winter months for gas and electricity. A less obvious feature of the electricity consumption chart is the small summer peaks which are probably due to cooling power usage.

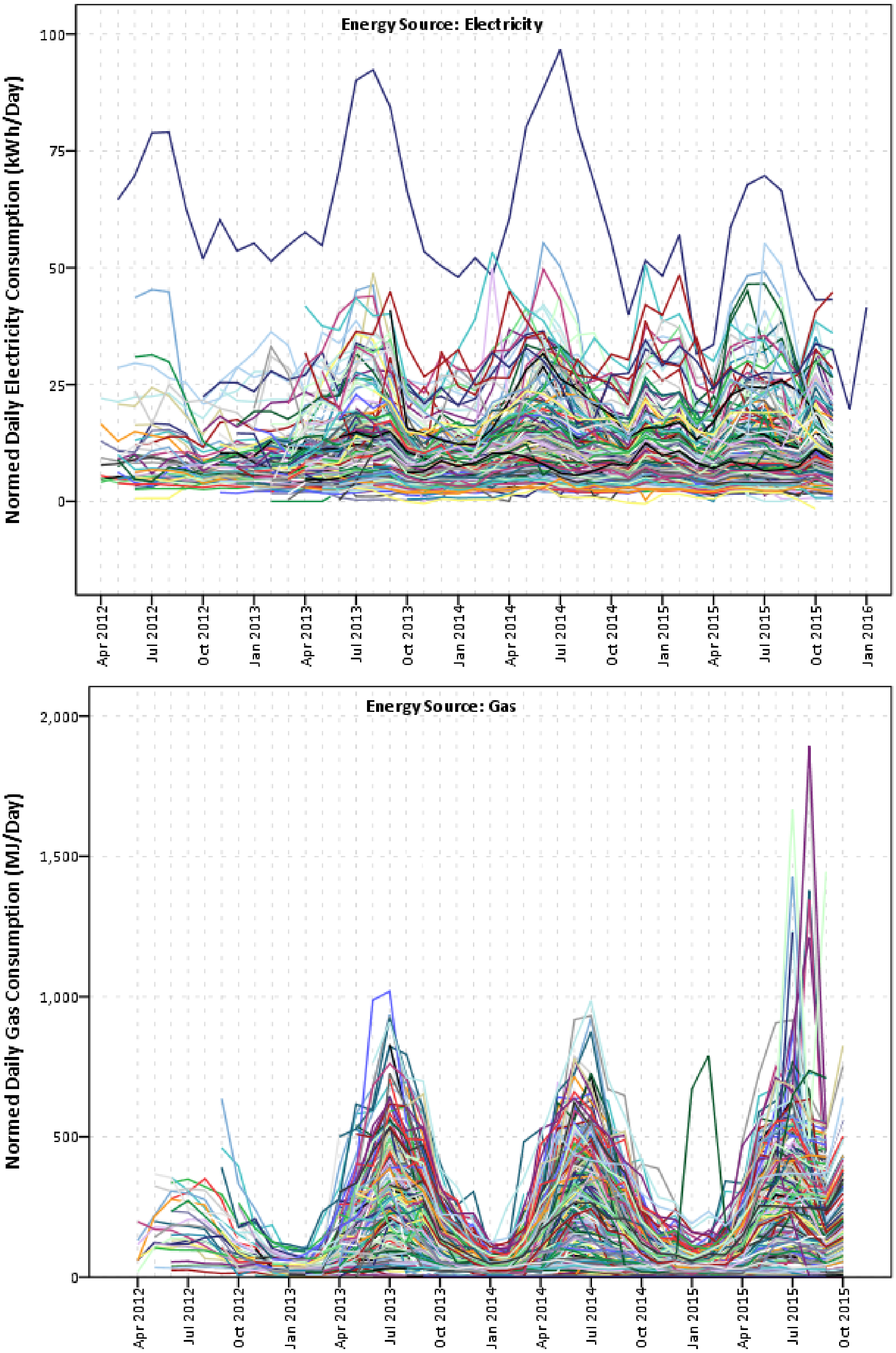

Figure 12 Seasonal variation in energy consumption data

The charts also show some very unusual energy consumption patterns particularly for electricity where a few households consumed well over 50 kWh per day for most of the study period. For gas consumption there are a few unusually large observations during the last winter peak (July 2015). It is unclear why these households have such unusual usage patterns but there are certainly not typical and may bias results and so these households were not included in the analysis.

The stepped wedge design

As it was not feasible to carry out all interventions within a short period (one or two months), and it was difficult to recruit a separate control group[5], a stepped wedge design was used in this study. This design allows for a sequential rollout of the intervention in such a way that households in the pre-intervention stage act as controls for those in the post-intervention stage. The design was first used in the Gambia Hepatitis study (Hall et al., 1987) and is a form of cluster randomized trial design. It has been used with varying levels of success particularly in the health field (see reviews by Mdege, Man, Taylor, and Torgerson, 2011; Brown and Lilford, 2006). Although there a few if any examples in the literature of using a stepped wedge design in household contexts, the Mexican study by Gruber et al. (2013) examined the effect of installing UV-disinfection devices in households on water contamination and its consequences.

Cluster	2012	2013	2014												2015											
	1-12	1-12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1							4																			
2								12																		
3									25																	
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19																									2	
20																										2

Post Intervention
Pre Intervention

Figure 13 The stepped wedge design (numbers on diagonal are the number of households in each cluster (cluster size)).

The design is best illustrated by the grid in Figure 13 where rows index clusters and columns index time. Data collection started in early 2012 and continued until December 2015. All households were initially in the pre-intervention control stage. The first

[5] A separate control group would need data on all demographic variables collected for the intervention group not just the energy consumption data.

intervention occurred in May 2014 when the 4 households in Cluster 1 received their upgrades/retrofits. From June 2014, these households were in the post-intervention stage while clusters still in the pre-intervention stage acted as controls for this cluster. This process continued until the two households in Cluster 20 received their upgrades/retrofits. The Cluster 20 households have no controls which is unavoidable and does not prevent analysis of the previous 19 clusters proceeding.

Ideally a stepped wedge design should be balanced with respect to cluster size as this ensures maximum power and efficiency in estimation. It is clear from Figure 13 that balance was not achieved since cluster size varies between 1 and 46 households. However, modern statistical techniques such as the linear mixed models (LMM) or general estimating equations (GEE) can cope with departures from this ideal to some extent.

Upgrade pathways

The principal intervention in this study was a hot water service upgrade and 30 distinct simple pathways are possible as shown in Table 6.

	Installed HWS Type (B)					
Existing HWS Type (A)	Gas instant	Gas storage	Solar (elec. boost)	Solar (gas boost)	Heat pump	Total (A)
Electric Storage	18	2	6	13	27	66
Electric instantaneous	1	1	0	1	0	3
Electric boosted Solar	1	0	0	1	1	3
Elec A –> B Total	20	3	6	15	28	72
Gas Storage	42	40	0	90	10	182
Gas instantaneous	14	2	0	14	0	30
Gas boosted Solar	0	0	0	1	0	1
Gas A -> B Total	56	42	0	105	10	213
Gas & Elec A -> B Total	76	45	6	120	38	285

Table 6: Possible simple upgrade pathways. Numbers give count of households taking indicated upgrade pathway.

For households with an existing electric HWS there are 15 simple pathways and also 15 for those with an existing gas HWS. Not all pathways were actually observed (zero counts) or occurred in numbers too small for estimation of their effect. For those pathways with fewer than 5 households involved no estimation is attempted.

Table 7 contains ten estimable upgrade paths along with the number of households taking each path and the number of pre and post intervention observations available to estimate the intervention effect.

Upgrade path	Households (N)	Observations	
		Pre	Post
Elec Sto to Elec Solar	6	157	73
Elec Sto to Heat Pump	27	688	129
Elec Sto to Gas Inst	18	452	102
Elec Sto to Gas Solar	12	298	93
Gas Sto to Gas Inst	42	1010	303
Gas Sto to Gas Sto	40	970	175
Gas Sto to Gas Solar	89	2211	495
Gas Inst to Gas Inst	14	340	84
Gas Inst to Gas Solar	14	333	88
Gas Sto to Heat Pump	10	211	20
Total	272	6670	1562

Table 7: Estimable hot water service upgrade pathways

Analysis preliminaries

The primary outcome was the average effect of the intervention which was estimated separately for gas and electricity consumption. This effect, if present will be buried in the systematic seasonal variation in the data which must be accounted for in the analysis through some form of seasonal adjustment. Another source of nuisance variation is due to annual climate variations which can be accounted for by weather normalizing the data prior to analysis.

Weather normalization

Weather normalization was carried out using heating and cooling degree day (HDD and CDD) data from weather stations as close as possible to the postal area of each household. In the study area there are 15 weather stations and it was possible to select stations within a few kilometres of each postal area. For the HDD data the base temperature was 18 degrees Celsius and for the CDD data the base temperature was 24 degrees Celsius. The normalization factor was calculated using the formula

$$NF = \frac{\overline{HDD}_i + \overline{CDD}_i}{HDD_{it} + CDD_{it}},$$

where i indexes the postal area and t indexes the time point in months. The averages in the numerator were calculated over 5 years. The raw daily data were then normalized by multiplying by this factor. Normalization allows for month to month comparisons between years but does not remove seasonality in the data.

Seasonal adjustment

Seasonal adjustment allows for within year month-to-month comparisons of the weather normalized data to be made. Several methods of seasonal adjustment were considered (ARIMA X11, Ratio to Moving Average and the ABS Census Method) however all require at least 4 years monthly data for each household and so could not be implemented. One method that does not suffer from this restriction is harmonic regression adjustment which involves fitting the following first (frequency = 1/12) and second (frequency = 2/12 = 1/6) order harmonic model

$$\boldsymbol{H_{it}} = \boldsymbol{\beta_{0i}} + \boldsymbol{\beta_{1i}t} + \boldsymbol{\beta_{2i}}\text{Cos}\left(\frac{\boldsymbol{2\pi t}}{\boldsymbol{12}}\right) + \boldsymbol{\beta_{3i}}\text{Sin}\left(\frac{\boldsymbol{2\pi t}}{\boldsymbol{12}}\right) + \boldsymbol{\beta_{4i}}\text{Cos}\left(\frac{\boldsymbol{2\pi t}}{\boldsymbol{6}}\right) + \boldsymbol{\beta_{5i}}\text{Sin}\left(\frac{\boldsymbol{2\pi t}}{\boldsymbol{6}}\right) \quad (\boldsymbol{1})$$

where H_{it} is the expected value of household i at time $t = 1,2, \ldots T_i$ and the $\beta's$ are coefficients to be estimated. This model can be fitted to the data for each household and then adding the constant and trend component (i.e. $\beta_0 + \beta_1 t$) to the residual series to form a seasonally adjusted data series. The adjusted series can then be analyzed to examine the effects of the intervention and other factors. Alternatively, the above model components can be included in the main analysis as covariates so that the seasonality is simultaneously estimated with the intervention and other factor parameters. The advantage of the latter approach is that a random coefficients model can be used which not only accounts for the seasonal component but also allows for any differences in the component between households. This can be achieved using a linear mixed model without need of the large number of interaction effects that would be required to estimate a separate model for each household. This approach is adopted in this work and preliminary regression using the above model yielded an overall R^2 value of 96% so the harmonic model does an excellent job of accounting for the seasonal variation observed in Figure 12 (on p. 32).

Demographic factors

The inclusion of demographic factors is governed by availability and their percentage of missing values. Including a factor such as Home Type with nearly 60% missing values greatly reduces the sample size available to estimate the intervention effect which is the main focus of this study. As a compromise, we assess the effect of each demographic factor on the intervention effect separately and then use a multiple comparison adjustment maintain a 5% Type I error rate across the comparisons.

The analysis model

Following Hussey and Hughes (2007) and using the components defined above, the individual level household responses are modelled as

$$Y_{it} = \mu + \alpha_i + HHC_i + HAC_i + HBC_i + HDC_i + H'_{it} + \theta X_{it} + e_{it} \qquad (2)$$

where μ is the overall mean, α_i is a random household effect, HHC_i is the household characteristic component for household i, HAC_i is the appliance characteristic component for household i, HBC_i is the behavioral characteristic component for household i, HDC_i is the demographic characteristic component for household i, H'_{it} is the harmonic component for household i minus β_{0i} (since it is absorbed by μ), θ is the intervention effect, X_{it} is an indicator of the treatment mode in household i at time t (0 = control arm, 1 = intervention arm). The term e_{it} is the random error for household i at time t and reflects the fact that energy use of households cannot be modelled perfectly due to many other unknown factors that influence household energy use patterns. These other factors are assumed to operate randomly in their influence on energy use (e.g. relatives come to stay, the HWS breaks down, people go on holidays, etc.). Since we are dealing with repeated measurements over time, e_{it} cannot be assumed to be independent but this can be accommodated by the LMM or GEE procedures.

In traditional analysis the error at time t is assumed to be independent of errors at any other time. We are dealing with repeated measurements on each household which means that measurements (and hence errors) at time t will be correlated with earlier measurements. This correlation is usually short-term and may only extend one or at most two time periods. To account for this correlation we assume the error follows an auto(self)regressive process such as

$$e_{it} = \phi e_{it-1} + \psi_{it}$$

where ϕ is a constant (autocorrelation coefficient) to be estimated and ψ_{it} is an error term that is independent of all other error terms. An unstructured error term is a more general method of handling correlation in repeated measures and allows for a much wider range of correlation structures to be considered when fitting the model.

The LMM procedure was chosen for this analysis at it provides a more a natural fit for individual level data and allows for random covariate coefficients to account for possible between household variance in the seasonal component.

The results of the analysis are given in terms of marginal means from (2) which are therefore directly comparable between control and intervention arm due to the seasonal adjustment terms entering the model as covariates. This negates the need for a month by month analysis as all months are comparable after seasonal adjustment.

Results

The GEE procedure was applied separately to the electricity and gas data for the overall intervention effects and then separately to the subsets of electricity and gas data that are defined by the 10 upgrade pathways.

Overall effect of HWS upgrades

Table 8 shows the results of overall pre-post intervention comparisons for the daily electricity and gas consumption measures for all upgrade pathways not involving a fuel change. In both cases a highly significant ($p \leq 0.003$) decrease in energy consumption was observed. The decreases of 25% and 7% for electricity and gas respectively are of practical (as well as statistical) significance give an annual reduction of 762 KWh ($213.46) for electricity consumption and 2,787 MJ ($55.64) for gas consumption. That is, in overall terms the intervention was successful.[6] Upgrades involving a fuel change are considered in the next section.

Consumption Units	kWh/day	MJ/day
Pre upgrade fuel	Electricity	Gas
Post upgrade fuel	Electricity	Gas
Pathways	1,2	5,6,7,8,9
Households (N)	33	199
Pre upgrade consumption	8.474	103.028
Pre upgrade observations	845	4864
Post upgrade consumption	6.385	95.393
Post upgrade observations	202	1145
Post - Pre consumption	-2.089	-7.635
Percent change	-25%	-7%
p-value[a]	0.000	0.003
Annual Cost change	$ (213.46)	$ (55.74)

a. The p-value is for testing if the post-pre difference in consumption is significantly

Table 8: Overall Intervention effect on daily electricity and gas consumption

Effect of selected upgrade paths

Table 9 displays the pre-post intervention comparisons of daily energy consumption for the four pathways where pre upgrade fuel type was electricity. In these four cases the response variable was electricity consumption in kWh per day. Note that third and fourth upgrade paths involve a change of fuel type post upgrade and so the analysis of these paths was repeated using gas consumption as the response variable in order to calculate the net effect of the intervention on cost savings.

Upgrade paths yielding significance decreases in average daily electricity consumption were electric storage to heat pump ($p < 0.001$) with a 29% reduction in consumption, electric storage to gas instant ($p < 0.001$) with a 42% reduction in consumption and electric storage to gas solar ($p < 0.001$) with a41% reduction in consumption. The non-

[6] The St Vincent de Paul Society's Victorian Tariff Tracking Project (Mauseth Johnston, 2015a, 2015b) data which monitors electricity retailer market offers indicates that, for January 2014, the average market offer for 14 Victorian retailers was $0.28. For market offers concerning seven gas retailers, the data provided for January 2015 indicates an average value 0f $0.02. Applying these figures to the consumption changes provides an estimate of average daily savings or expenditures per annum.

significance of the Electric storage to electric solar ($p = 0.605$) is possibly due to the small number of households (6) involved and the resulting low power of the statistical test. A larger sample of this type of upgrade may well yield a significant result.

Consumption Units	kWh/day	kWh/day	kWh/day	kWh/day	MJ/day	MJ/day
Pre upgrade fuel	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity
Post upgrade fuel	Electricity	Electricity	Gas	Gas	Gas	Gas
Upgrade Pathway	Storage to Solar	Storage to Heatpump	Storage to Instant	Storage to Solar	Storage to Instant	Storage to Solar
Households (N)	6	27	18	12	19	11
Pre upgrade consumption	9.107	8.207	7.106	7.114	46.016	58.733
Pre upgrade observations	157	688	452	298	509	264
Post upgrade consumption	8.758	5.818	4.133	4.221	57.054	67.491
Post upgrade observations	73	129	102	93	83	70
Post - Pre consumption	-0.348	-2.389	-2.973	-2.893	11.038	8.758
Percent change	-4%	-29%	-42%	-41%	24%	15%
p-value[a]	0.605	0.000	0.000	0.000	0.109	0.478
Annual Cost change	$ (35.60)	$ (244.14)	$ (303.89)	$ (295.65)	$ 80.57	$ 63.94
Net annual cost change[b]	-	-	$ (223.31)	$ (231.71)	-	-

a. The p-value is for testing if the post-pre difference in consumption is significantly different from zero.
b. Net annual cost change only calculated for upgrades involving fuel change as - annual cost change in electricity plus annual cost change in gas for the particular upgrade pathway.

Table 9: Intervention upgrade pathway outcomes for electricity consumption

The results involving a fuel change (paths 3 and 4) exhibit 42% and 41% decreases in electricity consumption respectively. This is to be expected since they involve changing the fuel type from electricity to gas. The annual cost change for these paths has been offset by adding the cost change associated with post upgrade gas consumption yielding the net annual cost changes in the table.

Table 10 displays the pre-post intervention comparisons of daily energy consumption for the six pathways where pre upgrade fuel type was gas. In these six cases the response variable was gas consumption in MJ per day. Note that the sixth upgrade path involves a change of fuel type post upgrade and so the analysis of this path was repeated using electricity consumption as the response variable in order to calculate the net effect of the intervention on cost savings.

Upgrade paths yielding significance decreases in average daily gas consumption were gas storage to gas instant ($p < 0.001$) with a 15% reduction in consumption, gas storage to gas storage ($p = 0.011$) with a 16% increase in consumption and gas storage to gas solar ($p = 0.001$) with a 13% reduction in consumption.

The non-significant results for the gas instant to gas instant ($p = 0.923$), gas instant to gas solar ($p = 0.183$) and gas storage to electric heat pump ($p = 0.091$) imply that although these changes are real enough for the sampled households we do not have enough evidence to infer that these result would occur in the target population of households. That is, we cannot generalize beyond the sampled households.

Consumption Units	MJ/day	MJ/day	MJ/day	MJ/day	MJ/day	MJ/day	kWh/day
Pre upgrade fuel	Gas	Gas	Gas	Gas	Gas	Gas	Gas
Post upgrade fuel	Gas	Gas	Gas	Gas	Gas	Electricity	Electricity
Upgrade Pathway	Storage to Instant	Storage to Storage	Storage to Solar	Instant to Instant	Instant to Solar	Storage to Heatpump	Storage to Heatpump
Households (N)	42	40	90	14	14	10	14
Pre upgrade consumption	105.425	101.596	106.911	69.408	122.977	98.988	7.221
Pre upgrade observations	1010	970	2211	340	333	211	366
Post upgrade consumption	89.747	117.801	92.944	70.035	108.310	77.478	7.706
Post upgrade observations	303	175	495	84	88	20	56
Post - Pre consumption	-15.678	16.206	-13.967	0.627	-14.667	-21.510	0.485
Percent change	-15%	16%	-13%	1%	-12%	-22%	7%
p-value[a]	0.000	0.011	0.001	0.923	0.183	0.091	0.275
Annual Cost change	$ (114.45)	$ 118.30	$ (101.96)	$ 4.58	$ (107.07)	$ (157.02)	$ 49.56
Net annual cost change[b]	-	-	-	-	-	$ (107.46)	-

a. The p-value is for testing if the post-pre difference in consumption is significantly different from zero.
b. Net annual cost change only calculated for upgrades involving fuel change as - annual cost change in gas plus annual cost change in electricity for the particular upgrade pathway.

Table 10: Intervention upgrade pathway outcomes for gas consumption

The impact of household, appliance, behavioural and demographic characteristics.

To assess the impact of household and demographic characteristics on the intervention effect, each factor defining the characteristics was entered into model (2), and the interaction between the factor and the intervention factor estimated. This allowed for the pre-post differences for each level of each factor to be estimated and assessed for significance. The results from this process are displayed in Appendix F2 for electricity and gas consumption respectively. The tables contain the number of households (N), the number of observations (Obs) and marginal means from the model pre- and post-intervention, the difference between marginal means, and the *p*-value for testing if the difference is significantly difference from zero (*p*-values < 0.05 are bolded). Also note that some factor levels were collapsed to avoid the numerical estimation problems associated with levels with few observations.

Since there are 60 tests for each energy source, some attention needs to be paid to limiting the Type I error rate to 5%. This may be achieved by choosing a per-comparison significance level of $0.05/60 \approx 0.002$ which is the Bonferroni correction. That is, a pre-difference is only considered significant if its *p*-value is less than 0.002 which is very conservative[7]. A less conservative method is the false discovery rate (FDR) method of Benjamini and Hochberg (1995) which gives an adjusted *p*-value of 0.006 for each

[7] With such a low *p*-value cut-off we would likely miss real significant effects.

comparison. Using this approach we find the significant results listed in Table 11 and Table 12.

Overall, pre and post intervention marginal means were statistically similar for almost all factors and their levels. This is probably not surprising since the household and demographic factors remained constant throughout the trial and although many do affect the level of energy use, it is difficult to see how they could moderate the intervention effect for better or worse. It may be reasonable to assume that some household residents have a more positive attitude to energy conservation and the level of the factor is a proxy indicator of this. For example, it may be that the motivations that might lead residents to install roof top PV are the same motivations that could lead them to make the most out of the intervention, resulting in a reduction for this group that is not present for homes without roof top photovoltaics. However, beyond this speculation, further research is required to test the hypothesis.

Factor	**Level**	**p-value**	**Post - pre**	**Interpretation**
Age of existing HWS	0-2 years	0.000	-4.044	Homes with a HWS less than 2 years old are associated with a highly significant post intervention reduction in consumption of 4.044 kWh/day
Washing machine size	medium	0.005	-1.534	Home with a medium size washing machine are associated with a very significant post intervention reduction in consumption of 1.534 kWh/day
Employment status	Retired	0.001	-1.419	Homes with retired residents experienced a very significant post intervention reduction in consumption of 1.419 kWh/day

Table 11: Energy source = Electricity. Significant household, appliance, behavioural and demographic factor interpretations.

Factor	**Level**	**p-value**	**Post - pre**	**Interpretation**
Home ownership	Owned or mortgaged	0.003	-21.39	Homes that are owned outright or mortgaged experienced a very significant post intervention reduction in consumption of 21.39 MJ/day
Home age	10 to 20	0.000	-30.83	Homes between 10 and 20 years old experienced a very significant post intervention reduction in consumption of 30.83 MJ/day
Number of occupants	2	0.006	-19.94	Two person households are associated with a very significant post intervention reduction in consumption of 19.94 MJ/day
	3	0.009	-38.07	Three person households are associated with a very significant post intervention reduction in consumption of 19.94 MJ/day
Number of	2	0.003	-25.71	Homes with two bathroom experienced a very significant post intervention reduction in consumption of 25.71 MJ/day

bathrooms	3	0.000	-42.06	Homes with three bathrooms experienced a highly significant post intervention reduction in consumption of 42.06 MJ/day
	4	0.000	-21.61	Homes with four bathrooms experienced a highly significant post intervention reduction in consumption of 21.61 MJ/day
Existing energy source	Electricity and natural gas	0.008	-18.36	Home with electricity and natural gas are associated with a very significant post intervention reduction in consumption of 18.36 MJ/day
Age of existing HWS	17-20 years	0.000	-45.66	Homes with a HWS between 17 and 20 years old are associated with a very significant post intervention reduction in consumption of 45.66 MJ/day
Rooftop PV	Yes	0.001	-28.54	Homes with rooftop PV are associated with a very significant post intervention reduction in consumption of 28.54 MJ/day
Number of showers/week	8-14 min showers	0.001	-26.38	Homes in which residents shower between 8 and 14 times a week are associated with a very significant post intervention reduction in consumption of 26.38 MJ/day
Average shower time	medium	0.004	-28.09	Homes in which take a medium amount of time (7-12 mins) for a shower are associated with a very significant post intervention reduction in consumption of 26.38 MJ/day
Employment status	Not in workforce	0.008	-27.49	Homes where residents are not in the workforce (not retired) are associated with a very significant post intervention reduction in consumption of 27.49 MJ/day
Education level	Secondary	0.001	-30.32	Home in which the highest education level achieved are associated with a very significant post intervention reduction in consumption of 30.32 MJ/day

Table 12: Energy source = Gas. Significant household, appliance, behavioural and demographic factor interpretations.

Discussion

What change, if any, in household energy consumption results from the hot water service upgrades?

The results of overall pre-post intervention comparisons for the daily electricity and gas consumption measures (not including pathways involving a fuel change) indicated a highly significant decrease in electricity and gas consumption. These decreases of 25% (2.09 kWh per day) and 7% (7.63 MJ per day) for electricity and gas respectively are of practical (as well as statistical) significance give an annual reduction of 762 KWh ($213.46) for electricity consumption and 2,787 MJ ($55.64) for gas consumption. That is, in overall terms the intervention was successful in producing energy savings.

The overall program effects cannot be easily compared with Solar Cities projects because of the different emphasis they place on interventions aimed at reducing energy consumption (in addition to different research designs, data management and analysis procedures, regions, etc.). Nonetheless, the reduction achieved in average daily kWh exceeds the range of 0.7 and 1.7 kWh reported by the CSIRO (2013) for their analysis of electricity interventions in Perth and Alice Springs that championed solar hot water replacements. One might expect to see solar hot water solutions to make the most of sunny conditions more characteristic of Perth and Alice Springs than Melbourne, but this assumption was not met. Note also that shifting from electric storage systems to solar hot water is expected to bring about generous savings relative to alternatives pathways, and that this pathway was much more common in the two solar cities projects (23% of households in Alice Springs and 32% in Perth) than was the case in the HEEUP (5.4% of households).

What change, if any, in household energy consumption results from specific types of hot water service upgrades?

Upgrades affecting electricity consumption

The upgrade paths yielding significant decreases in daily *electricity consumption* were electric storage to heat pump (29%); electric storage to instantaneous gas (42%) and electric storage to gas solar (41%) compared to the stepped wedge control. The latter two pathways reflect the fact that the new technology was gas rather than electric, such that a concomitant decrease in electricity consumption is expected in these instances. In fact, these two pathways were associated with non-significant increases in gas consumption of 11.04 MJ (gas instantaneous) and 8.76 MJ (gas solar) as households make use of their new gas water heating technologies.

Net annual cost savings resulting from shifting from electric storage to gas instantaneous gas from electric storage to gas solar were in excess of $220 in both cases. Of the 19 households opting for this pathway, 85% were on an off-peak tariff and 95% resided in households of two people or fewer. Using the running cost information supplied by Sustainability Victoria (2015) a differential can be estimated based on an off-peak tariff for the electric storage units and based on household residents of one or two. Done this way, the expected net annual saving in running costs are $247, which is consistent with the HEEUP savings estimate.

When the above procedure was applied to the pathway from electric storage to gas solar, the expected running costs amounted to $417 per annum on average. This figure is a good deal larger than the HEEUP estimate of $231.71. However, slightly more than half (53.85%) of these solar systems were installed between March and September 2015 suggesting that the consumption record of these households did not cover the months most important to the technology’s efficiency. Households involved in this pathway had electric storage systems mostly operating on an off-peak tariff (84.6%) and comprised one or two residents (69.3%).

The 29% (2.39kWh) reduction owing to the installation of a heat pump was below the estimate of 23.49 MJ (6.52 kWh) provided by DEDJTR (2015). However, 95.6% of all heat pumps were installed between March and November 2015 such that household consumption did not reflect their operation during the hottest months of the year in Melbourne and surrounds.

The financial savings realised by shifting from electric storage to a heat pump amounted to $244.14 per year on average. The electric storage units in these households operated on an off-peak tariff and the households consisted of one or two residents. Based on estimates of the operating cost of running electric storage and heat pump systems the expected financial saving is in the vicinity of $192 per annum for households of one or two people (Sustainability Victoria, 2015).[8] The estimated saving of $244.14 from the HEEUP data exceeds the expected financial saving assuming that the heat pumps operated on a standard peak tariff. If an off peak tariff is assumed for the heat pumps then the difference in running costs is around $305.

The pathway involving an upgrade to electric-boosted solar was not significant unlike that reported by Lynch et al. (2013). In the Central Victorian Solar City trial, the installation of solar water heating decreased electricity consumption by 22% (or 4.84 kWh/day on average). Similarly, in the Alice Springs Solar City trial, the reduction in energy achieved from upgrading from an electric storage system to an electric-boosted solar system was 16.7% (4.27 kWh).[9] The HEEUP results indicate that the effect in kWh of installing the solar units was not significantly different to zero.

This non-significant effect cannot be easily explained on the basis of an installation time that avoided exposure to the hottest months of the year because most of these installations were completed in the middle of 2014. The consumption records for these households reflected the operation of the solar systems during the summer of 2014/2015. The non-significant effect in this case might instead be attributable to low statistical power owing to a small number of households and observations.

In sum, the reductions in electricity consumption and financial savings estimated on the basis of the HEEUP model results showed some alignment with expectations provided by Sustainability Victoria (2015) and the DEDJTR (2015) although they are not completely consistent with either one of these sources. Rather, deviations from expectations tend to suggest that the HEEUP interventions achieved lower energy reductions. These differences may be due to the sample households and study context having characteristics (e.g. low-income households, older residents, small number of residents, relatively cooler climate, etc.) different to those on which the DEDJTR and Sustainability Victoria estimates have been based.

Upgrades affecting gas consumption

Upgrading from a gas storage unit to either an instantaneous gas system or a gas-boosted solar system reduced gas consumption by 15% and 13% respectively. These

[8] The estimates supplied by Sustainability Victoria (2015) are based on the following tariffs: peak electricity (28 c/kWh), off-peak electricity (18 c/kWh).

[9] The Alice Springs Solar City report does not provide statistical information against which the significance of this point estimate might be assessed.

reductions were equivalent to 15.68 MJ/day and 13.97 MJ/day and $114.45 and $101.96 per annum. However, according to the deemed energy savings data provide by EnergyConsult (2012), the expected reduction might have been 36.05 MJ or $263.16 for solar.[10] Employing alternative figures from DEDJTR (2015) the expected gas reduction was 26.85 MJ or $195.98. The financial data by Sustainability Victoria (2015) offered an estimate of $184 based on a tariff equal to 1.75 c/MJ and assuming a 3-star rated gas storage unit. By all these measures, the HEEUP estimates achieve less gas and financial savings than was expected by the gross data. It is not clear why this should be the case without further investigation.

One curious result arising from the data analysis was the 16% increase in gas consumption associated with upgrading from an existing gas storage unit to a new gas storage system. According to EnergyConsult (2012) the change in hot water service should have brought about a reduction in consumption of 8.88 MJ per day based on their modelling assumptions. Perhaps the replacement storage units were larger allowing some households to use more hot water than they were able to access with their previous smaller system. However, further enquires are needed to determine why the increase in consumption occurred.

Another ‘like-for-like’ upgrade – instantaneous to instantaneous – did not affect consumption to a statistically significant extent. Neither Sustainability Victoria (2015), DEDJTR (2015), nor EnergyConsult (2012) provide data upon which to estimate an expectation for this pathway. Of the 14 households involved, half of them had installation dates between April and October 2015, toward the end of the program. It may be that there was not a long enough record for these 7 households to establish reliable results. Otherwise one might conclude that the new instantaneous systems were not much more energy efficient than the ones they replaced.

Non-significant results were observed for the upgrade from instantaneous to gas solar. The solar water heating systems were installed between June 2014 and October 2015 with 81% of installations completed before July. This suggests that the timing of the installation likely had little impact on the model result. The model estimate implies that the gas solar upgrade did not improve households’ energy consumption to a statistically significant degree.

The final gas pathway included in the analysis can be considered as marginally non-significant given the low participation rate (i.e., 10 households). A decrease in gas consumption was expected because the heat pumps operated on electricity. That said, the electricity consumption of these households did not increase to a statistically significant effect resulting in a net benefit. In fact, the net annual cost saving was estimated to be $107.46 per annum. The heat pumps were installed between April and October 2015 and, therefore, were not operating during the summer months suggesting that the cost savings might be an underestimate of the potential savings.

[10] EnergyConsult (2012) does not provide figures for instantaneous gas.

An estimate of the financial savings from switching from gas storage to a heat pump can be calculated from the Sustainability Victoria (2015) running cost data. Sixty percent of the households involved in this pathway resided in households of 2 or 3 people suggesting a differential equal to $82 (off-peak tariff). The HEEUP estimate of the benefit ($107.46) was about double this figure. Interestingly, the peak tariff estimate based on Sustainability Victoria results in a net cost of $70 assuming a 3-star rated gas storage unit.

To summarise, significant reductions in household gas consumption was achieved by replacing gas storage units with instantaneous and solar systems. There was an increase in consumption on average in households when existing gas storage units were replaced with new ones, but this effect had a lower probability compared with the upgrades to instantaneous and solar. Like the effects observed for reductions in household electricity consumption, the significant reductions in gas consumption tended to fall short of expectations based on available data from a number of government sources. This might simply reflect the different methods of calculating the estimates and the different populations from which they were derived.

What variables explain any change from pre-intervention consumption to post-intervention consumption?

The analysis of household, appliance and demographic variables identified significant predictors of consumption. There were many more significant relationships involving gas consumption than electricity consumption. Where the latter fuel source was concerned, the pattern of associations was not very informative and one result was counterintuitive. That is, households having hot water service less than two years old were associated with a post-intervention reduction in electricity consumption. It may be that the energy saving was likely involve more of these households moving from electric storage to a more efficient alternative.

The only other two significant effects identified households having medium sized washing machines and households with retired residents as experiencing decreased consumption. The former relationship is not very meaningful and the latter may suggest that retirees had a greater commitment to reducing their energy use following the intervention, but this requires further investigation.

For gas consumption, there are relationships involving the number of residence in a household and the number of bathrooms in the dwelling. Reductions in gas consumption were associated with more residents, more bathrooms and more frequent showering. These relationships most likely signal that economies of scale are at play. As more people use the new hot water system the greater the benefit compared to the hot water service that existed prior to the intervention.

Other relationships were unsurprising such as households having electricity and natural gas experiencing post-intervention reduction in gas. This would likely be the case for households that shifted from an existing gas hot water service to an electric appliance, an option that is not open for households with access to only one type of energy source. Likewise, households with photovoltaics might be expected to demonstrate a reduction in their gas consumption if they installed an electric water heating device. In fact, 90 households reported having photovoltaics on the roof. Also, somewhat expected was the association between older existing hot water services and reduced gas consumption following installation of a new appliance.

Limitations and lessons learned

Some of the limitations of the research have been noted in the preceding discussion. These are (i) the non-random assignment of households to time-based clusters required in step-wedged designs resulting in group numbers that varied considerably, (ii) small numbers of households in some of the pathway groups and varying group sizes across pathways, (iii) missing values on some of the participant data. The issues of random assignment to time and the creation of clusters and intervention groups may be difficult to achieve given the need for a flexible, participant-centred recruitment process, but efforts might be made in future programs to minimise missing values especially where data is collected via face-to-face structured interviews.

While the extent of rebound effects is unknown in this study, they are likely to occur to some extent when new technologies are introduced for the purpose of improving energy efficiency in residential households. In order to limit the effect of rebound behaviours and to maximise the potential savings that new technologies promised, there are opportunities to refine the HEEUP technology upgrade intervention by directly addressing the human dimensions of using technology in everyday settings (Giglio et al., 2014; Gill et al., 2015). Tailored and timely feedback about households' energy consumption can help householders learn to adjust their behaviour in ways that achieve targeted savings in line with the reductions expected from the new technology (Delmas et al., 2013; Karlin et al., 2015; Vine et al., 2013). Combining this intervention with information about how best to use the new technology (Gill et al., 2015) and goal setting strategies for attaining commitment from householders to achieve an agreed energy consumption target (Karlin et al., 2015) might be additional activities that work to reduce the inevitable rebound effects that have been shown to operate in similar upgrade interventions.[11]

Rebound effects suggest that the very installation of new technology can change consumption behaviours such that behavioural patterns before the intervention are different to those following it. For example, Gill et al. (2015) studied how solar hot water heating technology is actually used in households and found that the efficiency benefits of solar water heating were not fully realised because householders did not know how to use the technology to maximise savings, even in households committed to reducing their energy consumption. The researchers concluded policy approaches based on

[11] A Spanish study estimated the rebound effect for water heating to be 34%, 36% and 38% for high, medium and low-income households respectively (Gálvez et al., 2015).

implementing so-called ‘technological fixes’ need to shift toward a position that better appreciates the way newly installed technology becomes integrated with the ‘norms, expectations, practices and habits of the household’ (p.92). For Gill et al., post-installation ‘marks a point at which households might be supported to experiment with combinations of water use timing, booster operation and to develop new habits that incorporate the contingencies of weather, household processes, and SHW system operation’ (p.92). Put simply, technological solutions to rising energy consumption may require more than targeted efforts to increase adoption, but also efforts to ensure that the use of this technology is likely to see the expected energy savings realised in practice and in ways that are consistent with the needs of households.

Future evaluation methodologies might include data about householders’ experience with using new technologies in their homes (i.e. post installation), and their perceptions of its performance, convenience and acceptability. Understanding how new technologies are used in the home may assist with behavioural programs, technology design and installation procedures that facilitates its operation and helps achieve energy efficiency targets. Installers might also be coded in evaluation data sets so that water heating performance and household energy consumption can be compared in an effort to identify any pervasive installation issues.

Conclusion

The Brotherhood of St Laurence partnered with Monash Sustainability Institute to provide an independent evaluation of the HEEUP trial. This evaluation assessed the effectiveness of the HEEUP program by employing a stepped wedge controlled design and estimating effects directly attributable to the various water heater upgrades. To this end, most of the upgrades (i.e. heat pumps, instantaneous gas, and gas solar) that replaced electric storage units were effective in reducing electricity consumption in low-income households. Similarly, upgrades that replaced gas storage units with instantaneous gas and solar gas units resulted in significantly lower gas consumption in low-income households. These upgrade options and pathways are recognised in publicly available material as options likely to improve water heating efficiency and energy costs in residential households (e.g. DEDJTR, 2015; Sustainability Victoria, 2015).

The evaluation indicated that some of the pathways failed to realise energy and cost savings that might be expected on the basis of publicly available estimates and past energy efficiency trials. This may be attributable to factors such as the study population of low-income households, regional location, and characteristics of the research design and data that most likely differ to the contexts in which other estimates have been derived. Future evaluations of energy efficiency trials in low-income residential contexts similar to those described in this report are required to bring more insights to this important area of policy and research.

3 What is the optimal incentive level to promote a switch to an efficient system?

A key objective of the HEEUP program was to understand the optimal incentive level that would enable a low-income home owner to upgrade to a more efficient hot water system. Two approaches were used to better understand the optimal incentive level:

1 Program delivery experience
2 A discrete choice experiment

PROGRAM DELIVERY EXPERIENCE

Summary of results

- Upgrades to solar and heat pump systems could be achieved in 65% of households with the following subsidy mix:
  - $2,300 to $2,900 for upgrades to solar (with a householder contribution around between $1,900 and $2,000)
  - $2,000 to $2,300 for upgrades to heat pumps (with a householder contribution between $1,600 and $1,800)
- Conversion rates from a home visit to an installation were higher when the subsidy was higher and the out-of-pocket expense lower.
- Higher subsidies and more choice coincided with more energy efficient systems being installed.

Introduction

Changes made to the format of the subsidy and the amount of the subsidy (affecting the out-of-pocket cost to the household) during the program provided a basis for a preliminary assessment of the households' response to different subsidy levels.

Data and methodology

Owner-occupier home visits were analysed to assess the proportion of home visits that translated to an upgrade, and the installation mix, in each program period. The HEEUP administrative data used in this analysis was collected by BSL HEEUP staff and includes:

- Number of standard owner-occupier home visits
- Type and date of hot water systems installed
- Subsidy amounts and out-of-pocket cost to the household –Subsidy provided by the BSL or the HESS program and recorded by HEEUP staff. The out -of-pocket cost refers to the cost to the household (up-front or with a loan) after all subsidies and discounts.

The data was assessed in the light of changes in program offer – changes to hot water system types on offer, the subsidy amounts and the format of the subsidy.

Results

The pattern of subsidies and fixed costs for hot water upgrades is shown in Table 13.

During the HESS phase, householders contributed a fixed $1,200 for solar or instant gas systems (the three on offer) which represented between 63% and 76% percent of the total cost depending on the upgrade type. They received a variable subsidy ranging from a median $2,078 for instant gas to $3,792 for electric boosted solar.

During BSL phase 1, they received a fixed subsidy of $2,000 for solar gas systems and contributed a median out-of-pocket cost of $2,426, representing between 10% and 45% of the total cost.

In BSL phase 2, the size of the subsidy also varied by installation type, from $150 for gas storage, to $2,500 for solar systems. The household median contribution by installation type ranged from $1,370 up to $1,892, representing between 10% and 57% of the total cost.

The last stage (BSL 3) reverted to a variable subsidy and a maximum fixed price per installation type that varied from $1,400 (gas storage) to $2,000 (solar or instant gas). Overall households contributed between 23% and 59% of installation costs.

Table 13: Installation types by subsidy period - percentage

Subsidy period and hot water systems on offer	Scheme rules – cost to household	Scheme rules – subsidy type and amount	Number of installs	% installs by type	Actual median cost paid by hh	Actual median subsidy	HH cost % of total price (after veet & stc)
HESS program subsidy 1/4/14 to 31/6/14	**Fixed amount. No less than:**	**Variable**	***42***				
Solar gas boosted	$1,200	Variable	21	50%	$1,200	$3,571	25%
Solar electric boost.	$1,200	Variable	17	10%	$1,200	$3,792	24%
Instantaneous gas	$1,200	Variable	4	40%	$1,200	$2,078	37%
BSL 1: Fixed subsidy 1/7/14 to 28/2/15	**Variable amount**	**Fixed amount**	***40***				
Solar gas boosted	Variable	$2,000	21	53%	2,426	$2,000	55%
Solar electric boost.	Variable	$2,000	0	0		N/A	

Instantaneous gas	Variable	$350	8	20%	1,894.5	$350	84%
Gas storage	Variable	$150	11	28%	1,340	$150	90%
BSL 2: Fixed subsidy 1/3/15 to 31/5/15	**Variable amount**	**Fixed amount**	***65***				
Solar gas boosted	Variable	$2,500	32	49%	$1,892	$2,500	43%
Solar electric boost.	Variable	$2,500	0	0%	0	N/A	N/A
Heat pump	Variable	$2,000	10	15%	$1,595	$2,068	44%
Instantaneous gas	Variable	$500	17	26%	$1,859	$500	79%
Gas storage	Variable	$150	6	3%	$1,370	$150	90%
BSL 3: Floating subsidy 1/6/15 to 18/12/15	**Max. cost to house hold**	**Variable**	***377***				
Solar gas boosted	$2,000	Variable	154	41%	$2,000	$2886	41%
Solar electric boost.	$2,000	Variable	23	6%	$1,890	$2309	45%
Heat pump	$1,800	Variable	101	27%	$1,800	$2334	44%
Instantaneous gas	$2,000	Variable	60	16%	$2,000	$800	71%
Gas storage	$1,400	Variable	39	10%	$1,200	$350	77%

Conversion rates: from home visit to hot water installation

Figure 14 shows home visits that led to an installation and those that did not. Both the total number of home visits and the installations that resulted from those home visits fluctuated per month. The changes largely reflected the timing and focus of recruitment or the varying subsidy levels. Most installations occurred soon after the home visit. It is apparent that the HESS period (April to June 2014) had very high conversion rates from home visit to installation; however, it had relatively low installation numbers. By contrast January and February 2015 had 100 or more home visits, but only 23 and 28 installations resulting from these home visits.

Figure 15 shows the proportion of households who received a home visit in a given month and subsequently installed a hot water system. It is important to note that there were some changes in recruitment in the different periods, especially in the final BSL subsidy period.

Figure 14: Number of installs and home visits per month (standard HEEUP only)

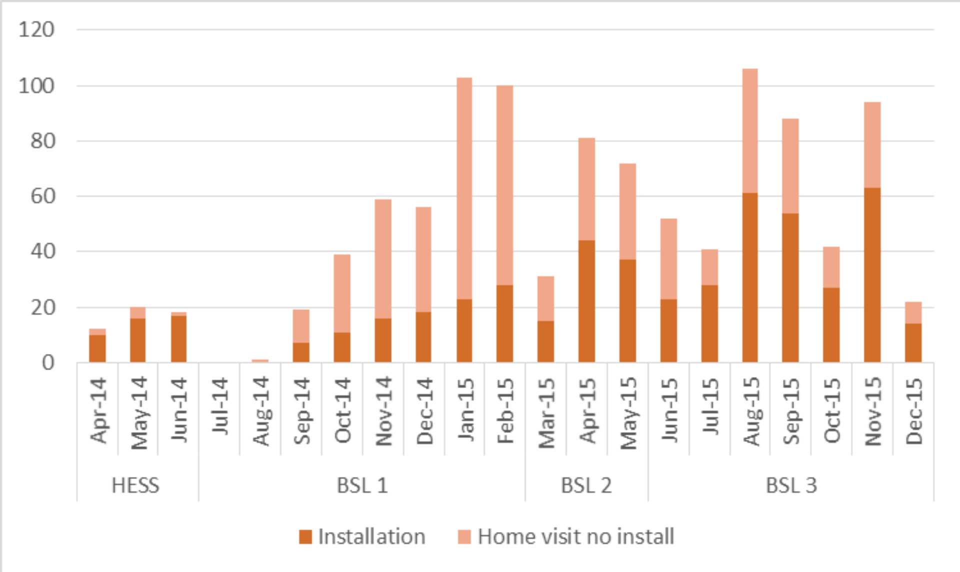
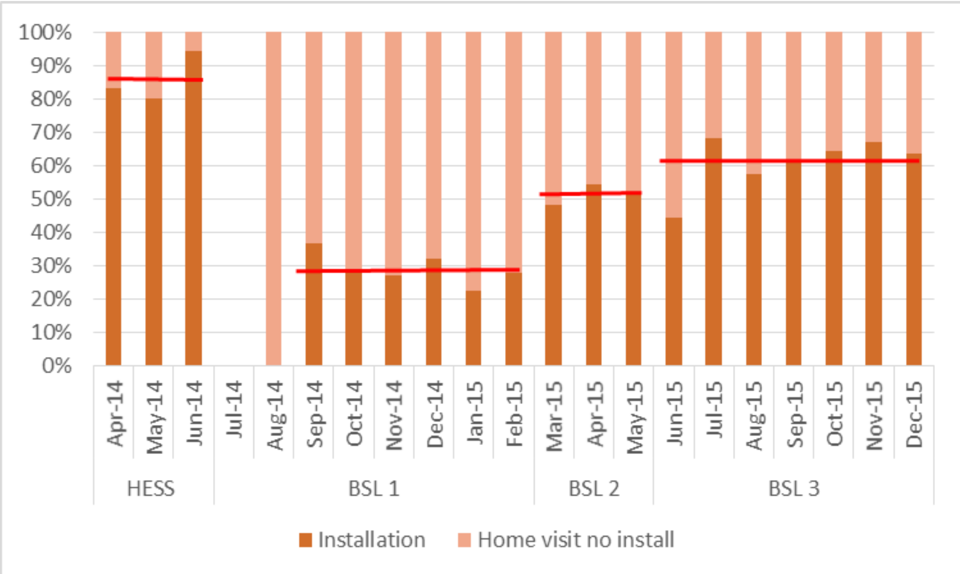


Figure 15: Installs as a percentage of home visits per month (standard HEEUP only)



Note: July and August 2014 had little activity and were not included in the calculation for BSL 1s

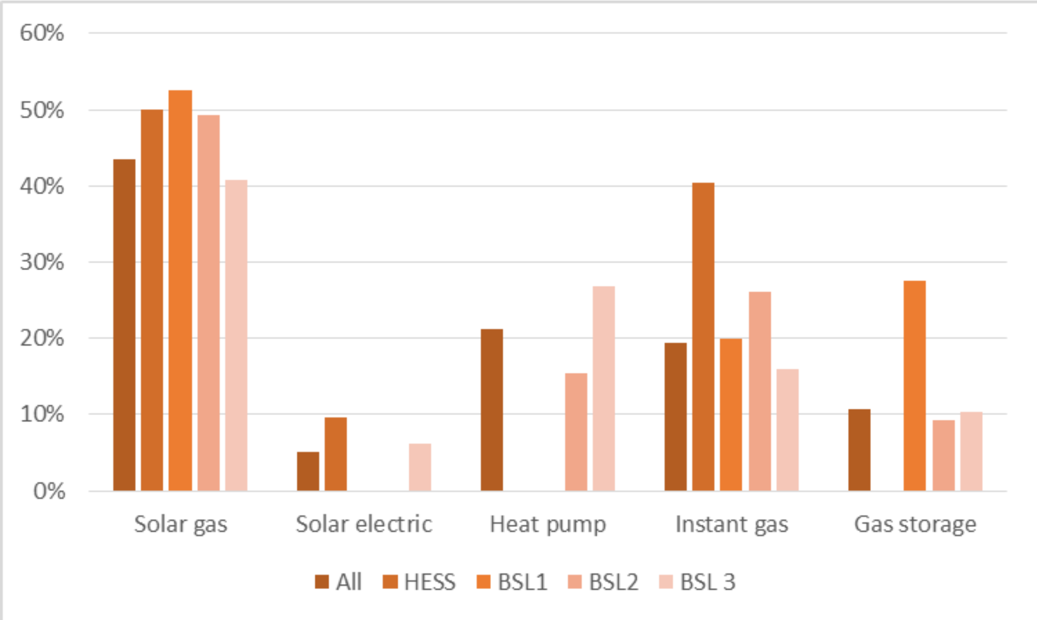
Figure 15 shows the average observed rates of conversion for each period:

- HESS program period – fixed up-front cost of $1,200 and a floating subsidy– 86% conversion from home visit to installation
- BSL 1 fixed subsidy period, floating up-front payment – 29% conversion from home visit to installation
- BSL 2 fixed subsidy period, floating up-front payment – 51% conversion from home visit to installation
- BSL floating subsidy, fixed upfront payment – 61% conversion from home visit to installation

Installation mix during different installation periods

The installation mix during the different subsidy periods is presented in Table 13, Figure 16 and Figure 17. Heat pumps, which were not available during the HESS period and much of BSL 1, became a larger proportion of the upgrades as the program progressed. Instant gas systems also decreased as gas storage systems were introduced and the out-of-pocket expense increased following the closure of the HESS program.

Figure 16: Installation types during subsidy periods (standard HEEUP)

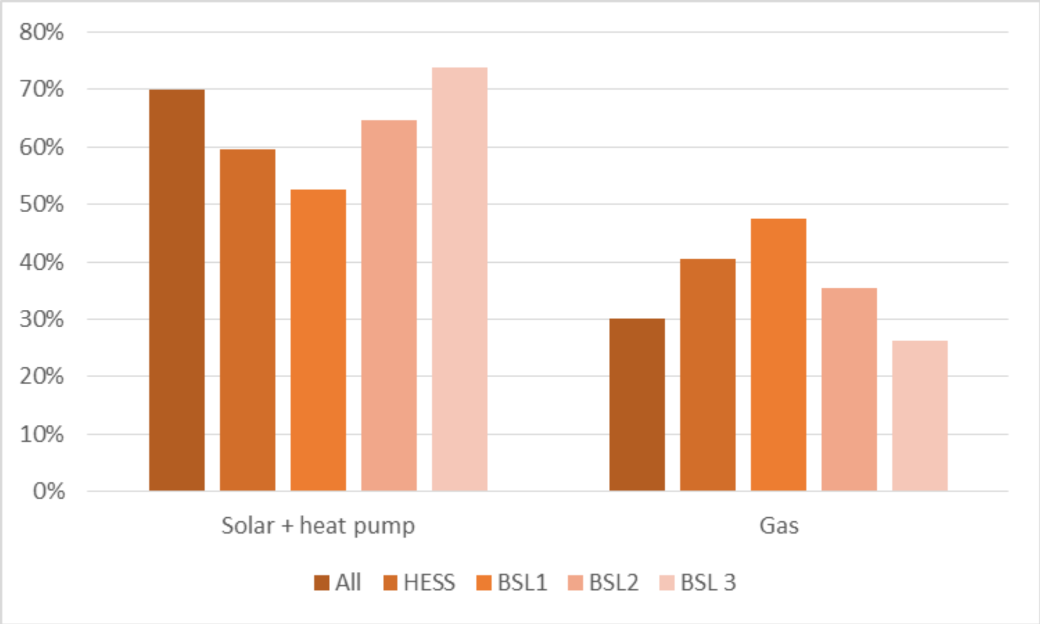


N: All: 524; HESS: 42; BSL 1: 40; BSL 2: 65; BSL 3: 377

When grouped together (Figure 17) the more energy efficient, and expensive, systems – solar or heat pump – reached a maximum of 74% of the installation mix during the final BSL subsidy period, which had a maximum out-of-pocket expense of $2,000 for solar and $1,800 for heat pump. The efficient systems were 60% during the HESS period (when households only had to pay $1,200 for solar) and were at their lowest during the BSL 1 subsidy period, when households received a maximum $2,000 subsidy and heat pumps were not yet included into the program. Gas systems were highest during the HESS subsidy and BSL 1, with instant gas driving the uptake during HESS and gas storage during BSL 1.

Along with a change in subsidy, the final BSL subsidy period also coincided with new recruitment strategies which specifically targeted households who were interested in solar or heat pump installations.

Figure 17: Solar & heat pump vs instant and storage gas, different subsidy periods



n=524

Discussion

The analysis suggests relationships between the level of subsidy, the conversion of home visits to hot water installations and the types of hot water services installed.

Conversion rates were higher when the subsidy was higher and the out-of-pocket expense was lower

As would be expected, a higher subsidy and lower out-of-pocket cost to the household led to a higher conversion rate from home visit to installation. This was most notable during the HESS program period when the installed cost of a solar or instant gas system was only $1,200 and the conversion rate was 86% (though with low installation numbers). Similarly in BSL phase 3 the conversion from home visit to installation was 61%. During this period the out-of-pocket cost was fixed at below $2,000 for solar and below $1,800 for heat pump. The median subsidy for solar gas was $2,886 and for solar electric and heat pump just over $2,300.

Higher conversion rates mean the home visits are better value for effort.

Higher subsidies and more choice coincided with more efficient systems being installed

The mix of systems installed fluctuated with the different systems on offer and with different subsidy levels. The proportion of solar or heat pumps installed was lowest when the subsidy was lowest in the BSL 1 period. The HESS period with the highest subsidy and lowest out-of-pocket expense to the household coincided with a 60% installation rate of the most efficient system offered at that time. Both BSL 2 and BSL 3 had higher rates of installations of efficient systems, even though they had lower subsidy levels than HESS.

The addition of heat pumps to the systems offered increased the uptake of efficient systems, without requiring a subsidy of the level provided in HESS.

Taken together these results suggest that:

1. Upgrades to solar and heat pump could be achieved in 65% of households with the following subsidy mix:
    - $2,300 to $2,900 for upgrades to solar (with a householder contribution between $1,900 and $2,000)
    - $2,000 to $2,300 for upgrades to heat pumps (with a householder contribution between $1,600 and $1,800)

   These subsidies would need to be on top of any existing subsidies in the market such as VEET or STC.
2. The subsidy level needs to be high enough to stimulate the preferred purchases in the target group, but not so high as to be too costly to fund.
3. Lower subsidies mean that more home visits are required to achieve the same number of installations. One approach to maximise the value of the home visits could be to limit them to those households who demonstrate a need for advice. While this would not necessarily impact on the conversion rate it would reduce the overall costs of the program.

Further research

While this analysis provides some initial insights into the optimal level of subsidy, further research could address important limitations that occurred because of a lack of data on:

- the financial characteristics of the households. The reflective practice process identified possible differences in liquidity (cash in the bank) between the households in the HESS phase and those in other program phases.
- the households that expressed interest but dropped out prior to the home visit
- the different intake and recruitment processes used during HEEUP.

DISCRETE CHOICE EXPERIMENT, RESULTS AND ANALYSIS FOR HEEUP

Authors: Professor Michael Ward and Dr Danny Brent,
Monash University Department of Economics

Summary of results

This study first explored household preferences for hot water service replacement and then produced a flexible tool to estimate the levels of subsidy that would be most likely to encourage take-up of more energy-efficient systems.

A stated choice experiment was conducted to provide information about household demand for hot water systems at various net costs. The experiment was conducted through a survey of over 500 homeowner households with concession cards in the Melbourne area. Participants were presented with choices between different types of generic hot water systems with varying upfront cost and running costs; and then with choices between systems using different technologies, with corresponding upfront and running costs. The cost estimates were adjusted according to the participant's household size, to make them realistic.

The generic choice set showed that:

1 An extra dollar of annual running cost has about 6.7 times the impact of an extra dollar of upfront cost on people's choice.
2 A subsidy has more effect than a comparable reduction in upfront cost.

The response to running cost did not correspond to the person's financial literacy.

The technology choice set, with the scenario that their current hot water system is within two years of its rated life, showed that:

1 People preferred to retain their existing system rather than to install a new system, except for solar and gas.
2 A subsidy had no more effect than a reduced market cost on people's preference: evidently this choice was based on the technology.
3 The annual running cost had more influence on people's preference than in the generic choice set.

The project's core objective was to produce evidence for determining the best subsidies. The decision-support tool that was developed uses three types of input:

- estimates of demand (from the experiment)
- estimates of household hot water costs (initially from HEEUP households)
- budget constraints (funds available for subsidy and for recruiting households)

An important decision in using the tool is identifying the desired objective.

If the purpose is to minimise average running cost for eligible households, then the best option is to provide very high subsidies for solar gas systems, and minimal subsidies for other technologies. However if the objective is to maximise household utility, the maximum subsidies should be similar for all technologies and around $2,000, leaving the choice to the consumer. It may be desirable to balance these two objectives; in any case, the mix of subsidies should be at a level to attract enough recruits.

Introduction

A stated choice experiment was conducted to provide information about household demand for hot water systems at various net costs. The experiment was conducted through a survey of over 500 homeowner households with concession cards in the Melbourne area. A decision-support tool was developed in Excel, based on the analysis of the experimental results. The tool combines three types of input: (1) estimates of demand from the experiment, (2) data on the estimated costs of various hot water systems to a sample of real households and (3) user-defined constraints such as available budget and recruitment costs. Using these inputs, the tool provides an estimate of the impacts of various subsidies for various energy-saving hot water technologies in the Home Energy Efficiency Upgrade Program (HEEUP) program. The report details the objectives, design, conduct, and analysis of the experiment, as well as the development and use of the subsidy decision-support tool. The operation of the tool is described in section 5 (particularly subsection 5.3); readers interested only in the practicalities may wish to skip there directly.

Overview of objectives and methods

The HEEUP program administered by the Brotherhood of St Laurence (BSL) provides subsidies to eligible households for the purchase of more energy-efficient hot water systems. BSL specified that the program objective is to reduce energy bills for eligible households as much as possible. The level of these subsidies must be selected with care to meet this program objective cost-effectively. If the subsidies are set too low, then uptake will be low and recruitment costs high. If the subsidies are set too high, then the budget would cover fewer household system upgrades than desired.

The demand relationship between subsidy levels and household adoption of various technologies needs to be estimated to analyse these trade-offs. To do so, we apply the widely used method of stated preference in a discrete choice experiment format. In this approach, a sample of households is provided a series of hypothetical choices between water systems with various initial costs, subsidy levels, and running costs. Using data on the most-preferred choices, researchers can estimate the demand relationship between subsidy level and adoption rate. We use widely accepted best-practice experimental design to limit any difference between the stated choices of households and the real choices they would make if actually offered the choices.[12]

The results of the choice experiment provide estimates of demand for various hot water system upgrades (or no upgrade) as the subsidy level, installation cost, and running cost of the systems vary. In the experiment, these elements can be varied somewhat arbitrarily to get information about choices under a wide range of conditions. However, to estimate actual demand as a function of subsidies in a real setting, of course one must first plug in realistic estimates of installation costs and running costs for these technologies.[13] Given this information, a decision support tool is provided to recommend subsidies that are predicted to best achieve the program objective of minimising household energy bills, subject to program budget and recruitment costs.

Survey design

The survey instrument is the core component of a stated preference study. In addition to our personal research experience with stated preference surveys, we used evidence from four sources to refine the survey design: prior research on energy efficiency, a focus group, BSL participant data, and pilot data.

Prior studies

Wasi and Carson (2013) examine hot water system purchases in an Australian context. They use a discrete choice experiment to study how consumers respond to upfront costs, running costs and a government subsidy for a variety of hot water systems. We draw on the lessons of this study to guide our design. For example, we are able to use their results to optimise the statistical efficiency of our DCE. This determines the combination of hypothetical scenarios that the respondents see in the survey. The hypothetical scenarios are called ‘choice sets’, and we combine two features of recent research. We also expand on their survey in several important ways. For example, we provide a generic choice that highlights upfront costs and running costs similar to Newell and Siikamäki (2014), as well as a scenario that includes specific types of hot water systems as in Wasi and Carson (2013). Respondents answer five choice sets of the generic choice and five choice sets for the technology-specific choice. Choice sets vary by the values chosen to learn how consumers’ preferences vary between different features of the hot water purchase decision. An example choice set for the generic choice is displayed in Figure 1, and an example of the technology specific choice is shown in Figure 2. For the technology-specific choice we also provide a fact sheet

[12] Carlsson and Martinsson (2001) test the degree to which such hypothetical and real choices might differ in one choice experiment and find no evidence for differences. Murphy et al. (2005) present a meta-analysis of hypothetical bias that finds no significant impact for private goods in a choice experiment context, such as this. Nevertheless, there is always some risk that hypothetical answers will differ from real choices.

[13] For the decision-support tool, we use estimates of these costs from a sample of houses that have received on-site visits; however, these estimates can be changed by the end-user as appropriate.

describing features of each system. Similar to Wasi and Carson (2013) we condition the scenarios on the household size in order to make the scenarios as realistic as possible.

An important feature in choosing a hot water system is trading off between upfront costs and running costs. Most high-efficiency systems that have lower running costs are more expensive. Economists have found that many consumers do not appear to make an investment in energy efficiency that would essentially pay for itself over the lifetime of the product. For example, Allcott and Taubinsky (2013) find that consumers do not purchase compact fluorescent light bulbs even though they will be cheaper in the long run compared to incandescent light bulbs. This anomaly is termed the energy efficiency gap, and we design our survey to better understand to what extent this gap may exist in the context of the HEEUP. Most importantly, we gather information about financial literacy Lusardi & Mitchell 2014) and numeracy that may impact the ability to make a complicated decision such as purchasing a hot water system. Second, we collect information on individual rate of time preferences (discount rates) through a task that asks respondents to choose between receiving some money in one month or more money in seven months. Third, we elicit preferences for risk through a task where respondents choose between various uncertain outcomes, which may be relevant in understanding whether households will replace a system before it completely fails. These three tasks may help explain the energy efficiency gap, and identify different types of consumers that underinvest in energy efficiency.

Figure 18: Generic choice

Choice Experiment Set 1

	New system A	New system B	New system C
Upfront cost	1450	4650	950
Rebate amount	0	50	0
Upfront cost after rebate	1450	4600	950
Annual running cost	640	110	710
Preferred option	○	○	○

Figure 19: Technology-specific choice

You can click the **"Hot Water Systems Information"** to learn more about the specific systems.

Choice Experiment Set 6

	Keep Current System (2 years away from rated service life)	Electric storage	Gas Storage	Gas Instantaneous	Solar + electric	Solar + gas	Heat pump
Upfront cost	0	900	1300	1550	4500	3900	2800
Rebate amount	0	0	0	50	560	470	260
Upfront cost after rebate	0	900	1300	1500	3940	3430	2540
Annual running cost	510	570	520	490	180	350	450
Most preferred option	○	○	○	○	○	○	○
Second-most preferred option	○	○	○	○	○	○	○

Focus group

After designing the initial survey we conducted a focus group to test and get feedback on the draft survey instrument. The focus group comprised nine individuals, mostly concession card holders, recruited by Taverner Market Research. The session was conducted by Dr Brent and was video-recorded. A primary aim was getting general feedback about the wording and clarity of the questions. In addition, we created choice sets to determine whether respondents were making 'mistakes' with respect to choosing between upfront costs and running costs. If costs are the only decision factor (as they should be in the generic choice) then a respondent should select the option that minimises the lifetime net present cost, defined as the upfront cost plus discounted future running costs. We found that respondents often did not select the option that minimised the net present costs. There were several general decision rules mentioned by the focus group:

- payback period: determining how many years it would take to pay back higher upfront costs through reduced running costs
- environmental concerns: even in the generic choice higher running costs were associated with more energy use and more environmental damage
- information content of the subsidy: since the subsidy program was funded by the government and run by a non-profit the hot water systems with a subsidy were thought to be higher quality

Respondents also provided testimonies of their own experiences buying hot water systems. One theme was that the layout of the home meant some hot water systems would have very expensive installation costs if they require significant plumbing and/or electrical work. Additionally, respondents said that choosing an expensive energy efficient hot water system would come at the expense of other investments such as double-glazed windows. Lastly, we tried to understand whether the subsidy program could induce consumers to update their hot water system before it failed. Some respondents indicated that they would be willing to update their system if it was close to the end of the rated service life though it wasn't showing any signs of failure. Respondents also indicated that the survey was mentally taxing since it involved complex calculations to determine the best system.

We updated the survey in response to the focus group in several ways. First we included a button that calculates the payback period relative to the cheapest option. We randomise whether the respondent has access to the button, to determine whether the additional information changes the respondents' choices, and particularly whether it increases the likelihood of selecting the system with the lowest net present costs. We also changed some of the language that the respondents found unclear, such as framing the risk task in the context of investments in hot water systems.

BSL participant data

One of our goals in designing the survey instrument was to make it relevant to the HEEUP so that policy recommendations could be made based on the results. Therefore we analysed early participation data from the program. Our participation data is from 1 April 2014 to 12 March 2015; until 1 July 2014 HEEUP was run in conjunction with the Home Energy Saver Scheme (HESS), which offered larger rebates than the subsequent phase of HEEUP. We used two primary datasets. The first is the administrative data on participation including everyone who enquired about the program but eventually dropped out. The second dataset contains data collected during home visits by staff from the BSL, using options derived from the Hot Water Tool (HWT).The HWT was developed by the New South Wales government and takes inputs such as the number of occupants, type of appliances, and number of showers per week to estimate the running costs and upfront costs of a new hot water system. The BSL selects a subset of the sixteen options to show to the householder to help them decide which hot water system to purchase.

One key feature of the participation data is that of the roughly 1000 participants who had expressed interest in HEEUP (as of April and after HESS ended) 7% have completed installations with another 13% somewhere in the process that could lead to a successful installation. Presumably, the other 80% choose not to replace their system at this time (or at least not to replace it as part of this program), even though they had been considering the possibility. This suggests that it is important to understand the decision to replace an ageing hot water system even if it is still functioning. In order to address this question, in the technology-specific choice (Figure 2) we allow the respondents the option to keep their current system. We tell them that the current system has two years left on its rated service life, and that the subsidy may not be available next year. This is expected to replicate the decision process of many of the people who drop out after expressing interest. In this setting we ask for the top two choices, so that we are able to learn what system a respondent would choose if their first choice is to keep their current system.

The second feature that we consider is the lifetime cost estimates that we generate from upfront and running cost estimates from the Hot Water Tool. As described above we calculate the net present lifetime cost (NPLC) of a new system with the following formula that accounts for both upfront and running costs.

$$net\ present\ lifetime\ cost = upfront\ cost + \sum_{0}^{T} \frac{running\ cost}{(1+r)^t}$$

We assume a rated service life of 10 years (*T*=10) and a discount rate of 5% (*r* =0.05). Higher values for *T* and lower values of *r* will make more efficient systems like solar have lower NPLC. A discount rate of 5% is on the lower side of what is found in the economics literature. In the context of hot water systems Wasi & Carson (2013) find an average discount rate of 20% and (Newell & Siikamäki (2014) elicit average discount rates of 19%. Based on these assumptions we find that in the sample that received a home visit, even accounting for the BSL subsidies, gas systems had the lowest NPLC for 60% of the households and solar systems were the cheapest in terms of NPLC for the remaining 40%. These numbers are similar in the sample that eventually installed a new system through HEEUP. While 60% of the HEEUP installations post-HESS were solar + gas systems, this was the system with lowest NPLC for only 30% of the participating households. On average the NPLCs were approximately $800 higher for the installed model compared to the model with the lowest NPLC.

Pilot data

Running a pilot wave in a discrete choice experiment is advantageous for two reasons. The first reason is to identify areas of the survey that are unclear to the respondents and update accordingly. Second, getting pilot data allows the researcher to update the design of the discrete choice experiment based on the initial round of data, which can produce a more efficient design from a statistical perspective. There were not many changes that we made to the survey based on the pilot, but we did update the experimental design to improve statistical precision. It was helpful to understand two strains of comments from the pilot data. Many respondents stated that the survey was very interesting and challenged them to think in different ways from other surveys they completed. Another group of respondents stated that the maths made the choice sets quite difficult. This is important to consider in the context of actual purchase of hot water systems, which is even more complex than the choice experiment. Some comments from the pilot are listed below:

> ‘Very interesting exercise to try sensible, realistic comparisons’
>
> ‘Very thought provoking’
>
> ‘Unexpectedly mentally challenging!!!’
>
> ‘A fantastic and very different but very interesting survey, really enjoyed’

'Very interesting, makes you think about long term costs'

'A bit tough on the grey matter!!'

'You have to be good at maths to work this out'

'Thanks, made my maths brain work hard'

Final survey

The final survey was implemented by the Iview market research company with a sample of over 500 households that satisfied all the selection criteria: homeowners, concession-card holders and in the Melbourne area. These selection criteria, which reflected the original eligibility criteria for HEEUP, produced a sample predominantly of older adults. The instructions to the survey firm are included in Appendix G: Discrete choice experiment. The survey participants are part of an online panel that has agreed to be invited to participate in a variety of studies. The participants receive a small incentive for participation, with a cash equivalent value of a few dollars. The panel provider performs periodic checks on panel members' responses for quality assurance. In our sample, we gathered completion time data as a check on attentiveness. The survey instruction specified that we expected the questions to take no more than 20 minutes. Some 95 per cent of the sample took at least 12 minutes to complete the survey. The quickest 5 per cent of the sample were discarded as potentially non-attentive.

A key design feature is that the hot water system choice sets for each respondent are customised for the household size. This is important for maintaining plausibility and realism. For example, it would make little sense to provide a one-person household with a choice-set that contained typical annual running costs for a five-person household. The reasonable and relevant ranges for each household size were taken from the BSL participation data discussed in section 2.3. Each participant was asked to select their most preferred option in each of 10 choice sets, half of which specified technologies and half of which were generic. As noted before, Figure 1 and Figure 2 are examples of the main types of choice sets.

Sample characteristics and summary of survey responses

Age: The mean age is 67 years. Half of the sample is between 64 and 71 years of age.

Housing: 86% of the sample own a house. The remainder own flats, townhouses, or duplexes.

Language: 98% of the sample speak English at home; this high rate is not surprising given that the sample consists of people who sign up to participate in English-language surveys.

Sex: 51% of the sample is female.

Household size: 1 – 22%, 2 – 65%, 3 – 6%, 4 or more – 7%

Marital status:

Marital	Freq.	Percent	Cum.
De facto relationship	22	3.98	3.98
Divorced	61	11.03	15.01
Married	343	62.03	77.03
NA	55	9.95	86.98
Refused	8	1.45	88.43
Separated	7	1.27	89.69
Single	57	10.31	100.00

Employment: 71% retired, 10% part-time, 10% no response

Current hot water system:

Current hws	Freq.	Percent	Cum.
Don't know	15	2.71	2.71
Electric	98	17.72	20.43
Gas instant	148	26.76	47.20
Gas storage	221	39.96	87.16
Heat pump	5	0.90	88.07
Multiple	31	5.61	93.67
Other	4	0.72	94.39
Solar	31	5.61	100.00

Age of current hot water system:

Hws age	Freq.	Percent	Cum.
1-2 years	80	14.47	14.47
3-5 years	123	22.24	36.71
6-10 years	152	27.49	64.20
Don't know	37	6.69	70.89
More than 10 years	161	29.11	100.00

Considering replacing hot water system: 7.5% yes

Gas connection: 88% yes

Q13. What would be the four most important factors to you in choosing a new hot water system?

*Select exactly 4 answers [**PERCENT SELECTING IN SAMPLE INDICATED]***

1. **23%** Plumber's recommendation
2. **71%** Fuel type (electricity, gas, solar, heat pump)
3. **10%** Flow rate

4. **28%** Lifetime
5. **6%** Noise/quietness
6. **45%** Upfront cost
7. **13%** Simple installation process
8. **14%** Sitting position (e.g. indoor/outdoor, roof/ground)
9. **16%** Temperature control
10. **26%** Least chance of running out of water
11. **11%** Tank material (e.g. stainless steel)
12. **72%** Low running cost
13. **27%** Environmental friendliness
14. **28%** Warranty
15. **9%** Brand
16. **1%** Other (please specify) __________

Q14. Also, what would be the three least important factors in choosing a new hot water system? *(Remove top four choices)*

*Select exactly 3 answers [**PERCENT SELECTING IN SAMPLE INDICATED]***

1. **30%** Plumber's recommendation
2. **6%** Fuel type (electricity, gas, solar, heat pump)
3. **15%** Flow rate
4. **12%** Lifetime
5. **34%** Noise/quietness
6. **14%** Upfront cost
7. **26%** Simple installation process
8. **35%** Sitting position (e.g. indoor/outdoor, roof/ground)
9. **10%** Temperature control
10. **17%** Least chance of running out of water
11. **28%** Tank material (e.g. stainless steel)
12. **4%** Low running cost
13. **12%** Environmental friendliness
14. **8%** Warranty
15. **50%** Brand
16. **1%** Other (please specify) __________

Q20

Expected change in natural gas price over 10 years:

Gas price	Freq.	Percent	Cum.
Decrease by 5% or more	1	0.18	0.18
Don't know	70	12.66	12.84
Increase between 10-25%	217	39.24	52.08
Increase by less than 10%	102	18.44	70.52
Increase by more than 25%	136	24.59	95.12
No significant change	27	4.88	100.00

Q22. If you received a letter from a non-profit offering a rebate of up to $____ for a gas hot water system or up to $_____ for a solar hot water system would you call the listed number to find out more information?

1. **29%** Yes
2. **61%** No, I don't need a new hot water system
3. **10%** No, other reason, please specify_________

[If No #2 above] Q23. If you need to replace your system in the next __ years, would you call to find out more about the rebate?

1. **81%** Yes
2. **19%** No

NOTE: the dollar and year amounts in Q22 & Q23 did not significantly predict response

Discrete choice analysis

Generic choice sets

A typical generic choice set is displayed in Figure 1 of Section 2.1. Here, generic is taken to mean that the particular type of water heater is not specified, but only the (a) net cost, (b) subsidy, and (c) annual running cost. The directions specify that the current water heater must be replaced due to failure. Each choice set provides 3 options, one of which is not subsidised.

The choices were analysed using a conditional logistic regression, with explanatory variables being net (of subsidy) initial cost, annual running cost, and subsidy. The unit on each is $10,000. In addition, a 'dummy' variable indicating presence (not level) of subsidy is included. All variables are highly significant.[14] There are two key findings here. First, an extra dollar of annual running cost has about 6.7 times the impact on people's choice as an extra dollar of installation cost. This is a plausible figure, as the running cost will be borne annually over the life of the system (the rated life is specified as 10 years).

Second, a subsidy has greater impact than simply a dollar-for-dollar reduction in net upfront cost. In effect, $0.80 of additional subsidy has the same impact on purchase decisions as a $1.00 reduction in the market cost of a system. This may be consistent with respondents inferring that subsidised systems have higher quality in unspecified dimensions. Regression output is displayed in Table 14.

Table 14

```
Conditional (fixed-effects) logistic regression   Number of obs    =       8295

                                                  Wald chi2(4)     =     383.10

                                                  Prob > chi2      =     0.0000

Log pseudolikelihood = -2767.4463                 Pseudo R2        =     0.0890

                                      (Std. Err. adjusted for 553 clusters in id)
```

		Robust				
Chosen	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Net10k	-7.02803	.3849137	-18.26	0.000	-7.782447	-6.273613
Run10k	-47.90285	3.098502	-15.46	0.000	-53.9758	-41.8299
Sub10k	1.733758	.2383739	7.27	0.000	1.266554	2.200962
Subdum	.2429807	.1068316	2.27	0.023	.0335946	.4523667

About half of the sample were presented with a calculation aid in the form of 'payback period' relative to the unsubsidised option. This treatment was provided to explore how sensitive respondents are to the framing of choices. This information treatment had very little economic or statistical effect on the estimated results.

The impact of financial literacy was tested by including an interaction between the respondent's literacy index and their responses to running costs. No significant effect was detected.

A more general random-parameters specification (mixed logit with normal terms) was also tested as a robustness check. As is typical, there is evidence of correlation between choice set decisions for individuals. However, as a predictor of average demand, the random parameters specification adds no significant value. This is evident from using a pseudo-likelihood approach that omits group structure, as if each choice were independent.[15]

Technology-specific choice sets

A typical generic choice set is displayed in Figure 2 of Section 2.1. Here, technology-based is taken to mean that the particular type of water heater is explicitly specified in

[15] Kelejian and Prucha (1999) present the theory of pseudo-likelihood estimation in discrete outcome models.

addition to the (a) net cost, (b) subsidy, and (c) annual running cost. The directions specify that the current water heater is within two years of the rated service life. However, keeping the current system at no immediate cost is an option. Each choice set provides 7 options: no new system, electric storage, gas storage, gas instant, solar with electric boost, solar with gas boost, and heat pump. The survey directions contained a link to a description of these technologies.

The choices were analysed using a conditional logistic regression, with explanatory variables being net (of subsidy) initial cost, annual running cost and subsidy. The annual running cost for no change is entered separately, because the scenario states that the unit will reach the end of its rated life in two years. The unit on each is in $10,000.

In addition, indicator variables for the type of technology are included. The default technology is no change, so the technology coefficient should be interpreted as relative to no change. Results from a conditional logistic regression are presented in Table 15.

Table 15 (Preliminary model)

```
Conditional (fixed-effects) logistic regression   Number of obs   =      19355
                                                  Wald chi2(11)   =     430.91
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -4612.7517                 Pseudo R2       =     0.1427
                                   (Std. Err. adjusted for 553 clusters in id)
```

Chosen1	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
Electric	-1.465992	.2580195	-5.68	0.000	-1.971701	-.9602834
Gas storage	-.7843474	.2269523	-3.46	0.001	-1.229166	-.339529
Gas instant	-.3013716	.2571037	-1.17	0.241	-.8052856	.2025424
Solar+gas	-.3335984	.2917927	-1.14	0.253	-.9055016	.2383049
Solar+electr	.0413374	.2975617	0.14	0.890	-.5418728	.6245477
Heatpump	-1.909594	.3354738	-5.69	0.000	-2.567111	-1.252078
Net10k	-3.226535	.3703205	-8.71	0.000	-3.95235	-2.50072
Run10k	-30.43153	4.767202	-6.38	0.000	-39.77508	-21.08799
Runcur	-22.11087	4.2943	-5.15	0.000	-30.52754	-13.6942
Sub10k	.2065826	.3001683	0.69	0.491	-.3817365	.7949017
Subdum	.1568391	.1576509	0.99	0.320	-.152151	.4658292

Here, the first six variables are technology indicators. We observe from the negative signs a significant distaste for moving to new technologies, except solar and gas instant, relative to what might be expected from net upfront cost and annual running cost.

In contrast to the generic model, the subsidy terms are no longer significant by themselves. Of course, subsidies are still quite important through their impact on net upfront cost, but a dollar of subsidy has the same impact as a dollar reduction in the market cost of a system. This is consistent with respondents focusing on the technology choice as the primary indicator of quality, rather than focusing on existence of a subsidy.

We also observe a higher focus on the annual running cost as compared to the generic choice, with the ratio now about 9.5. Arguably, this is *too* much focus, as it would be consistent with an effectively zero discount rate if the systems last their rated 10-year life. As one would expect, the impact of the current system running cost (denoted runcur) is less than the replacement system. However, the ratio is higher than one would expect from discounting considerations. However, it is not implausible as a predictor of actual behaviour, which is our goal in this analysis.

These findings suggest that the model may be usefully simplified for predictive purposes by omitting the direct subsidy effects. Table 16 shows this simplified (and preferred) model.

Table 16 Simplified and preferred model

```
Conditional (fixed-effects) logistic regression   Number of obs   =      19355
                                                  Wald chi2(9)    =     436.65
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -4614.0334                 Pseudo R2       =     0.1424
                                   (Std. Err. adjusted for 553 clusters in id)
```

Chosen1	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
Electric	-1.42968	.2547836	-5.61	0.000	-1.929046	-.9303128
Gas storage	-.7095775	.2165917	-3.28	0.001	-1.134089	-.2850657
Gas instant	-.1216188	.2026653	-0.60	0.548	-.5188355	.2755979
Solar+gas	-.0938273	.2129212	-0.44	0.659	-.5111453	.3234906
Solar+electr	.2801706	.2292201	1.22	0.222	-.1690926	.7294338
Heatpump	-1.683753	.2636747	-6.39	0.000	-2.200546	-1.16696
Net10k	-3.333995	.3386235	-9.85	0.000	-3.997684	-2.670305
Run10k	-31.19573	4.743465	-6.58	0.000	-40.49275	-21.89871
Runcur	-22.29274	4.311943	-5.17	0.000	-30.744	-13.84149

As with the generic choice experiment, a random parameters generalisation was estimated as a robustness check (mixed logit with normal terms). The qualitative results are similar. Again, there is evidence of heterogeneity across households in the acceptable trade-offs. However, once again a pseudo-likelihood approach finds no evidence for improved prediction of average demand. Accordingly, we do not use the random-parameters approach in estimating demand for the decision tool.

Decision-support tool

The core objective of this project is to provide an evidence base for the determination of the best subsidies. To provide this evidence in a user-friendly format, we have produced a decision-support tool in Excel. The tool combines three types of input: (1) estimates of demand from the experiment, (2) data on the estimated costs of various hot water systems to a sample of real households and (3) user-defined constraints such as available budget and recruitment costs. It allows use of the Solver functionality in Excel to solve a constrained optimisation problem, though we recommend an experimental and iterative user-driven approach centred around the current subsidy scheme.

Methodology

One reasonable objective function is to minimise the expected sum of annual running cost of households eligible for HEEUP. We focus on this for clarity, but later address alternative objective functions (see Section 5.3 below). The primary constraint is the program budget. The variable costs in this budget are (a) expected subsidy requirements and (b) recruitment costs associated with in-home consultations.

To make the tool operational, we apply the optimisation procedure as if the sample of households who have participated in the program through BSL are representative (see 2.3).[16] To fix ideas, consider expected running costs for a single household. That household is offered a menu of new technologies (indexed by *j*) each with a differing subsidy level sub_j (possibly 0). One option is always to not participate in the subsidy program. The expected running cost for this household can be expressed symbolically as

$$\sum_j p_j(sub|\beta, z)\ run_j.$$

Here, *p* indicates the demand for technology *j* in terms of the probability that the household will choose each technology. The choice variables that we use to control demand are the subsidies *sub.* Demand also depends on the vector of characteristics *z*, which include running costs and market costs of the systems. The term β indicates that demand depends on the parameters statistically estimated from the experiment, as presented in Table 3.

[16] It is straightforward for the end-user to adjust the sample as new information arrives about the characteristics of eligible households.

To operationalise this, it is helpful to write out the full expression for the probabilities *p* implied by the form of the conditional logistic regression implemented in Section 4*:*

$$p_j \propto \exp\left(\alpha_j + \beta_{net}\, upfront_j - \beta_{net} sub_j + \beta_{run} run_j\right)$$

Here, α_j is the technology corresponding coefficient (e.g. solarg). β_{net} is the coefficient on net upfront costs, and β_{run} is the coefficient on the running cost. The subsidies are choice variables. The symbol ∝ indicates 'is proportional to', and so the exact values of the probabilities *p* can be determined by normalising the sum of the technology probabilities to sum to one for each household. In the decision tool, the various coefficients correspond to those displayed in Table 3.

The upfront costs and the running costs in the probability equations are data for the household options. The goal is to select a standard subsidy for any household. So we need to average the predicted demand over many representative households, because the running cost and installation cost data for households will vary.

In sum, the decision tool chooses subsidies to maximise the expected total annual running cost *savings* over *T* households, relative to current (no change) running costs of run_0.

$$T * \sum_{i=1}^{N} \frac{1}{N} * \left(run_{i0} - \sum_j p_{ij}(sub|\beta, z)\ run_{ij}\right)$$

subject to the constraint

$$T * \sum_{i=1}^{N} \frac{1}{N} * \sum_j p_j(sub|\beta, z)\ sub_j\ + T * visit\_cost < budget$$

Here *visit_cost* reflects any marginal cost of providing a home consultation. This parameter, as well as the available budget, can be supplied by the analyst. Here, we take the target number of households visited *T* as a fixed parameter. However, it can be adjusted by the user to explore different options. The first summation and then division by N reflects the averaging of demand over data for N representative households.

Implementation

To operationalise this method, of course we need a sample of representative cost data. Of course, there are many households with different characteristics and costs. For this purpose, we use a sample for which BSL has conducted in-home consultations and run HWT estimates (see 2.3). The working hypothesis is that the characteristics of this sample are representative of the overall potential Melbourne base of eligible households. This is the most defensible default source of data for the model, in the sense that it assumes that future households that receive home consultations under the BSL scheme will be on average similar to the sample of past households. However, the data supplied can always be customised to reflect any improved information on that score.

Our initial data sample includes 230 observations from the HWT provided by BSL. In addition to options for new technologies, the tool specifies the closest approximation to the current technology. Of these 71% are ‘natural gas storage 4’, 19% are ‘electric off-peak’, and 9% are ‘natural gas instant 4’. Our 7 options in the choice experiment are taken to correspond to the HWT options of ‘current technology’, ‘electric storage off-peak’, ‘natural gas storage 6’, ‘natural gas instant 6’, ‘solar natural gas’, ‘solar electric off-peak tariff’, and ‘heat pump’.

Operation

The decision-support tool is implemented in Excel. The user must supply:

1) Data on a representative sample of hot water system costs at the household level. The tool currently uses output from the HWT on a sample who have received home consultations from BSL. The user may change these. These are coded in blue in the tool.

2) Coefficients for household preferences in the logit model. These are taken from Table 3 in this report, based on analysis of the discrete choice data. These are coded in green in the tool.

3) Key parameters. These include (a) total budget for subsidies and visits (currently input at $1.5 million), (b) cost for a home consultation (currently $150), and (c) target number of home consultations (currently 1000). In addition, the user may specify weights to put on household utility versus total energy bill savings, which are not the same as discussed later. These are coded in orange in the tool.

4) Key choice variables. These are (a) the subsidies by technology and (b) a minimum co-payment by the household by technology. These are both specified in units of $10,000. So, for example, the tool currently specifies $500 as the minimum co-payment. This is entered as 0.05. These choice variables are coded in yellow in the tool. There are extra columns just below that translate these back into ordinary dollars, so the user can easily ensure that the units are translated correctly.

5) Results of the tool calculations. These are coded in light red in the tool. These include (a) average current running cost, (b) average new running cost (post-HEEUP), (c) average subsidy, (d) expected recruits, (e) total cost of home visits and subsidies, (f) participation rate (home consultations converting to participation), and (g) predicted shares of technologies. Two additional outputs are the ‘average household utility’ and ‘weighted criterion’. These may be helpful in determining broader impact of the program on participants. These will be discussed more later.

Currently, the tool has illustrative choices for all inputs, and so it is fully operational. BSL users can update the data and parameter choices as appropriate and required.

The most basic mode of operation should be changing the subsidies (in yellow), and observing what happens to the result measures (in red).

With care, the Solver plug-in can be used to calculate optimal choices under various criteria. The 'with care' is especially important when minimum co-payments are positive. It is not recommended to choose these co-payments with Solver, because of corner cases. For example, if the minimum co-payment exceeds the actual cost of a system type, then no subsidy will ever be given (making a very high subsidy confusing but mathematically reasonable). Solver currently has an example loaded. All that is required is to go to Tools/Solver and hit 'Solve'. However, it may be more informative and practical to start near the current scheme and experiment by hand with changes that seem institutionally plausible or promising.

Minimising running costs

Next, we discuss patterns in optimal choices from a variety of test runs. Our key finding is that the choice of objective function is extremely important. If the objective function is to minimise the average annual running cost, then a robust pattern is to set very high subsidies on solar gas, and very little (or no) subsidy for other technologies. This was surprising to us at first. However, on detailed inspection it appears to be correct. The intuition is that solar gas has the lowest running cost on average by a fair margin. When the objective is to minimise running cost, there is a strong logic to putting almost all weight on getting people to adopt that technology. Subsidising a less running-cost efficient technology in addition makes more people choose the less efficient technology; hence, there is a logic to having low or no subsidies for alternatives. The pattern of very high subsidies on solar gas is robust to many experimental variations. These include setting the technology coefficients to zero, increasing the net cost coefficient, and increasing minimum co-payments. While combinations can be found that do offer modest subsidies to other technologies, solar gas is robustly much higher. This may be somewhat unexpected, and that may be because the benefit to the consumer is intuitively a consideration as well. We discuss this point next.

Maximising utility

Note that very high solar gas subsidies are not necessarily the best outcome for HEEUP participants. That is because some participants would rather have a different technology, and will only adopt solar gas with the very high subsidies. From the point of view of such a person, they would often be better off with a reasonable but lower subsidy on a different technology (with higher running costs). The capital cost subsidy is a direct benefit to HEEUP participants, and so they do not care only about the running cost. If the total pool of subsidies is roughly fixed, one might wonder how this can be an issue. The calculations show that a policy that focuses exclusively on solar gas induces households to spend more on upfront costs (net of subsidies) than do more balanced subsidy policies. One alternative objective function that reflects this issue is to maximise household utility[17]. Underlying the logistic discrete choice model is a utility-based model

[17] In economics, utility is understood as the ability of a good or service to satisfy one or more needs or wants of a consumer. A hot water service, for example, might be assessed by a consumer in terms of its appearance, environmental impact, durability, etc, as well as its direct financial costs.

of consumer choice (McFadden 1986). The expected utility reflects both the costs and the probabilities of choosing various alternatives. This is also known in the literature as the 'inclusive value', and it has the form of the log of sum of the exponential terms underpinning the probabilities.

In experiments with the household utility as the objective function, a reasonably robust pattern is that the largest available subsidies for all technologies should be similar and on the order of $2,000 (though in practice they will differ due to binding co-pay constraints). While perhaps surprising at first, there is a reasonable economic logic to this pattern. The utility approach takes the consumer preferences as the key guiding principle. Offering similar maximum rebates leaves the best decision in the hands of the consumer, without steering this way or that overly much. Such steering is not needed if we take consumer preferences as well-informed and our core guide. Of course, one will not actually deliver a $2,000 subsidy on an item that costs less than that (co-pays cannot be negative at the least). But that is a separate constraint and does not limit what one might reasonably pay if the costs had been higher.

Balancing cost and utility

While there is logic in the previous outcomes, neither the cost-minimising nor utility-maximising results seem 'comfortable'. One intuitively expects an outcome between these, probably because one intuitively places weight on both objective functions. It is reasonably straightforward to create a criterion that balances the two, with weights determined by the user. The most important element is normalising the two objective functions to the same implicit scale. The tool implements this as the 'weighted criterion', based on the choice of user-selected weights that should sum to one. A weight of 0 on either term and 1 on the other boils down to using just one of the objective functions. As an illustration, we have experimented with weights of 0.5 on each.

Bottom line

Different choices of objective function lead to a different balance of subsidies between technologies. However, perhaps more important is getting the overall mix of subsidies to be at a level that brings in sufficient recruits to the program. That requires a balance of large enough subsidies to be attractive and keep recruiting and drop-out costs low, and small enough subsidies that many people can benefit. The tool provides estimates of program enrolment for any mix of subsidies. The recommended approach is one of experimentation around a general pattern of subsidies that makes sense to BSL. In doing so, one can gain information about how a general increase or decrease in the levels will affect outcomes including overall recruitment. As one would expect, the results are between the two extremes, with (conditional on the illustrative parameter choices) maximum subsidies of 0 for electric storage and heat pump, $900 for gas, $1300 for gas instant, $1400 for solar electric, and very large $3800 for solar gas. The overall pattern is the point here, not the exact figures, as those will be driven especially by available budget and target number of recruits.

Limitations

We have conducted this analysis in good faith using best practice techniques as we understand them, subject to time, budget and logistical limitations. However, it should be understood that this analysis is only a guide to overall patterns that may be expected. The analysis is based on stated preference responses to hypothetical choices. Accordingly, there will almost surely be some discrepancy between the choices that households would actually make, and those that they state they will make in a survey context. Further, the analysis is based on a sample of householders participating in an online market research panel, who appear to be eligible for HEEUP. These households may not be representative of average eligible households along various dimensions relevant to water heater investment. The parameters and the data implemented in the tool should be scrutinised by the BSL. The current choices are illustrative, based on the best albeit limited information we have at hand. They are intended to be fine-tuned. The insights of the analysis and the tool should be combined with practical experience, both past and future, by the HEEUP team. It should not and cannot be taken as an exact prediction of what will happen in various scenarios. In short, this is a research project, not a crystal ball. While we have done our best, the end user should apply judgement and experience in interpreting the results.

4 Did HEEUP change purchasing decisions?

In assessing the impact of the HEEUP program it is important to ascertain to what extent HEEUP led to hot water upgrades that would not otherwise have occurred. In other words, would the participants have upgraded to the same system even if HEEUP had not assisted them?

Two approaches have been used to assess whether HEEUP participants changed their purchasing decision as a result of the program:

1 HEEUP participant survey and installation results
2 HEEUP case studies

HEEUP SURVEY AND INSTALLATION RESULTS

Summary of results

HEEUP shifted upgrades to a planned decision

Without HEEUP, (73%) of HEEUP participants would not have changed their hot water system until it broke down. HEEUP brought forward these households' upgrade decisions and made them a planned upgrade. In doing so HEEUP was able to prevent ad-hoc decisions, when there is limited opportunity for households to weigh up the relative costs and benefits of different hot water systems.

HEEUP participants upgraded to a more efficient system than they would have without HEEUP

HEEUP also shifted participants' upgrade choices to more efficient hot water systems. Without HEEUP, only 19% said they would have upgraded to solar and 7% to heat pump. With HEEUP participants opted for more efficient systems, with 47% purchasing solar and 27% purchasing heat pumps.

HEEUP also shifted participants to their ideal upgrade choice

Participants final upgrades were more in line with their overall preference than they would have been without HEEUP.

Introduction

HEEUP aimed to change the hot water system purchasing decisions of low-income households by bringing them forward as a planned upgrade, which increased the opportunity of a shift to more efficient solar or heat pump system.

Data and methodology

To assess whether the program shifted purchasing decisions, participants' views on upgrades were compared with their final upgrade choice.

During the home visits, energy engagement officers asked the HEEUP participants three questions to ascertain whether they had changed their purchasing intentions as a result of the program:

1. If not for the HEEUP program (this program), when do you think you would have replaced your hot water system?
2. If not for this program, what type of hot water system would you have replaced your existing system with (taking into account what you know of the existing price and with no additional rebates)?
3. Cost aside what would be your preferred hot water replacement?

These questions, part of the collection of CSIRO/DIIS data, were asked of 548 standard HEEUP participants and 19 emergency replacement participants. Community housing tenants were not asked the questions because they do not control the upgrade decision. Independent installers were not asked the questions either because they decided to upgrade independently of HEEUP.

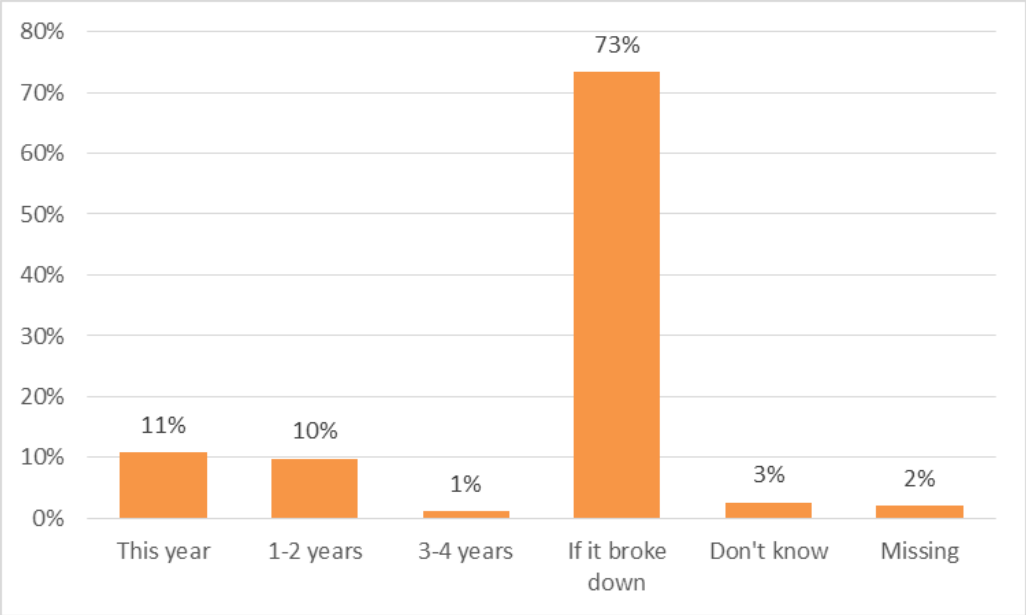
Actual upgrades, recorded in the administrative data, were compared with this survey data.

Results

HEEUP brought forward upgrade decisions

The overwhelming majority of responding participants (73%) said if not for HEEUP they would not have replaced their hot water system until it broke down. Another 22% said they would have replaced their system within 4 years, including 21% within 2 years (Figure 20).

Figure 20: When households would have upgraded their hot water system



n=416

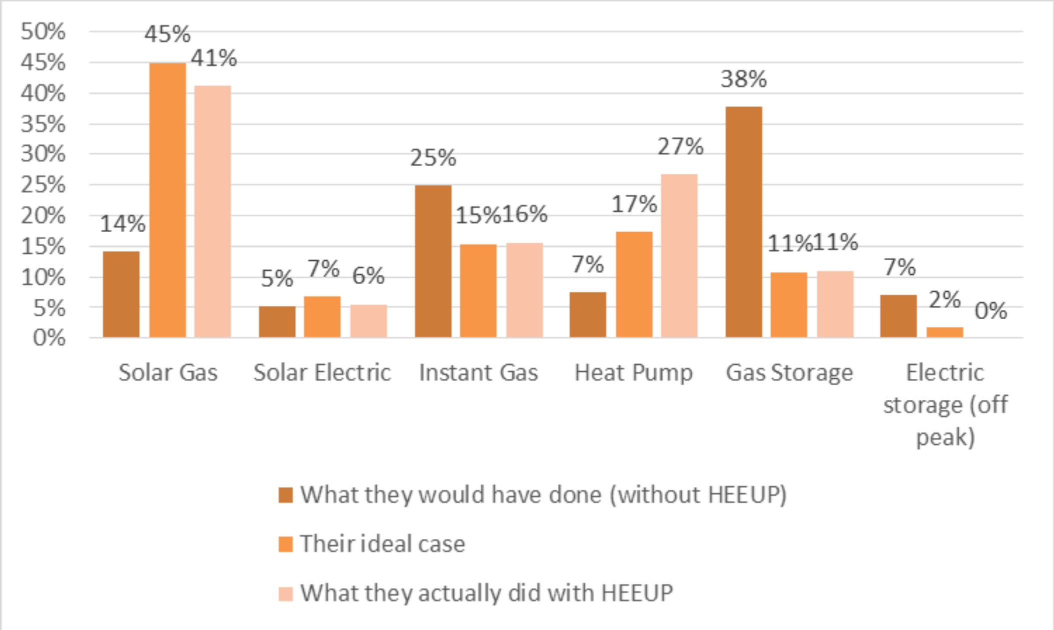
Participants shifted to preferred options: solar and heat pump

If not for the HEEUP the majority of participants said they would have upgraded to natural gas storage (38%) or instantaneous (25%) hot water systems. Only 19% would have upgraded to solar (gas or electric boosted) and 7% to heat pump, which are the more efficient systems.

By contrast when participants were asked what their ideal upgrade would have been, 52% selected solar hot water as their ideal upgrade and 17% selected heat pump.

The actual upgrade choice the participants made closely aligned with their ideal for the solar hot water preferences, with 47% upgrading to solar. However, there was an increase in the number of clients who actually installed heat pumps (27%), compared with those who chose it as their ideal (17%). The actual installations of instant gas (16%) and gas storage (11%) aligned closely with the proportion who chose it as their ideal upgrade (15% and 11% respectively).

Figure 21: Changing preferences as a result of the HEEUP intervention



n=416; 2 missing results

Discussion

Participant responses indicate that for the majority of households, HEEUP brought forward hot water system purchasing decisions from an emergency breakdown scenario to a planned early upgrade.

This change was a key objective of the HEEUP program. HEEUP was able to circumvent a last minute upgrade decision. At such times, with pressure to replace the broken system, there is often limited opportunity for households to fully assess the relative costs and benefits of different hot water systems.

This had important implications:

1 More households were able to upgrade to the type of hot water service they wanted
2 More households were able to upgrade to highly energy efficient systems

Further research

While no attempt has been made to assess the savings achieved by early upgrades in the HEEUP program, it would be possible to model the age of the replacement system and the estimated working life of the corresponding systems. This would enable a calculation of the savings associated with an early upgrade to a more efficient system.

5 What lessons were learnt from the program, what were the enablers?

One of the objectives of HEEUP was to identify lessons from the program including what enabled the program to function effectively and what the barriers were.

This section of the report includes:

1 HEEUP research case studies
2 Lessons from the reflective practice process

RESEARCH CASE STUDIES

The eleven household case studies presented in this chapter provide insight into a small group of participants' motivations for joining the Brotherhood of St Laurence's Home Energy Efficiency Upgrade Program (HEEUP) and their experiences of the program. They highlight factors influencing householders' decisions about upgrading hot water services and illustrate some of the ways HEEUP achieves and fails to achieve its stated objective of addressing barriers to upgrading hot water services.

Collectively the case studies add to the research knowledge about residential energy efficiency in the context of hot water and the factors that facilitate participation in energy efficiency programs for households with low income.

Summary of results

Household context

The case study households were different sizes, at different life stages and managing their energy use and upgrade decisions in the context of varying levels of low income, wealth, financial hardship, energy bill arrears and access to suitable financing options.

They all had old hot water services, some of which were unreliable or damaged and one of which was completely in-operative.

Participants' goals

Case study participants had varying reasons for joining HEEUP, including

- improved energy efficiency of hot water service to improve affordability of household energy use
- decreasing the environmental impact of their hot water consumption
- ensuring the reliability of their hot water service
- amenity benefits such as improved hot water and control over hot water

Lessons learnt

The case studies illustrate some experiences of the eleven participating households, including that HEEUP addressed:

- capital barriers through a combination of either rebates, loans or full funding
- information barriers, mostly through a mixture of EEO and installer advice
- the tenancy barrier.

HEEUP did not overcome information asymmetry and trust barriers for one household and did not run long enough to engage one other.

Case study households reported achieving energy savings, bill savings, greener energy use and peace of mind.

Changing purchasing decisions

HEEUP influenced case study households' purchasing decisions by making upgrades possible, bringing upgrades forward, making upgrades more energy efficient and influencing future purchasing decisions.

Research framework

The HEEUP case studies provide description and illustration of the householder experience of HEEUP and exemplify some of the findings of other parts of the research.

The case studies focus on the third and fourth of the HEEUP research questions:

3. Has HEEUP overcome the identified barriers (capital, information, trust) to energy efficiency for low income households?

4. What has enabled and impeded achieving program goals?

Research objectives

The objectives of the case study research are to:

- describe and illustrate the factors influencing decisions in relation to upgrading hot water services, with a focus on the role of information and financial capital
- present feedback from householders about their experience of the HEEUP program
- provide input to the HEEUP lessons learnt research
- illustrate some of the real world complexity shaping the results of the quantitative data analysis

Selected literature: Pro-environmental behaviour change

HEEUP aims to address capital, information and trust barriers to the upgrade of hot water services for homeowners on a low income. It aims to test whether addressing these barriers shifts people's purchasing decisions to more energy efficient choices.

Shifting people's hot water service purchasing behaviour toward a more energy efficient choice is an example of pro-environmental behaviour change. For pro-environmental behaviour change programs to be successful, attitudes, behaviour, context and habits need to be addressed together (Stern, 2000).

Abrahamse et al. (2005) have refined this broad framework of attitudes, behaviour, context and habits to argue that macro-level factors including technological, economic, demographic, institutional and cultural (contextual) factors can shape the motivation, abilities and opportunities ('micro-level' factors) in households. This reflects a central question in the HEEUP trial; does providing access to capital and to appropriate information from a trusted source, positively influences people's motivation, abilities and opportunities to undertake pro-environmental behaviour change?

The case studies illustrate the operation of these elements in the experiences of a small group of HEEUP program participants. In particular, they focus on the role the information and financial capital provided through HEEUP had on upgrade decisions and the enablers and impedance to positive program outcomes.

Another aspect of motivation in the context of HEEUP relates to the particular goals of energy efficiency. Residential energy efficiency can decrease the amount of energy used in the home, or increase the level of amenity enjoyed in the home with little change to the level of energy used (IEA, 2014). Where energy use decreases, this can decrease household expenditure on energy (where price remains constant) and decrease the greenhouse gas emissions produced (IEA, 2014).

Research design

Case studies were chosen for this part of the research because they can produce rich, qualitative knowledge about the social and situational issues known to influence behaviour change (Flyvbjerg 2006). They can capture the uniqueness of how a program functions for each of the small number of case study households (see Berg, 2004). As well as shedding light on the dynamics present in a single household, they can also illustrate issues in the larger analysis (Eisenhardt 1989).

Research participant recruitment

The 11 households participating in the case studies joined HEEUP between May 2014 and December 2015. Households were purposefully recruited to reflect characteristics known to influence energy and hot water use, including different household sizes and life stages, households with a member with a disability requiring additional hot water use and not, electric only and dual-fuel homes. They were also selected to represent different program experiences and pathways including recruitment channel, program phase, NILS finance used or not used, metropolitan Melbourne and rural Victoria and upgrade type. Once shortlisted, households were approached using the least common criteria first, until 11 households were engaged in the research.

Consent

On entry to HEEUP, participants were asked to nominate whether they were willing to be contacted by researchers regarding this study. The contact details of consenting project participants fitting the target criteria were provided to the researcher who made an initial phone contact to describe the research. The voluntary nature of participation was reinforced in this explanation. Participants expressing interest at this stage were sent the plain language description and consent form and re-contacted by telephone to discuss the study. Those who wished to join the study after this discussion had an interview booked. They were interviewed in early 2016.

While desirable, it was not possible to recruit households according to their level of energy usage (high, medium or low) because of a lack of data. Those who agreed to participate did not include households requiring an interpreter to participate in HEEUP, multi-family households, or households that received HEEUP information but did not join the program.

Data collection items and collection process

The following data was used in the case studies where consent was provided by participants and EEOs:

- Participant interview data on hot water use, rationale for upgrade, feedback about the program experience, barriers faced and addressed. This was collected in audio recorded, semi-structured interviews, using an interview guide, conducted in a home visit
- Photos of hot water service and hot water use
- Energy consumption meter data and expenditure data
- Program administration data as recorded in the BSL HEEUP database including demographic data, referral pathway, advice provided (including from HW tool), loan data, quote, install, repayments
- HEEUP case manager interview data on barriers the household was facing, what worked, difficulties, surprises, learning and changes. This was collected in an audio recorded, semi-structured telephone interview, using an interview guide.

Analysis

Interview data was transcribed and collated alongside the administrative and energy and water use data and photos where available.

Data was coded using a framework informed by the pro-environmental behaviour change frameworks described above.

The analysis informed the development of each of the household case studies with a focus on the effect of the information and financial capital provided through HEEUP on decisions. They describe some of the lessons learnt in program delivery and illustrate the outcomes of HEEUP in the eleven case study households.

The second stage of analysis draws out typologies of hot water upgraders in response to the question; Did HEEUP influence purchasing decisions?

Points illustrated in the case studies

The eleven householder case studies describe the participant journey through HEEUP including:

- context – the reasons the participant joined the program and what they hoped to achieve,
- experience – feedback from the participant on their experiences with HEEUP, with a focus on program processes and the role of finance and information, and
- outcomes – what's changed for the household.

Contextual factors that influenced participation

The householders participating in HEEUP were at different life stages and managing their energy use and upgrade decisions in the context of varying levels of income, wealth, financial hardship, energy arrears and access to suitable financing options.

They all had old hot water services, some of which were unreliable or damaged and one of which was completely in-operative.

The influence of these factors is evident in the householders' decision to change their hot water service and also in their motivations for participating in HEEUP.

For example, households with solar PV could benefit from heat pump technology that potentially brought significant savings to them via managing their water heating to maximise their solar feed-in-tariff. The households facing significant financial hardship chose hot water services that they felt would be most reliable in the long-run. The influence of contextual and 'macro' factors (Abrahamse et al. 2005) on the opportunities and decisions made in households are illustrated throughout.

The case studies demonstrate energy efficiency goals frequently noted in the research literature:

- affordability of family / household energy consumption by; changing to a more energy efficient unit, changing to a unit that costs less to run, or changing the unit to one that can maximise the savings associated with previously installed solar PV
- decreasing the environmental impact of hot water consumption by; decreasing energy consumption through greater energy efficiency or by 'greening' consumption by switching to renewable (solar) energy for heating water.

They also reveal additional objectives in the motivations of householders engaged with HEEUP. These emergent objectives include the reliability of the hot water service over time and amenity benefits, for example a temperature controller on the unit.

Lessons learnt

The case studies also highlight some of the enablers and impediments to program participation and to addressing barriers to energy efficiency upgrades.

Enablers

Enablers evident in the case studies include that HEEUP:

- addressed the capital barrier through providing rebates, access to no interest loans and further or full funding for those with no ability to service a loan (all households)
- addressed information barriers and asymmetries through a mixture of advice from trusted sources including HEEUP EEOs, installers and energy retailers (Anna, Sarah, Michelle, Rex and Lin, Bill)
- addressed the landlord/tenant split-incentive (Ron)
- assisted householders to navigate program processes through an EEO skillset that included technical as well as communications and support skills (all households)
- engaged the targeted households by connecting with energy retailers (Janet, Anna, Bill, Sarah, Danielle), hot water installers (Isabel, Rex and Lin, Jenny), Community Housing providers (Ron), local government (Ehsan) and water retailers (Michelle),

Impediments

Impediments to achieving program goals evident in these case studies include that HEEUP did not:

- always overcome the plumber / homeowner split-incentive and information asymmetry (Sarah, Jenny)
- run long enough to fit all households' timelines (Danielle), and
- provide information considered trustworthy (Sarah).

Outcomes

In all of the case studies where program participation led to a hot water service installation, people felt they were achieving the goals they set out to achieve including energy savings, bill savings, greening their energy use and peace of mind.

The case study stories illustrate the way HEEUP addressed macro-level factors, such as capital, information, institutional and technological factors to broaden the opportunities available to people to make pro-environmental choices in upgrading their hot water service.

The influence of HEEUP on purchasing decisions

HEEUP influenced purchasing decisions in four ways; making upgrades possible, bringing upgrades forward, making more efficient upgrades possible and influencing future purchasing decisions.

HEEUP made upgrades possible by:

- engaging with Ron's landlord to address the common barrier of tenants not having the authority to make such a changeover in a property they do not own
- fully funding the replacement of Michelle's completely broken-down hot water service and of Isabel's hot water service that was causing very high, unaffordable bills. The purchase of a new hot water service was otherwise unaffordable in both these households.

HEEUP brought forward the changeover of hot water services in five households thereby avoiding a replacement at breakdown.

Anna and Janet described how, in the absence of a program like HEEUP at the point of breakdown, they would probably make a rushed decision that may not be the best decision either financially or environmentally. Sarah described how without HEEUP, a replacement at breakdown would push her into significant financial hardship.

Rex and Lin and Ehsan also brought forward their upgrade but did so because they wanted to move to a more efficient or renewable system and HEEUP provided the opportunity to do that now.

HEEUP made a more efficient choice affordable for Isabel, Anna, Janet, Rex and Lin and Ehsan, who without HEEUP may not have been able to upgrade to the more environmentally friendly system they wanted. Bill was going to changeover his unreliable hot water service anyway but **the information he received through HEEUP emphasised the benefit of solar in his situation** and changed his choice.

Danielle did not upgrade during HEEUP, but felt **the information she received** about the comparative running costs of different hot water service options **would influence her choice** when she got to the stage of making a purchase.

The participant case studies

The following pages present these case study stories:

Michelle: HEEUP response to a broken-down hot water service

Sarah: Flexible finance options enable efficiency upgrades

Anna: HEEUP helps environmentally conscious householders afford more efficient upgrades

Isabel: HEEUP helped address very high energy use

Danielle: HEEUP can influence future purchasing decisions

Ron: HEEUP addresses the landlord / tenant split-incentive

Rex and Lin: HEEUP engaged environmentally minded retirees

Jenny and Ian: Unexpected costs halt upgrade

Ehsan: Trust in BSL facilitates engagement

Janet: NILS loan provides simple affordable finance

Bill: Hot water upgrade changes energy consumption

HEEUP response to a broken-down hot water service

North-eastern Melbourne

Water company referral

Joined August 2015

Install September 2015

Gas storage to instant gas

Michelle's story identifies a gap in the community support system that HEEUP was able to address for a household with a broken-down hot water service. It illustrates the importance of being able to fully fund a replacement when the household can't afford it and demonstrates the benefit of HEEUP connecting with water retailers as well as energy retailers.

It describes strategies used by a family to manage without hot water and highlights the importance of HEEUP being able to respond rapidly.

Michelle's story

Michelle's hot water service had broken down and while she was working to get a replacement, Michelle and her teenage children managed by boiling water on a camping stove and using the electric kettle. They showered at Michelle's parents' home and otherwise made-do with cold water.

With no capital to finance an upgrade herself, Michelle had tried all the avenues she could think of, her energy company, insurance company and superannuation fund, emergency relief, financial counsellors and three community service organisations. The avenues Michelle tried were sympathetic; 'I was helped talking wise but I wasn't helped financially'. In the end, her water retailer referred her to HEEUP.

As soon as she made contact, things moved swiftly. A temporary hot water service was installed so Michelle and her family could return to some normality in their daily routines.

The HEEUP EEO came out to Michelle's home the following day and the quotes and NILS loan application were developed straight away.

The timing of the hot water service breakdown couldn't have been worse. Michelle is currently managing a large mortgage and significant utilities arrears that were accrued during her absence from the home post-separation. A NILS loan was unaffordable because of this level of debt.

The HEEUP team assessed Michelle's situation as high need, with potential for a large benefit from the changeover. Her defunct electric storage hot water service was inefficient and had been extremely expensive to run. The BSL fully funded the installation so the replacement could go ahead.

Michelle has a generally energy conscious and pennywise approach. She has previously accessed support to improve the efficiency of light bulbs and showerheads and fixed a leaking toilet and washing machine. She also removes light globes so they don't get used.

For Michelle, the decision about what type of hot water service to upgrade to was influenced by wanting a system she wouldn't have to worry about. She felt confident the information she received through HEEUP was well researched and found the advice from the plumber very helpful. Michelle wanted a system that was efficient and effective for her household size and also felt the cost of solar was an 'extravagant' expense. For these reasons Michelle chose an instantaneous gas system.

Flexible finance options can enable efficiency upgrades

Sarah's story illustrates the way HEEUP addressed the capital barrier to a hot water service energy efficiency upgrade for a householder who wanted to improve the affordability of her family's energy consumption. It shows that additional drivers in the decision about the type of hot water system chosen became evident after Sarah got involved in the program; reliability over time and access to a temperature controller on the unit.

South-eastern Melbourne

AGL letter recruitment

Joined July 2015

Install October 2015

Gas storage to instant gas

Sarah's story exemplifies some of the ways HEEUP expands the opportunities available to householders to make upgrades. Enabling aspects of the program included; the offer coming directly from her energy retailer, access to a no interest loan in the context of a lack of suitable financing options, the flexibility to provide an additional rebate to make the changeover affordable and the ease of repayment through Centrelink.

A split-incentive that is faced by many plumbers is toward recommending a system that is more profitable for them because of commercial links, or because it is simpler for them to install (DRET, 2013). HEEUP aimed to provide independent information, however Sarah wanted additional information about hot water energy efficiency upgrades so researched them herself.

Sarah's household also achieved an additional unintended benefit of the upgrade.

Sarah's story

When Sarah first received information about HEEUP, she was getting behind in her electricity and gas bills, so HEEUP presented an opportunity to change her hot water service to a more efficient unit. She hoped this could bring down her everyday hot water-related expenditure to make bills more affordable.

Sarah's current (gas storage) system was nearing the end of its life and **she definitely didn't want a repeat of the awful situation she was in ten years ago when her hot water system broke down**. She and her three young children went six months without hot water because a replacement was just too expensive.

After an initial meeting with HEEUP staff and a recommendation to switch to a gas-boosted solar system, Sarah did extensive additional research on upgrade options because she felt the information she received from HEEUP was a 'hard sell' on solar that didn't adequately take account of her situation. She read a lot of online reviews of solar systems and sought advice from two plumbers. Sarah particularly wanted long-term reliability of her hot water service.

The Energy Engagement Officer who provided the HEEUP advice to Sarah said that although solar was more cost effective in the long run, he wasn't able to provide the exact costs and savings of each different system type because the quotes weren't available from the supplier at the time of the home visit. He also explained that Sarah was concerned about the reliability of solar and whether she would have the time and money to manage future maintenance or repairs.

In the end, Sarah chose instantaneous gas because it suited her household composition which varies regularly from two to five people, concerns about solar heat losses from shading by two large trees on her northern boundary, fear of the loss of discounts provided by her energy retailer if she went solar and doubts about the long-term reliability of solar and a concern that 'if it failed after a year, there would be a good chance that I wouldn't be working enough to get it fixed'.

Sarah is a self-reliant upgrader who did her own research in addition to the information provided by HEEUP. Another important factor in Sarah's decision making was that she found a unit that has a temperature controller, which is important for her son's needs.

> …being able to adjust the temperature for my son in the bath. It's allowing him to have more independence. He has autism, he only has baths. So it means – because he's 12 now – it means he can have a bath on his own and I don't have to worry. So I don't have to be nearby and I don't have to sort of be, every time I hear him turn the tap on - because he was tending to just put the hot on and he would sit there until he burnt himself.

This unintended benefit has led to greater autonomy and wellbeing for Sarah's son and more independence and peace of mind for Sarah.

The greatest benefit for Sarah was the flexible subsidy and finance options that made the upgrade possible. Sarah accessed a $1,400 loan through the No Interest Loans Scheme (NILS) to cover the up-front, out-of-pocket expense that would have made an upgrade unaffordable. At first there was doubt about whether the repayments were affordable and there was a lot of chasing up of information that was time consuming and frustrating for Sarah. Eventually the HEEUP subsidy was increased slightly to $641 to bring the loan amount down. This was important because Sarah didn't have other reasonable alternatives for financing a hot-water upgrade; HEEUP made it possible. As she explained;

> …well if it explodes on me, I'm going to be putting it on credit and paying a higher interest rate, so I'll be worse off than I am now. And I'd probably have to fudge figures with some dodgy finance company to get the finance.

Sarah uses Centrepay and bill-smoothing for her utilities costs, so having the $27 per fortnight loan repayment coming straight out of her carer pension through Centrepay, is straight-forward.

Even though paying back the loan is presenting budget challenges, balanced against rising energy costs and the risk of her old hot water service breaking down, Sarah feels she has made the right decision.

HEEUP can assist environmentally conscious householders afford more efficient upgrades

North-eastern Melbourne

AGL letter recruitment

Joined March 2015

Install April 2015

Gas storage to heat-pump

Anna's story provides an example of HEEUP addressing the capital barrier to a high- efficiency upgrade for someone who did not have sufficient capital to make the 'environmentally conscious' choice they would have liked.

It demonstrates how a household with solar PV was able to benefit from heat pump technology by using their generated electricity to heat water while the family was out during the day. It also shows how information from both the EEO and installer was needed for calculating costs and benefits in this complex situation.

Anna's story shows the impact of under-insurance on a household's ability to recover from flood damage and the way a hot water upgrade has influenced one householder's future appliance choices.

Anna's story

Anna has an interest in the environment.

> I've got two kids and I would like them to have a planet to breathe on into the future.

She has friends who were early adopters of photovoltaic electricity and drive hybrid cars. Anna says they can afford to make those sort of decisions, but she's in a different position. Anna has two children and recently bought her ex-husband out of the home, so she has a large mortgage, high living expenses and a small income from part-time employment. The house was severely damaged in floods and she took out a loan to do repair work, but the budget didn't stretch to the hot water service, so she left that to 'limp along'.

Anna had a really positive experience of the program and said 'everyone I dealt with was uniformly fantastic'. **She felt HEEUP helped her make a 'planned and measured' decision that was the best solution for her.** This was preferable to an emergency replacement at the point of breakdown.

> If I'd left it until the thing was dead - I mean, can you imagine? Your kids can't have a hot bath or shower. I mean, you're just - you're just like, just chuck it in. I don't care if it's got a zero star rating or it's costing a fortune. I just need the hot water. That's what would have happened to me.

Anna had joined HEEUP originally wanting solar hot water because she 'hadn't really heard of heat pumps'. She received a recommendation from the installer for a heat pump programmed to run during the day. **Anna has solar PV but gets a low feed-in tariff, so it's best for her household to use the power generated during the day while they're out:**

> If you've got free electricity during the day, why aren't we using it to heat your water?

Anna said she really valued the expert advice of the installer who provided detailed information and quotes. She said the EEO gave her 'a lot of comparison information but I found it a bit overwhelming… what really swung me to the decision was the photovoltaic on my roof and that was not in the comparisons at all'.

The changeover also influenced future purchasing decisions. When Anna's dishwasher needed replacing, she researched and chose one that takes in hot water, rather than heating it, so she could maximise the use of the heat pump.

HEEUP helped address very high energy use

Remote coastal Victoria

Enviroshop recruitment

Joined July 2015

Install January 2016

Electric storage to solar electric

Isabel's story exemplifies the way HEEUP was able to provide substantial benefit to a household where the hot water service was having a major impact on energy expenditure. It highlights the importance of having fully funded support for some clients with high needs.

It also demonstrates the way NILS program processes can be overwhelming and the importance of the EEO skillset in supporting clients and identifying households where additional support is required.

Isabel's story

Isabel lives in an early Victorian cottage in a tiny coastal village. She has access to on-grid electricity, but not gas. Isabel has large water tanks that supply her with ample water for her needs. Her electric storage hot water service had a header tank on the roof where the hot and cold water were pumped up to be mixed before it came back down into the house. When she moved in to the property about three years ago, it wasn't working, so she made-do by boiling the electric kettle for her hot water until she was able to get it fixed six months later.

When Isabel saw the HEEUP advertisement in the local paper, she'd been having further problems with the hot water service. The header tank was leaking and so the pump was continuously running to keep it topped up and the boiler had to run a lot more to keep heating the water. This would have been contributing significantly to her 'over the top', unaffordable bills.

Isabel sees solar as the appropriate technology for her situation. She is motivated by both environmental and financial reasons. As she explained it;

> … because we've got so much sun here, what happens is, my hot water pipes used to warm up in summertime, so I could shower with cold water, but having hot water. And I thought 'wow' solar will be really great!

Isabel was unsure at first whether she would be able to access HEEUP because of the location of the Brotherhood of St Laurence being so far away from her home. But when she made contact, she was pleased to discover the application could be made over the phone and internet and a local installer could provide the quotes and manage the installation. Computer access and literacy bridged the distance.

Nonetheless, the process wasn't straightforward. Isabel spent a lot of time with the HEEUP information, application forms and quote trying to work out whether it was the right thing for her to do.

> I could see the benefit of it, but, even with the benefit of getting nearly halved or paid quarter of it…I still couldn't afford it. It was just one of those things. As you can see, I've got no sink.

Isabel applied for a NILS loan and found trying to provide all of the detailed information needed for that, overwhelming.

> I said to the young man on the phone …' I'm giving up. I can't handle this ... [providing] Centrelink papers and bills and I thought, no I can't and its part of it that stressed me out completely … and yeah I'm sitting throwing my hands up in the air and panicking and crying, but yeah, no he was professional and very caring.

The HEEUP worker assisted Isabel to complete the NILS loan application. This involved many phone calls and emails, at times just checking how she was going, not only to collect the needed information.

The NILS assessment identified the loan would be unaffordable and a decision was made that the upgrade be fully funded.

The installers came from a larger town about an hour and a half away. They removed the old system from the roof and installed a new solar system with an electric backup and tank. The electrician also upgraded the fuse-box so it would be compliant with electrical safety standards.

The hot water changeover led to saving both electricity and water.

> I find that it's far more efficient now, because the hot water is hot and I don't have to run the water. I save water now actually. There's a two-way thing now, I save water and electricity, because the water I used to have to run and run until I got to the hot water.

This new system is saving even more electricity, because the pump doesn't need to run continuously to keep the system topped up.

HEEUP can influence future purchasing decisions

South-eastern Melbourne

AGL letter recruitment

Joined May 2015

No hot water upgrade

This household joined HEEUP but did not proceed to making a hot water service purchase. Danielle and Lucas' story illustrates the influence of timing in relation to a renovation project cycle and budget, and investment payback times in relation to family life stage. It is an example of HEEUP having a legacy benefit through the education it provides and reveals a need for flexible delivery approaches such as phone advice.

Danielle's story

Danielle and Lucas are extending their home to accommodate their family of four and Lucas is doing the building work himself. The way they manage the budget is to look for low-cost opportunities well in advance. For example, they try to source things second-hand (Lucas is a '*Gumtree* fanatic'), but if they can't, then they'll consider purchasing something new.

The payback time of hot water service investments is an important decision making factor. A five year payback time on a hot water upgrade would be a good length for Danielle. Partly because if it were much longer, the technology would be obsolete by the time it's paid for and partly because she wants to see the returns sooner, rather than later. Danielle and Lucas are at a stage in life where they're under a lot of financial pressure. They have two young children and have only recently returned to part-time work. Danielle expects their financial position will be much stronger in five to ten years' time and so the bill savings won't be as important then, as the cost of the upgrade would be now. She also isn't sure whether her family will still be living in the same home in the long term.

When the letter about HEEUP came, it seemed like it could be one of those low-cost opportunities Danielle and Lucas keep their eye out for. However, they were a long way off installing their hot water service, both in terms of the renovation project stage and the budget.

When Danielle contacted HEEUP, she wanted to get some basic information about how the program worked and what was involved. Like the light-globe replacement scheme, she thought it could be a good deal, or might not be.

The response from HEEUP was to book a home visit. Danielle felt this wasn't the best use of everyone's time. She would have preferred to have a short chat on the phone to discuss her needs and get some estimated costs on the various upgrade options. Instead, a HEEUP Energy Engagement Officer came to her home, spent two hours doing a detailed assessment and signed Danielle on to the program. She also felt it was a waste of the installer's time to develop three different quote options, when she was still just at the information gathering stage. The HEEUP program process was mismatched to this household's needs.

When the quotes arrived Danielle wasn't ready to make a decision. She said 'I can't think hot water when I don't have plumbing, I don't have electrics and plaster'.

The next contact she had from the program was when she received a letter advising the program was closing soon. That was toward the end of the year and there was 'too much going on'. Danielle felt they'd just run out of time and they decided not to follow up and re-start the process.

The information provided through HEEUP may have a legacy benefit in this household. Looking back, Danielle felt that although they missed the opportunity to receive the rebate and finance available through HEEUP, she still benefitted from the education about the different running costs of the various options. She said she hadn't thought about the running costs of hot water before.

> I may have just gone for another gas storage, for example, even though my husband wanted instant gas. But then I didn't realise the boosted solar could save you so much money and it would pay for itself over a few years … So it actually was good to hear how each system worked and what the capabilities were.

I asked Danielle, 'When you do get to the point of making the decision, how do you think the information that you received as part of this process will influence that?' She replied:

> That will be quite useful actually, because I probably wouldn't have contemplated spending the higher amount of money on the boosted solar, for example. But, because we're going to be running quite a large house, I need my costs to be down.

HEEUP engaged environmentally minded retirees

This case study of Rex and Lin illustrates the HEEUP partnership with Enviroshop, which facilitated upgrades in 52 households, many of whom were environmentally minded retirees like Rex and Lin.

It shows how the experience of retirement on a lower fixed income can shape householder attitudes to day-to-day budgeting and long-term financial planning.

Eastern Melbourne

Enviroshop recruitment

Joined September 2015

Install November 2015

Gas storage to heat pump

It also illustrates how support for upgrading a hot water system can assist people to age well in the place they live.

Rex and Lin's story

Rex is keen on heat-pump technology. It piques his engineer's curiosity about new technologies and his environmental bent. Also, because he already has solar PV, it's a cost-effective way for him to heat water.

> Well, it's not using fossil fuels, and you know, it's perpetual motion if you like, apart from a little bit of electricity. Those things appeal to me.

Rex had been having a few problems with his hot water service. He'd moved it once, to try to reduce the amount of time it took for the hot water to get to the shower. He'd also had a leak repaired that was spraying onto electrical wiring and blowing the fuse. Rex felt it was 'near the end of its useful life'.

Rex contacted Enviroshop, where he's a long-time customer, to inquire about heat pumps and see what they thought of them. But he was turned off when they told him the price.

HEEUP can make newer technologies more affordable. Enviroshop knew Rex was pension age and asked him whether he had a concession card. He didn't, but was in the process of applying for one, so he proceeded with the heat pump quote and put the HEEUP application in process.

Lin is very budget-conscious and keen to save so they can afford their retirement. She's aware that gas prices are rising and wants to maximise the benefit they get from their solar PV system.

Rex and Lin have a high feed-in tariff on their solar PV, so Lin tries to do large energy using activities, such as steam-mopping the floors, during off-peak times. This seems counterintuitive because it's not using the solar power their system generates, themselves. Rex and Lin explained that it's '…not solar, but cheaper. You've got to be an actuary to work that out. Sometimes it's better to be using theirs … because we get 60 cents or 67 cents'.

The most advantageous arrangement for them is to sell the energy they produce back into the grid and use power at off-peak times. They want to run the heat-pump during the night and this is being arranged.

Where possible, Rex and Lin are investing in staying in their home. Their children are grown and no longer need their financial support, so any spare money they have is being used to adapt their home so they can continue to live there for as long as possible. It's something they feel they've 'got to do' if they want to stay in their current home.

Furthermore, as they age the physical benefits from hot water are becoming more important. Hot water is a comfort, particularly to Rex who loves his hot showers:

> I have the longest hot showers in creation … If I've got to go without that, then what's left in life at 83? A hot shower is the highlight of my day.

HEEUP can address the landlord / tenant split-incentive

Nothern Melbourne

Community Housing recruitment

Joined June 2015

Install August 2015

Gas storage to solar gas

Ron's story is an example of a HEEUP installation through the Community Housing activity stream. It illustrates how HEEUP was able to bring peace of mind to a householder worried about his unreliable hot water service.

Ron's situation highlights some of the complexities that can be faced in household energy management; differing energy needs, the landlord / tenant split-incentive and the difficulty of measuring the impacts of energy efficiency when there are multiple influences on energy bills.

Ron's story

Ron has been worried about his old, unreliable hot water service. It was expensive to run, ran hot and cold and often needed recharging, even in his small two person share-house. HEEUP brought an opportunity that he hadn't really considered before, because as he says, when you're renting you 'don't like to say 'We want this. We want this''.

Ron learnt about the benefits of energy efficiency mainly from the television program *A Current Affair* and then from personal experience. He's changed his lighting to CFLs and had ceiling insulation installed. Energy efficiency is a way he can manage his energy expenditure. The challenges he faces include the differing energy needs and habits of himself and his housemate and the ducted gas heating that is expensive to run.

Bill savings can be difficult for householders to accurately assess. Ron felt his energy and water bills were potentially reflective of the malfunctioning hot water service. He was hoping to save roughly $200 on his bills as a result of the changeover. Ron reports his gas and water bills have come down, noting however, the water bill saving is unclear because of credits he's receiving due to previous overcharging.

Ron's view is that hot water is something that's essential, without which you risk becoming sick. He enjoys a hot shower and thinks hot water does a better job than cold for washing clothes.

The main benefit for Ron has been 'Peace of mind. Peace of mind.' Having an unreliable hot water service was worrying. He was particularly concerned that the system might break down outside office hours.

> Because when things don't work you get worried. If things are not right you leave it but in the end you just get more wound up. You've got to address it.

Ron found the HEEUP process worked well for him. From his point of view 'it was just common sense … a no-brainer', in the situation of an old hot water service being replaced at no cost and potential savings. The installation went smoothly and the system has been running perfectly since.

Unexpected costs halt upgrade

Central Victoria

Enviroshop recruitment

Joined December 2015

No hot water upgrade

Jenny and Ian's story is an example of a HEEUP engagement that stalled at the point of installation for a changeover from gas storage to a solar gas system at a home in a rural town.

The case is an extreme example of a common issue; extra costs that occur as a result of gas piping and specific site requirements. It highlights difficulties that can be encountered when working with an installer that wasn't one of the program's regular suppliers.

Jenny and Ian's story

Jenny and Ian had planned to install both solar PV and solar hot water as part of major renovations to their mid-Victorian era cottage in a central Victorian town. Ian is still working part-time and they wanted to upgrade for 'the planet' and to bring expenses down before they are on a fixed lower income.

Jenny explained 'We couldn't afford both so we opted to do the solar [PV] for the house'. They joined a bulk-buy for the solar PV but had received an unaffordable quote for hot water, when a friend in a nearby town told them about HEEUP.

With the HEEUP rebate, Jenny and Ian's out of pocket cost was going to be an affordable $1,800. The quote and site assessment included an additional $500 to upgrade a gas pipe. Jenny and Ian queried this because they'd recently had new gas pipes installed. They were told the pipe had to be larger than what was there and the BSL could cover this additional cost.

Jenny described the installation day:

> It was pouring with rain the day they came out. They weren't happy anyway and they asked where the gas line was. So they were umming and ahhing, and 'Oh this is difficult', so and on and so forth ... They went and sat in their truck for quite a while. Then they came back and said, 'We've been in touch with our boss and it's going to cost you another $1500 for the upgrade'. And I said, 'What, $2000 to upgrade the gas line?'

Jenny and Ian were left wondering whether the $1500 was a genuine expense or the installer was inflating the price because they didn't want the work. They were 'gobsmacked' and disappointed because the installer's original quote was carefully prepared. Jenny's experience highlighted an important issue; a communication gap between a supplier and a purchaser. Trust developed between the BSL and their primary installers overcome this in many cases, but couldn't be completely managed in all.

At the new price, the upgrade was unaffordable. The BSL was unable to contribute more and the installation didn't go ahead. Asked what their plans are now, Jenny said, 'We've just shelved it and we'll wait till that hot water service decides not to work anymore and then we'll revisit it'.

Trust in BSL facilitates engagement now and into the future

North-western Melbourne

Hume City Council recruitment

Joined December 2014

Install January 2015

Instant gas to solar gas

Ehsan's story describes a motivated, engaged, policy-aware consumer and citizen who was able to make a solar hot water purchase through HEEUP. It shows how trust in the BSL facilitated participation in the program and how word-of-mouth through extended families can engage otherwise hard to reach households. It also demonstrates a recommendation that was made by multiple households in the research; that solar PV should be a priority for energy efficiency programs targeting low income households.

Ehsan's story

Ehsan wants to try to reduce energy bills in his family of five. As a chemistry PhD and science teacher, Ehsan knows a lot about hot water energy consumption and efficiency and a lot about solar. He anticipates a 20–30% energy saving from the solar panels he has added to his pre-existing instantaneous gas system.

Ehsan did his own research on solar options, in addition to the information provided through HEEUP. The flexibility of the program to facilitate Ehsan's access to the hot water system he wanted, through the installer he wanted, was important to his involvement in the program.

HEEUP brought the changeover forward. If it hadn't been for HEEUP, Ehsan would have waited until his current hot water service needed replacing before he would have considered an upgrade to solar.

Ehsan is well connected as he works in a lot of community associations, but hadn't heard about HEEUP through these channels. He knew about the BSL because his daughter is involved in the BSL's Saver Plus program so he had a positive view of the BSL and knew they have programs for people on low incomes.

When the HEEUP information came to him from Hume City Council, he felt comfortable to respond and he wants to be on a mailing list to be alerted to any future BSL programs. Ehsan also applied to HEEUP for his father-in-law who doesn't speak English. He was able to facilitate his father-in-law's involvement in the program and found the process simple, easy and helpful. His father-in-law upgraded his instant gas hot water to a solar gas system.

Ehsan's family are water conscious as well as energy conscious. His water bills inform him his household is a lower than average water user for its size. This is despite their coming from Iraq where water is plentiful and there is not the same culture of saving water as in Australia.

Ehsan is one of five case study participants who recommended making solar Photovoltaics available to low income households. He conceives of energy efficiency and environmental sustainability as national goals in the context of needing to keep Australia clean with a rapidly increasing population. He believes there is greater need for solar PV than for solar hot water, because there used to be significant government support (high feed-in tariff) but now that people understand the benefits, the support is no longer available.

NILS loan provides simple affordable finance

Southeast Melbourne

AGL recruitment

Joined May 2014

Install August 2014

Gas storage to solar gas

Janet's experience of HEEUP is an example of a straight-forward upgrade in a sole person household. It shows how HEEUP was able to address the capital barrier to a solar upgrade for someone committed to renewable energy. For Janet, the upgrade was about the capital replacement rather than to save on bills.

Janet's story sheds light on the experience of HEEUP for someone who is energy-literate and also demonstrates the way a NILS loan with repayments through Centrepay could provide a simple affordable option for covering the upfront costs of the upgrade.

Janet's story

Janet responded to the HEEUP offer she received from her electricity company for a couple of reasons. First, she is 'a very firm believer in using renewable energy' and second, her gas storage hot water service was near the end of its useable life and she would face an expensive replacement. She was also aware that:

> [I] probably would not have been able to replace it with a solar one because they were so much more expensive than just replicating what was there

Switching to solar was key for Janet. Without that option she would have waited for the old system to fail and then considered what she would do at that stage.

The financial benefit for Janet was more about addressing the replacement cost, rather than the everyday savings of lowering energy bills. In fact, Janet wasn't sure whether every day savings would happen, given her hot water needs tend to go up during winter when there is less solar radiance.

Janet found HEEUP 'seamless … very easy … absolutely no problems with any of it'. She found the information she received from HEEUP interesting, but felt she already knew a fair bit about solar because she's had solar PV since 2009. Janet did additional research on the unit she'd been recommended. She wanted to verify she wasn't getting 'a Mickey Mouse hot water service by Jo Blow around the corner'. She found a stainless steel tank with a much longer lifespan and HEEUP was able to accommodate this modification to the proposed system.

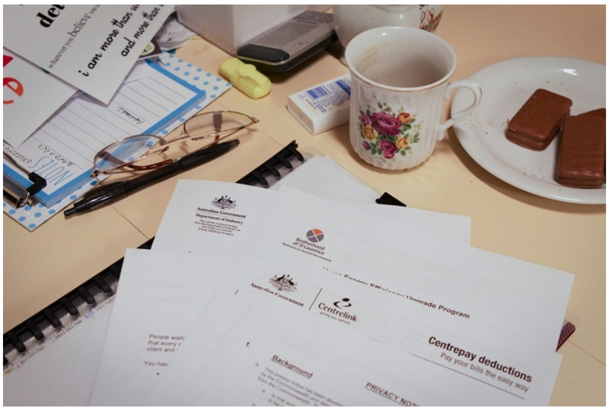
Janet also received a Home Energy Savings Scheme (HESS) visit. This was a requirement of accessing the HESS rebate that was available during the first three months of HEEUP.

The HESS worker thought Janet was ‘doing a reasonable job in being as efficient as possible’ and made a couple of suggestions that Janet chose not to act on. One was to cover the ceiling ducts from the old ducted heating system; Janet felt getting a plasterer to do this would cost too much. The second was to switch to a more efficient shower head. Janet explained:

> I have a very inefficient shower head, but it’s great and I wasn’t about to go into one of those miserable little things that drips water on you.

Janet is on a time of use tariff so she does high energy using activities, like running the washing machine, after 11pm when she pays the lowest rate. She receives the premium feed-in tariff and tries to sell most of the solar energy she generates back into the grid. Janet wants to change to a different energy retailer, but hasn’t found one that will take her on as a customer because of the 60c/KwH FIT she receives.

To help pay for her upgrade, Janet took a $1200 NILS loan. There was a delay in getting this approved, but it was addressed after Janet followed up with the EEO. Without the NILS loan option, Janet said she might have tried to afford the upfront cost by paying with her credit card. She was aware that she was unlikely to get such a significant rebate again.



Having the loan repayments automated via Centrepay worked well for her and meant she didn’t have to worry.

> It just came out of the pension before I ever got it so it wasn’t there that I’m thinking ‘oh have I got $50.00 this week’. That made it very simple and all right, maybe some fortnights I’d be down to the last five or ten dollars in the bank account by the time Wednesday night came but it was absolutely manageable, yes.

Janet has noticed a slight decrease her gas bill in summer, but not in winter. Overall HEEUP has had a relatively low impact on her finances. It had a bit of a negative effect while she was paying off the loan, but now that’s paid off. The hot water is not quite as hot as it used to be, but Janet said she would have followed it up if she really needed to.

Hot water upgrade reduces energy consumption

Outer-eastern Melbourne

AGL emergency recruitment

Joined April 2015

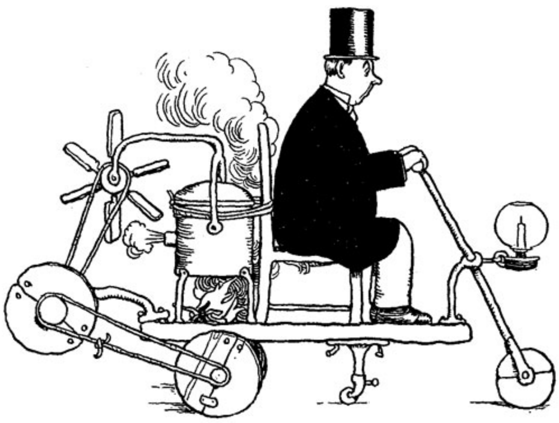
Install March 2015

Electric storage to solar gas

Bill's case study describes the impact on energy consumption, expenditure and greenhouse gas emissions from a changing fuel mix in the home. It also shows how HEEUP was able to replace an old unreliable system that had placed an additional burden on a carer. It provides an example of how a referral through AGL worked to bring down the cost of a solar upgrade in an emergency changeover. It also highlights the influence of the energy retailer on the householder's knowledge of and interest in, solar hot water.

Bill's story

Bill contacted AGL, his energy provider, to talk about changing his 50-year-old, unreliable hot water service. He'd had a lot of problems with it overflowing and described it as 'a very Heath Robinson effort' (18).



A WELL THOUGHT OUT AND NEARLY SUCCESSFUL EXPERIMENT BY EARLY RAILWAY PIONEER

Source: W Heath Robinson (undated)

With ongoing problems, **Bill and his wife were beginning to worry about the viability of the system** and were frightened of the problems 'going too far'. They decided it had to be replaced as soon as possible. They'd never thought of solar hot water and originally thought they might change to an instantaneous system.

18 The name 'Heath Robinson' became part of common parlance in the United Kingdom for complex inventions that achieved absurdly simple results following its use as services slang during the 1914–1918 First World War (Wikipedia, undated)

Bill said his decision was swayed by AGL who were 'very keen' on solar and then further by his friends who had solar and thought it was a good proposition.

Bill is the primary carer for his wife who has a chronic illness. This means he has taken on much of the running of the home. **Ensuring the reliability of the hot water service is one of the things they thought would help in their situation.**

A simplified analysis of the change in energy consumption, expenditure and greenhouse gas emissions is provided here for illustrative purposes;

Bill changed from an off-peak electric storage hot water system to a gas-boosted solar unit. Bill thinks his electricity bill has gone down as a result. Factors influencing energy consumption in this household are weather, the hot-water service replacement (26 March 2015) and the changeover of a highly inefficient gas oven to a new one. After the hot water service changeover, the weather was slightly milder on average: most comparison months recorded warmer minimum and cooler maximum temperatures and more solar exposure days than the year before. There haven't been major changes to the time Bill and his wife spend at home.

Comparison of eight months energy consumption data for 2014 and 2015, provided by Bill's energy companies, confirm his view that his electricity bill has gone down. There was a small increase in gas consumption and his electricity consumption almost halved, leading to a slight decrease in energy use overall (Table 17).

Table 17 Energy consumption

	Mar to Oct 2014	Mar to Oct 2015	Change	% change
Gas (MJ)	28167.35	31036.81	2869.46	10.19
Elec (KWh) – controlled load off peak[(1)]	1707.98	163.13	-1544.85	-90.45
Elec (KWh) - peak	1339.20	1318.13	-21.07	-1.57
Elec (KWh) - total	3047.18	1481.26	-1565.92	-51.39
Total gas + elec (MJ)[(2)]	39137.21	36369.36	-2767.85	-7.07

1. Hot water system was controlled load off-peak
2. 3.6 MJ/KwH

These figures were used to estimate changes to energy expenditure and GHG emissions.

As Table 18 shows, the increase in gas expenditure was offset by the saving on electricity mostly from the reduction of off-peak expenditure to zero after March 2015. This led to a 30 percent net saving on consumption costs.

Table 18 Energy expenditure estimates (consumption only)

	Mar to Oct 2014 ($)	Mar to Oct 2015 ($)	Change ($)	% change
Gas (1)	535.29	582.00	46.71	8.73
Elec – controlled load off-peak (2)	375.76	35.89	-339.87	-90.45
Elec peak (3)	372.83	366.97	-5.87	-1.57
TOTAL	1283.88	984.86	-299.02	-30.37

1. Consumption entered into Vinnie's Tariff Tracker July 2014 (Johnson 2016a)
2. July 2014 price ($0.22/KwH) (Johnson 2016b) applied to 2014 and 2015
3. Client provided price ($0.2784/KwH) applied to 2014 and 2015

The changeover made an important difference to the GHG emissions of Bill's household's energy consumption (Table 19). The shift from electricity to solar and gas for heating water has led to an estimated 37 percent decrease in emissions in the pre to post-intervention comparison period.

Table 19 Greenhouse gas emissions (kg CO2-e)

	Mar to Oct 2014	Mar to Oct 2015	Change	% change
Gas (1)	1442.17	1589.08	146.92	10.19
Elec(2,3)	4113.70	1881.20	-2232.49	-54.27
TOTAL	5555.87	3470.29	-2085.58	**-37.54**

1. Gas coeff - 0.0512 (AGDE 2014) 2. Elec coeff 2014 - 1.35 (ESC 2014) 3.Elec coeff 2015 - 1.27 (ESC 2015)

REFLECTIVE PRACTICE

Summary of results

Key program lessons identified in the reflective practice include the following.

Nature of support

- **Subsidies should be provided on a tapered basis.** That is:
  - a higher level of subsidy should be provided to those in energy hardship or fuel poverty who cannot afford to co-contribute
  - the subsidy level should be higher for solar and heat pump, and lower for less efficient, less costly options such as gas storage
- **Detailed in-home advice should only be provided to those who need it**: Many households need Independent, in-home advice; however, such advice shouldn't be provided to those who have already decided on the upgrade they want.
- **Community housing providers are keen to participate and provide economies of scale.** Public housing providers may also benefit from access to a program like HEEUP.

Flexible, tailored approach

- **Use diverse referral pathways to maximise uptake**.
- **Tailor the approach:** It is essential to understand the needs of different client groups, which may reflect demographic factors, location and tenure.

Trust, communication and engagement

- **Build trust with participants**: Trust in the organisation, the staff and the information provided and the suppliers is essential to engage participants and achieve upgrades to more efficient systems.
- **Understand and engage with the participants' motivations**, which include avoiding breakdowns, saving energy and money, and helping the environment.
- **Keep it simple for households**: Simple clear communication is essential for engaging householders.
- **Promote good engagement:** Staff are critical to the success of engagement with participants and subsequently the success of the program

Systems and processes

- **Reflect and improve:** Ongoing reflection, adapting and refining are essential, as is continuous improvement of the delivery processes.
- **Develop IT systems early in the program and modify them as needed.**

- **Mechanisms to control price are essential:** Bulk procurement agreements could further reduce costs

Introduction

Four reflective practice sessions took place during the HEEUP program. This process was undertaken as a continuous improvement practice for the program delivery team and other BSL staff. The sessions provided a space for all program staff to reflect on what was working well and wasn't working. They also provided an opportunity to record changes as they took place. A series of changes arose from the reflective practice processes.

Data

This section of the report draws on the reflective practice sessions and project management team meetings outlined below.

Participants in the reflective practice sessions included energy engagement officers, administrative staff, and program managers. These sessions were generally facilitated by the HEEUP program manager. The topics discussed at each meeting reflected the program issues at the time. All participants were encouraged to share openly about their experiences in the program.

A note taker was identified for each meeting and notes from the sessions were circulated afterwards. Participants were advised that information from the sessions would be used to improve the program, included in Milestone reports to the Department and in the annual or final report as appropriate. Participants were asked to identify any specific comments they didn't want reported.

The reflective practice sessions included here are:

Reflective practice 1 (RP1): Undertaken in July 2014, the first reflective practice session involved the program manager (facilitator), the energy engagement officer and BSL research manager for HEEUP. It focused on the in home process.

Reflective practice 2a and 2b (RP2): This included the HEEUP Energy Engagement team reflective practice workshop in early April 2015 and a reflective session with the HEEUP Project Management in March 2015.

Reflective practice 3 (RP3): Undertaken in October 2015, the session included the program manager, four energy engagement officers and the administration officer.

Summary of sessions

Lessons from the various reflective practice processes are summarised below. Where they resulted in a modification to the program process it is also identified.

HEEUP participants' views and motivations

EEOs reported their understanding of participant perspectives of the program. Participants:

- were quite unaware of their existing hot water system's energy requirements and its operating requirements
- were surprised by the level of financial and energy savings available from changing hot water systems
- had mixed needs for a loan. A considerable proportion of participants had some funds available to pay for the hot water system up front
- mostly had limited awareness of the different types of hot water system available, prior to the home visit
- had mixed levels of financial literacy. Some participants were very good money managers and highly financially literate.

There also appeared to be a high level of latent demand for the program. Clients reported they wanted to upgrade for a while but couldn't afford it or didn't have enough understanding of the best upgrade.

Avoiding a breakdown is a big motivator for those who get an upgrade (RP3[19])

EEOs reported that the majority of clients cite the age or risk of breakdown as the initial driver of a hot water replacement and an upgrade is seen to increase hot water reliability rather than to reduce energy consumption and costs.

Role of home visits

Home visits are essential for some households; however, others do not need them (RP3)

Home visits are an intensive engagement approach and the EEOs spent a lot of time engaging each participant (around 1 hour later in the program) and travelling to the visits. EEOs estimated that the home visits helped around 50% of households make their upgrade decision. Many of the other 50% already knew what the type of upgrade they wanted.

Future programs should use multiple and concurrent pathways to connect with the households including home visits, phone, email and mail should also be used.

Building trust and engaging participants

EEOs reported that building trust is essential to the success of the program.

Factors the EEOs identified as helping build trust include: the EEO has a big ID tag, the client has a number of contacts with the BSL (phone, letter), an appointment has been made and the client knows the EEO is coming, EEOs inform the client about hot water

[19] RP3 etc. identify the stage and session at which this issue arose

systems, the people need the service offered (a hot water upgrade), and the use of official DoI (DIIS) and BSL logos.

Specific points in the home visit that help engage the clients include:

Starting informally

A successful engagement is one which recognises the characteristics of the client (demographic and others) and tailors their engagement accordingly. It is important to be both relaxed and professional and if necessary build rapport by discussing topics outside the program (e.g. AFL, pets, etc). It is also good to begin the home visit by asking if the client has questions about the program process, as they generally do.

Varying the pace to the client’s needs

During the home visits it is important to vary the pace of delivery to respond to the client’s specific information requirements and ensure they understand of each program element and what is required of them.

Clients value the community service organisation motivations

Clients respond positively to the community sector’s motivations and to BSL's commitment to programs like HEEUP. Physical assessment of the hot water unit with clients reinforces the EEO's expertise.

However, some clients can be sceptical of the program particularly if there are commercial partners involved.

Many people are brand loyal to their electricity retailer.

This was surprising and suggests a possible benefit of co-branding the mail out with the retailer.

Some factors were identified, which may impact on trust.

Gender of the EEO may be a factor in trust in hot water related advice (RF3)

One female EEO reported that many of the households expected the adviser would be male. She reported that a small number of clients did not perceive female EEOs to be knowledgeable in this technical area.

Trust may be an issue in approaches that are not face-to-face (RF3)

EEOs identified that when phone calls are used instead of home visits, building trust may be an issue. Households get a lot of calls from energy efficiency programs saying they are from the government. Many people are wary and concerned about scams.

Participants in financial and energy hardship (RF3)

Some people are in real hardship and have no hot water (RF3)

EEOs reported that a small number of those visited appeared to be in extreme hardship. Some households had no working hot water system. For example, one EEO reported a client with three dependent children, whose sole income was the pension and who had very limited ability to fund her hot water upgrade.

In general these households have a hard time replacing their hot water system. NILS and the BSL program can work for some of these households but not all. People living alone face a particularly high cost burden. .

People who drop out often aren't those in the worst situations (RF3)

EEOs reported that the people who expressed interest but dropped out were often people with children and a mortgage. With many competing priorities, hot water replacement wasn't at the top of the list.

Eligibility could be tightened, however this comes at a cost (RF3)

A small number of participating households who appeared to have more assets, and were more likely to pay upfront, may not have needed the support of the program. These households met the eligibility threshold for the program; however, the family home is excluded from the assets test for concession eligibility).

Eligibility requirements could be tightened to rule out some of the asset rich clients. However, this might be time-consuming. The current arrangement is simple and fast.

Varied levels of support would be useful (RF3)

The variation in need even within low-income households – between those with very limited financial means and those who are better off – indicates that a tiered approach to subsidies may be suitable. Such an approach may involve a higher subsidy for those households with high needs and a lower subsidy for those with lower needs.

Working with a retailer

Program managers reflected on the value of working with an energy retailer. Positives included the ability to recruit concession clients (data and collateral) and access to metering data. Working with a retailer also provides potential for working further with energy hardship and at risk clients.

Key challenges included working with a large organisation with many departments (and varied objectives).

Working with community housing[20]

The engagement with housing providers was highly productive both in terms of the ease of circulating the offer details through the sector and the resulting administrative effort required by the BSL. By enlisting the maintenance function of each provider, the BSL avoided repeated visits and contacts with residents as well as the paperwork of a home owner engagement. BSL payments to providers were dependent on them providing the necessary certification. The use of mainly electronic communication enabled both small and large scale uptake of the offer.

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[20] Written reflection from Tony Robinson, BSL Financial Inclusion Senior Manager, in lieu of participation in the reflective practice sessions Feb 2016

The major challenge for housing providers was the rejigging of planned hot water system upgrades and, in some cases, the identification of funding that could be brought forward to take advantage of the offer.

The success of the community housing engagement appeared to be overwhelmingly related to the trust that existed between the housing provider and tenants.

Converting participants from a home visit to a hot water installation (RF2)

In early April 2015, EEOs and program management addressed a key problem in the program: while it had received a large number of expressions of interest, the conversion into installations had proved very difficult. The factors identified are discussed below:

Uncertainty about the out-of-pocket expenses put participants off

Under the BSL 1 and 2 subsidy formulation the participants were offered a fixed subsidy. However, the installation costs for the systems varied significantly depending on the specific dwelling and piping requirements. As a result, the participants' out-of-pocket expense varied.

To provide participants with more certainty on costs, the program manager placed a cap of $2,000 on all solar and $1,800 on heat pump installations (this was the BSL 3 subsidy).

Systems were unaffordable (cost, subsidy amount, fortnightly repayments)

In RF2, EEOs also expressed concern that participants were unhappy with the cost of the hot water systems (with or without a loan). Program staff identified that a lower out-of-pocket household expense would reduce attrition and increase installation rates.

RF2 identified the following factors influencing system price: supplier costs, subsidy amount, system chosen (e.g. solar or instant gas), and the specifics of the home (including the previous system and additional piping requirements).

The following measures were introduced to reduce costs.

- Subsidy amounts were increased
- Additional suppliers were introduced: EEOs identified that some prospective participants had been put off because they believed they could get similar systems installed more cheaply by local suppliers.

Family dynamics often stopped upgrades proceeding

EEOs reported that within households there were often diverse views about preferred hot water systems, value for money, technology, aesthetic, operational requirements, and need. EEOs were sometimes able to resolve the differences; however, when disagreements could not be resolved the households did not continue with the program.

Some households did not need an upgrade

EEOs reported that a number of households that requested a home visit turned out not to need a hot water system upgrade. Many of these households had systems between 2 and 10 years old.

HEEUP informed these households of the options and provided an independent point of view that the upgrade may be unnecessary, and not cost effective.

Some households did not understand the offer

Some households did not understand the HEEUP program offer and believed it was providing a free hot water upgrade. When these households learned the level of co-contribution required many chose not to continue.

In response, the program staff sought to clarify the offer in written material and improve the intake process to reduce the chance that people receiving a home visit do not understand the offer.

Data and consent can be difficult (RF3)

A lot of people would not provide data if it were truly optional (RF3)

EEOs reported that a lot of people would opt out of allowing access to their data if it were an option. There is a lack of trust about what the data would be used for—sometimes even after the strict limitations on use of the data had been explained. Some participants were concerned that data might be used in reporting to other government department, or for some other purpose they hadn't consented to.

There are specific parts of the consent and data that are difficult (RF3)

The consent forms proved to be the most difficult points in the home visit as they require the participant to sign four times. The least effective questions were about attitudes to energy efficiency including its impact on personal freedom. These questions elicit bland responses because this group is unlikely to admit that they are not interested in energy efficiency.

Making recruitment and intake effective (RF3)

Creating a sense of urgency can increase uptake (RF3)

EEOs reported that a number of households had put off their decision on an upgrade until the program was closer to completion. Revisiting the HEEUP database (see section 1) provided an opportunity to prompt the undecided households.

Responding to participants promptly is important (RF3)

If too much time passes after the expression of interest, participants forget about the program or get it confused with other programs and are less likely to participate.

Many participants take time to decide whether they want a hot water upgrade (RP3)

Many participants were not ready to upgrade after their initial expression of interest or the home visit. This contrasted with others who made a decision prior to or at the home visit stage.

Program design issues

EEOs and Program managers identified that a number of the issues for participating households had their roots in the program design. These include:

Point of intervention in the market (RP2)

Program managers noted that HEEUP aims to encourage households to upgrade their hot water system prior to a break down situation. This allows the household time to assess the most cost-effective options (over the lifetime of the system).

However, the intervention point (prior to a breakdown) changes the type of purchase decision the householder has to make from an essential purchase or repair (to maintain a hot water supply) to a discretionary purchase.

The program was modified to incorporate some support for emergency replacements.

Barriers to multiple and diverse hot water installers (RP2)

HEEUP used a small number of preferred installers. While that approach had some benefits, it also came with limitations. In particular, some households wanted to use an alternative supplier for cost or other reasons.

The problems with a small number of suppliers suggest the need to utilise multiple suppliers. However, a number of contract stipulations and program design issues restricted the ability to do so. These included

- ensuring all consent and data processes are delivered
- ensuring all suppliers meet LIEEP’s strict insurance provisions.

IT tools

Developing flexible and robust IT tools that can respond to the many needs in HEEUP was essential. This was particularly important for managing large numbers of EoIs and large volumes of data. It is easy to underestimate the complexity and importance of the IT platforms for this type of trial.

6 Cost-effectiveness and cost benefit analysis

Authors: Linda O'Mullane and Lance Hoch, Oakley Greenwood

Summary of results

OGW was engaged to carry out a cost-effectiveness (C-E) analysis and a cost-benefit analysis (CBA) of the Home Energy Efficiency Upgrade Program as a whole, based on the four cost levels set out in the Low Energy Efficiency Program (LIEEP) Guidelines.

Data illustrating the installation cost and timing, household characteristics and subsidy payments was collected throughout the program by Brotherhood of St Laurence (BSL) staff for each individual household while the Monash Sustainability Institute (MSI) estimated the energy savings and the daily and annual cost savings for eight relevant upgrade pathways.

MSI estimates indicate a decrease in energy consumption of 25 percent and 7 percent for electricity and gas respectively. These savings amount to 762 kWh ($216.13)[21] for average annual electricity consumption and 2,787MJ ($55.64) for gas consumption.

The energy savings estimated by MSI were compared with deemed energy savings estimated for the VEET scheme.

The most cost-effective pathway for electric HWS was upgrade pathway 1 – switching from electric storage to a heat pump. The most cost-effective gas pathway was upgrade pathway 8, switching from gas to a heat pump.

The analysis did not conclude a benefit cost ratio > 1 for any of the eight pathways, when estimating the cost and benefits based on the four cost level framework and the HEEUP energy savings estimates. However, pathway 1 estimated a result closest to 1 compared to the other pathways.

[21] In 2015 dollars residential tariff

The result for the C-E and the CBA was in line with the result based on the VEET electricity savings data by indicating that these are the most cost efficient pathways as the pathways with the highest BCRs.

Four-cost level analysis

The four cost level analysis[22] shows total costs per capita ranging from $2,063 at level 1 (direct costs of delivering the trial to a participant) to $4,649 at level 4 (total trial costs). Program wide costs range from $1,575,908 to $3,552,007. These costs exclude the co-contributions by householders. The C-E and CBA also consider a scenario with the inclusion of the household contributions; these results are presented in Table 23 and in Appendix H9: CBA results – scenario 2.

Table 20: Total annual cost by cost level 1, 2, 3 and 4 – cumulative

	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by cost level	Per capita
Cost level 1	$ 175,466	$ 962,496	$ 437,946	$ 1,575,908	$ 2,063
Cost level 1, 2	$ 239,776	$ 1,164,290	$ 607,965	$ 2,012,032	$ 2,634
Cost level 1, 2, 3	$ 374,640	$ 1,570,429	$ 893,995	$ 2,839,063	$ 3,716
Cost level 1, 2, 3, 4	$ 547,340	$ 2,021,168	$ 983,499	$3,552,007	$ 4,649

Cost-effectiveness analysis

The most cost-effective pathway for an upgrade from an electric hot water system (instant or storage) was to a heat pump ($0.36/kWh), the pathway with the lowest cost/energy savings ratio is the pathway that is considered to be the most cost-effective.

Table 21 Cost-effectiveness results: electricity pathways ($/kWh)

Cost level	Electric (instant or storage) to heat pump ($/kWh)	Electric (instant or storage) to gas instant or storage ($/kWh)	Electric (instant or storage) to solar electric ($/kWh)	Electric (instant or storage) to solar gas ($/kWh)
Level 1	0.16	(4.05)	1.08	0.82
Level 2	0.20	(5.17)	1.38	1.05
Level 3	0.28	(7.30)	1.94	1.47
Level 4	0.36	(9.13)	2.43	1.84
Total program effectiveness	**0.36**	**(9.13)**	**2.43**	**1.84**
Proportion of participants by pathway	12%	8%	3%	3%

[22] Due to time and contract constraints the cost benefit and cost effectiveness analysis were undertaken before program expenditure was finalised. As a result there are some differences between the figures used in the CBA and CEA and the final expenditure.

The most cost-effective pathway for an upgrade of a gas hot water system was gas instant or storage to heat pump ($0.04/MJ).

Table 22 Cost-effectiveness results: gas pathways

Cost level	Gas instant or storage to solar gas($/MJ)	Gas instant to solar gas ($/MJ)	Gas storage to Instant gas ($/MJ)	Gas instant or storage to heat pump ($/MJ)
Level 1	0.027	0.026	0.024	0.019
Level 2	0.034	0.033	0.031	0.024
Level 3	0.049	0.046	0.043	0.034
Level 4	0.061	0.058	0.054	0.043
Total program effectiveness	**0.061**	**0.058**	**0.054**	**0.043**
Proportion of participants by pathway	46%	7%	6%	16%

Cost-effectiveness results: electricity and gas pathways inclusive of all contributions

When all contributions are taken into account, the most cost-effective pathway for an upgrade from an electric hot water system (instant or storage) was still to a heat pump ($0.45/kWh), since that is the pathway with the lowest cost/energy savings ratio.

Table 23 Cost-effectiveness results: electricity pathways – all contributions

Cost level	Electric (instant or storage) to heat pump ($/kWh)	Electric (instant or storage) to gas instant or storage ($/kWh)	Electric (instant or storage) to solar electric ($/kWh)	Electric (instant or storage) to solar gas ($/kWh)
Level 1	0.25	(6.49)	1.73	1.31
Level 2	0.30	(7.61)	2.03	1.54
Level 3	0.38	(9.74)	2.59	1.97
Level 4	0.45	(11.57)	3.08	2.34
Total program effectiveness	**0.45**	**(11.57)**	**3.09**	**2.34**
Proportion of participants by pathway	12%	8%	3%	3%

When all contributions are taken into account, the most cost-effective pathway for an upgrade from a gas hot water system (instant or storage) was from a gas instant system to new gas instant system ($0.054/MJ).

Table 24 Cost-effectiveness results: gas pathways – all contributions

Cost level	Gas instant or storage to solar gas ($/MJ)	Gas storage to instant gas ($/MJ)	Gas instant or storage to heat pump ($/MJ)	Gas instant to gas Instant ($/MJ)
Level 1	0.043	0.041	0.039	0.031
Level 2	0.051	0.048	0.045	0.036
Level 3	0.065	0.062	0.058	0.046
Level 4	0.077	0.073	0.069	0.054
Total program effectiveness	**0.077**	**0.073**	**0.069**	**0.054**
Proportion of participants by pathway	46%	7%	6%	16%

Cost benefit analysis

The cost benefit analysis (whole of program, excluding co-contribution) found a benefit cost ratio (BCR) of 0.48 (NPV = $(2,397)) for electric (instant or storage) to heat pump to be the pathway that provided the largest benefits, although no pathway achieved a BCR > 1, meaning that there was no pathway that had benefits that exceeded its cost.

Table 25 CBA results based on total program cost: cumulated four-level cost analysis (excl. co-contribution)

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage) to heat pump	$ (2,397)	0.48	$ (3,133)	0.33
2	Electric (instant or storage) to gas instant or storage	$ (2,580)	0.45	$ (3,406)	0.27
3	Electric (instant or storage) to solar electric	$ (4,321)	0.07	$ (4,389)	0.06
4	Electric (instant or storage) to solar gas	$ (2,504)	0.46	$ (3,319)	0.29
5	Gas instant or storage to solar gas	$ (3,721)	0.20	n/a	n/a
6	Gas instant to solar gas	$ (3,674)	0.21	n/a	n/a
7	Gas storage to instant gas	$ (3,607)	0.22	n/a	n/a
8	Gas instant or storage to heat pump	$ (3,670)	0.21	n/a	n/a

Cost-benefit analysis: electricity and gas pathways inclusive of all contributions

The cost-benefit analysis (whole of program, including co-contributions) found a benefit cost ratio (BCR) of 0.38 (NPV = $(3,640)) for electric (instant or storage) to heat pump, which was the pathway that provided the largest benefits, although no pathway achieved a BCR > 1, meaning that there was no pathway that had benefits that exceeded its cost.

Table 26 CBA results based on total program cost: cumulated four-level cost analysis incl. co-contributions (see Appendix H8: CBA results based on total program cost, including household contributions).

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage) to heat pump	$ (3,640)	0.38	$ (4,376)	0.26
2	Electric (instant or storage) to gas instant or storage	$ (3,823)	0.35	$ (4,650)	0.21
3	Electric (instant or storage) to solar electric	$ (5,564)	0.06	$ (5,632)	0.064
4	Electric (instant or storage) to solar gas	$ (3,747)	0.36	$ (4,563)	0.23
5	Gas (instant or storage) to solar gas	$ (4,964)	0.16	n/a	n/a
6	Gas instant to solar gas	$ (4,917)	0.17	n/a	n/a
7	Gas storage to instant gas	$ (4,850)	0.18	n/a	n/a
8	Gas (instant or storage) to heat pump	$ (4,914)	0.17	n/a	n/a

Introduction to cost-effectiveness and cost-benefit analysis

Background

The Home Energy Efficiency Upgrade Program (HEEUP) was a trial project that assisted low-income households across Victoria in upgrading their hot water systems (HWS). The trial ran from April 2013 to January 2016 and was funded by the Department of Industry, Innovation and Science (DIIS) through the Low Income Energy Efficiency Program (LIEEP)[23]. It was delivered by the Brotherhood of St Laurence (BSL) in partnership with the Monash Sustainability Institute, AGL Energy Ltd., the NSW Office of Environment and Heritage, and the Alternative Technology Association.

The high level objectives and intended benefits of the LIEEP as outlined in the Guidelines are as follow:

- Objectives:
  - Trial and evaluate a number of different approaches in various locations to assist low-income households to become more energy efficient.
  - Capture and analyse data and information for future energy efficiency policy and program approaches.
- Benefits:
  - Assist low-income households to implement sustainable energy efficiency practices to help manage the impacts of increasing energy prices and improve the health, social welfare and livelihood of low-income households.
  - Build the knowledge and capacity of consortium members to encourage long-term energy efficiency among their customers or clients.
  - Build capacity of Australia's energy efficiency technology and equipment companies by maximising the opportunities for Australian Industries to participate in the projects.

Households were recruited to the program via direct mail (from AGL) or through community-based channels. The program distributed letters progressively to over 120,000 households. In total, 2,400 households expressed interest in the program and home visits were conducted with 1,291 of them. During the home visits an energy engagement officer discussed the costs and benefits of different upgrade options with the householder. These home visits resulted in upgrades of the hot water systems (HWS) of 764 households.

Participants had the choice of upgrading their HWS to:

- Solar with gas booster

[23] The LIEEP was a competitive merit-based grant program established by the Commonwealth Government to provide grants to consortia of government, business and community organisations to trial approaches to improve the energy efficiency of low income households and enable them to better manage their energy use.

- Solar with electric booster
- Heat pump
- Instant gas
  or
- Gas storage.

The cost of each upgrade option was subsidised by BSL (using DIIS funding). Households were also offered an interest-free loan for the unsubsidised portion of the HWS upgrade. Depending on the fuel type before and after intervention, the total cost of the new HWS could also receive additional financial assistance through the VEET[24] and/or via STCs[25], thereby reducing the initial installation cost even further. The BSL made subsidies either directly to the householder, or provided a flat subsidy of $1,200 per upgrade to participating Community Housing Associations, regardless of the chosen upgrade. The Community Housing Associations (rather than the occupant) also paid for the unsubsidised portion of the upgrades in these instances.

The subsidies made available to individual participating households (i.e., participants not located in Community Housing) by BSL varied over the course of the program, as shown in Table 27 below.

Table 27: Time frame and type of subsidy

Jul 13 – Jun 14	Jul 14 – 8 Feb 15	9 Feb 15 – April 15	May 15 – Dec 15	Jun 15 – Mar 16
BSL HESS: all available systems attracted a $1,200 cost to the householder	**BSL**, all subsidies were fixed at $2,000 for solar	**BSL 1**, all subsidies were fixed at $2,500 for solar	**BSL 2,** fluctuating subsidy, with a maximum out of pocket expense of $2,000	**Community Housing,** received a flat subsidy of $1,200 for each upgrade irrespective of the system and fuel type.

Purpose

OGW was engaged to provide advice to carry out a cost-effectiveness and benefit-cost analysis of the program as a whole using the methodology specified in the LIEEP Guidelines (discussed in the LIEEP contribution allocation methodology section below). Data on the cost of the program was provided by BSL. Data on the energy savings achieved in the program were provided by the Monash Sustainability Institute (MSI).

Data

Data regarding the installation cost and timing, as well as subsidy payments was collected throughout the program by Brotherhood of St Laurence (BSL) staff for each

[24] The Victorian Energy Efficiency Target provided additional financial assistance for upgrades to solar and heat pump HWS.
[25] Only gas or electric solar HWS were eligible for STCs.

individual household while MSI estimated the energy savings and the resultant daily and annual cost savings for eight relevant upgrade pathways.

The data set maintained by BSL included the following information for 764 individual participants:

- Pre-intervention type of HWS
- Post-intervention type of HWS
- Type and amount of subsidy and participant co-contribution
- Cost of installation
- Date of installation
- LIEEP contributions and non-LIEEP contributions (i.e. VEET and STC co-contributions).

The data on uptake was provided on an aggregate level across all households. As a result, we were not able to analyze the uptake rate by subsidy or by technology relative to all householders that expressed an interest in participating in the program[26].

MSI analysis

MSI provided pre-/post intervention consumption comparisons for participants by pre-intervention HWS energy source and technology pathway[27]. This data set allows comparison of different upgrade pathways, with the resultant average daily energy saving and average daily monetary savings resulting from the upgrade[28].

The MSI study results indicate a significant decrease in average daily pre-intervention energy consumption of 25 percent and 7 percent for electricity and gas respectively. These savings account for 762 kWh for average annual electricity consumption and 2,787MJ for gas consumption.

This translates into an annual average saving per household of $216.13 for electricity consumption and $55.64 for gas consumption, based on an average marginal market offer retail electricity price of $0.28/kWh (January 2015[29]) and an average marginal gas retail tariff of $0.02/MJ (January 2015).

[26] Where information was available on individual participating households, we were able to use it to adjust for missing data. For example, information was available on whether the household received VEET and/or STC co-contributions. Averages from this data were used to assign VEET and STC values to the 24% of the records for which data on these items was missing.

[27] The term 'technology pathway' is used to indicate each of the combinations or pre-intervention and post-intervention pairs of HWS equipment that occurred under the program.

[28] Full details of the MSI consumption analysis is provided by Byrne et al. What was the effect of the HEEUP on household electricity and gas consumption? in Chapter 2 of this report.

[29] Adjusted by CPI Mar 2014 – Mar 2015 http://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/32044F411E5ACC79CA257E89001B226A?opendocument

MSI compared their estimated energy savings with published energy savings from DEDJTR (2015), Sustainable Victoria (2015) and EnergyConsult (2012). The publicly available estimates from past trials and engineering approaches appear to be higher compared to the results from the HEEUP trial. Possible reasons for the size of the difference between the MSI results and these other studies include:

- The other studies were all engineering analyses, while the MSI study is a bill analysis. Engineering analyses can focus on the thermodynamic changes within an end use, and may not account for behavioural change. Bill analyses, by their very nature, reflect customer usage changes – for example, changes in family composition, changes in non-hot water usage, or the possibility that the customer, having had energy efficient measures installed, may decide that they can now 'afford' longer showers.
- For a whole-house billing analysis to accurately capture water heating energy consumption changes, the amount of energy consumed for all other end uses must remain relatively constant. Otherwise, changes in the energy consumed in those end uses will 'appear' as hot water savings. This sort of effect can be particularly pronounced if weather conditions change markedly across the pre- and post-intervention timeframes.

Data limitations and application of MSI data

There are issues with the representation of the data in the MSI report that limited our ability to answer some of the originally intended questions. The MSI report provides cost-savings on:

- four electricity pathways, three of which are deemed to have statistically significant results but all of which are deemed to be at a level of 'practical' statistical significance (the electric storage to electric solar is deemed non-significant due to the small sample size[30])
- six gas pathways, three of which are deemed to have statistically significant results and another two of which are deemed to be at a level of 'practical' statistical significance (gas instant to gas instant and gas instant to gas solar); and one is marginally not statistically significant (gas storage to heat pump) [31]

[30] For completeness, we still used the results and compared them with the outcomes of the VEET study.

[31] MSI estimated that the four upgrade pathways have a significant impact on electricity consumption, meaning that there is enough evidence to infer that these results would occur in a larger population. Practically significant results mean that these changes are real for the sampled households but there is not enough evidence to infer that these results would occur in larger populations. The marginally non-significant pathway, gas storage to heat pump, was based on a low participation rate and the heat pumps were installed between April and October, and did not operate during summer months. This may underestimate the potential savings.

- There is no information on the energy and monetary savings by subsidy type or technology; the savings are calculated by pathway and were aggregated across subsidy types
- The MSI study results do not include households that participated in the last months of the HEEUP and thus, the HEEUP encompasses a larger total sample size
- The MSI study accounted for 63[32] households in the electricity pathways and 210 households[33] in the gas pathways that are deemed to be of statistical significance.
- We extrapolated these results for our entire sample, resulting in estimating the benefits obtained by 725 out of a total of 764 households, accounting for 187 in the electricity pathways and 538 households in the gas pathways.
- The electricity savings in the upgrade pathways that involve a switch to gas are net of the increase in gas consumption.
- The dollar savings are based on the average retail offer price, but it is our understanding that most of the program participants that use electric hot water are on controlled load tariffs. There is only limited information in the program dataset to distinguish between households on controlled load tariffs versus households on continuous tariffs. We made some high level inferences to account for the lack of information by accounting for the proportion of the population that was on controlled load tariffs for each pathway (see Cost-benefit analysis of HEEUP below), and assuming that there were no changes in the householder's tariff choice after the intervention[34]

As a result of the above mentioned limitations:

- We could only perform a cost-effectiveness analysis and cost benefit analysis for the pathways for which savings data are available.[35] We also assumed that the useful life of all of the HWS upgrades is 15 years and that the maintenance costs of the new HWS were essentially no different from those of the pre-intervention technologies and therefore could be ignored.
- Cost-effectiveness and cost-benefit results were calculated using two sets of energy savings inputs: the MSI results and the savings as calculated by the Victoria Department of Economic Development, Jobs, Tourism and Resources (DEDJTR)[36]. This was undertaken as a means of assessing the potential savings that could be

[32] We note that the sample sizes for the electricity pathways in the MSI study are small. MSI used a step-wedge design to account for the lack of control groups and small sample sizes. The results were considered significant, meaning that there is enough evidence to infer that these results apply to larger sample sizes.
[33] See Tables 9 and 10, in Chapter 2 of this report.
[34] Unlike the MSI study, however, we did not account for household sizes, due to insufficient data.
[35] And assume use of the average tariff that is provided in table 10 of the MSI report (see Chapter 4), and an estimated proportion of households on controlled load tariff.
[36] DEDJTR: 'Modelling the future VEET certificate market for residential-type measures'. Savings estimates available from Sustainability Victoria report were investigated but not used for the purpose of this report as they have not been published.

masked by the limitations of a whole-load billing analysis as discussed in MSI analysis above.

The available sample size to estimate the energy efficiency savings was N = 63 for electricity pathways, and N = 210 for gas pathways[37]. We extrapolated these results to the complete sample size for the C-E and CBA, which is 764.

Application of Monash data for the cost-effectiveness and cost-benefit analyses

The C-E and CBA applied a 28 c/kWh peak tariff and an 18 c/kWh off-peak tariff, in line with the Monash study and their referenced estimates from Sustainability Victoria (2015). The peak tariff was CPI adjusted to align the electricity price with the gas price.

We applied sensitivities to allow variations in energy savings estimates by applying DEDJTR's (2015) energy savings data. In addition, we applied sensitivities to the cost of electricity by assuming that the entire population is on peak tariffs, compared to a weighted approach that assumes that a proportion of the population in each pathway is on a controlled-load tariff. This is detailed below (Cost-benefit analysis of HEEUP).

The MSI data uses upgrade pathways that only comprise electricity storage to relevant upgrade technologies. However, the HEEUP data set also includes electricity instantaneous technologies as the original, pre-intervention HWS. In these cases, we assumed that the savings from electric storage and electric instantaneous HWS would be the same for each post-intervention HWS. It should be recognised that this is likely to over-estimate the savings for the instantaneous pre-intervention segment of the sample.

We applied the following aggregations for pathways:

- *Our modelling:* electric (instant or storage) to gas instant or storage – *MSI modelling*: this is only electric storage to instant gas, assuming the energy savings from the Monash pathway and extrapolating it to the entire population in the respective pathway.
- *Our modelling:* electric (instant or storage) to solar electric – *MSI modelling*: electric (storage) to solar electric. This pathway was considered by MSI to be statistically non-significant, although previous trials reported decreases in electricity consumption of 16.7 and 22 per cent[38], hence can be considered to be practically significant.
- Like to like gas upgrades such as gas storage with gas storage and instant gas with instant gas, did not deliver statistically significant decreases in consumption. In fact, upgrading an existing gas storage unit to a new one resulted in 16 percent increase in consumption. Possible explanation may include that the replacement unit was

[37] See Tables 9 and 10, Chapter 2 of this report

[38] Lynch et al. (2013), Alice Springs Solar City trial.

larger, allowing some households to use more hot water than they would otherwise have done.

The DEDJTR 2015 (VEET) approach

The MSI report (2016)[39] compares the estimated HEEUP energy savings with the savings that were estimated by Sustainable Victoria (2015)[40] and DEDJTR (2015)[41]. It was acknowledged that the reductions in electricity and gas consumption and subsequent estimate of financial savings based on the HEEUP model results were not completely consistent with either one of these sources. The HEEUP results suggest that the intervention achieved lower energy reductions compared to either of these studies. These differences may be due to the sample households and study context having different characteristics (i.e. low income households, older residents, small number of residents, relatively cooler climate, etc.) to those on which the Sustainable Victoria and DEDJTR studies were based on.

Sustainability Victoria developed a spreadsheet model to predict the future behavior of the VEET certificate market for residential-type measures under a range of scenarios. The modelling for this data set was initiated by DEDJTR. These VEET results estimated four upgrade pathways, which were comparable with the upgrade pathways estimated by MSI.[42]

It is worth noting, that there are stark differences in the methodologies to estimate the energy savings from upgrading the HWS between the HEEUP/Monash estimates compared to the VEET estimates.

The HEEUP data is based on full-bill energy savings estimates, while the VEET estimates use an engineering approach. The full-bill energy savings estimate accounts for the entire energy usage across the whole household, not just the HWS. As such, a change in the usage of other appliances may cause changes in energy consumptions that could not be accounted for in MSI's estimates, such as:

- Changes in the usage of other appliances,
- Changes in the composition of the household, i.e. the number of occupants in the household might have increased after the intervention. For example, the house was occupied by a couple before the intervention and was replaced by a family with two children afterwards.

[39] see Chapter 4
[40] Sustainability Victoria (2015) Hot water running costs. Accessed May 17, 2016 http://www.sustainability.vic.gov.au/services-and-advice/households/energy-efficiency/at-home/hot-water-systems/hot-water-running-costs
[41] DEDJTR: 'Modelling the future VEET certificate market for residential-type measures',
[42] It was recognized that the underlying algorithms that estimate the energy savings overstate these savings and that VEET certificate creation algorithms will be updated from 2017. DEDJTR: 'Modelling the future VEET certificate market for residential-type measures', p. 9.

As such, there is a possibility that the real savings that could have been achieved through the HWS only, may have been underestimated.

To provide a comparison (likely upper energy savings estimate), we compared the HEEUP results with the deemed approach based on engineering estimates that was available from the VEET analysis. This approach applies engineering data to estimate the changes in energy usage as a result of only the differences in the thermodynamic properties of the pre- and post-intervention HWS technologies (i.e. behaviour is excluded except where an explicit assumption is made about its impact). These estimates are often a slight overstatement, as they do not take environmental factors and possible behavioral changes in the household into account.

Despite these drawbacks with both approaches, the results provide useful upper and lower bound estimates of the energy savings as a result of the HEEUP.

Organisation of the report

The report is organised as follows. The first section provides an overview of the four cost-level analysis framework specified by DIIS. The next section presents how the costs applicable to each of the four cost levels were derived. This is followed by the Cost-effectiveness analysis and then the cost-benefit analysis of HEEUP.

HEEUP four cost-level analysis

The LIEEP provided the primary funding source for the HEEUP, but this was supplemented by various sources of co-contributions. The C-E analysis and CBA include costs only attributable to the LIEEP funding and exclude any co-contributions. The analysis was also undertaken for all contributions (see summary and Appendix H)

The *LIEEP* contribution was used for:

- Staff costs, i.e. salaries to BSL staff for administration, recruitment and home visits
- Associated on-costs
- Subsidies for the purchase of HWS upgrades i.e. BSL and community housing (see LIEEP allocation methodology below for a description of the treatment of subsidies)

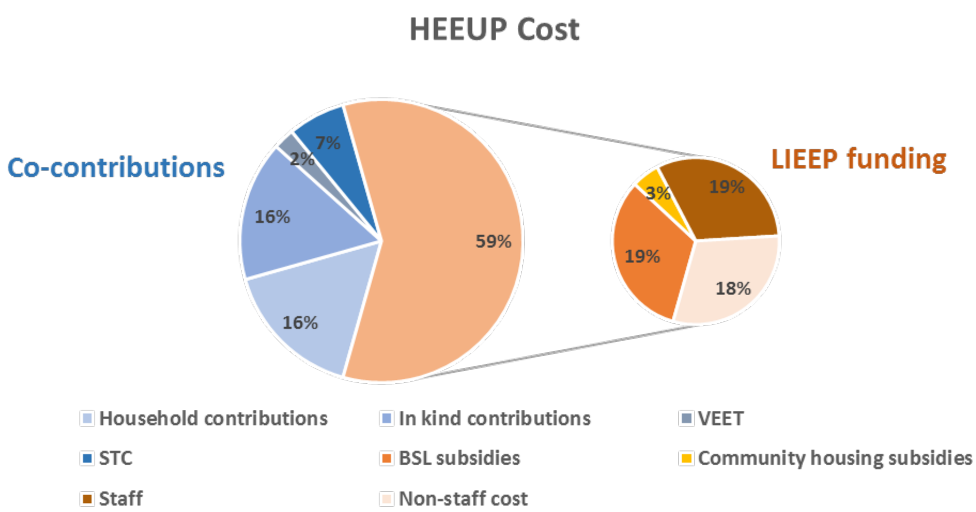
Non-LIEEP contributions are referred to as *co-contributions* and include:

- Contributions made by households to fill the gap between subsidies by BSL to the household for the HWS
- In-kind contributions by external stakeholders (see below)
- VEET[43] and STC[44] payments, which reduce the cost of the HWS at the time of installation.

[43] Under the VEET scheme, accredited businesses can offer discounts and special offers on HWS (and other selected energy saving products). The level of discount is dependent on the Victorian energy efficiency certificates (VEEC) the upgrade attracts.

Figure 22 provides an overview of the contributions by source.

Figure 22: HEEUP cost allocations



HEEUP funding was allocated according to the four cost-level analysis framework based on the LIEEP guidelines and outlined in Table 28 below, which provides an overview of the LIEEP framework and the allocation of costs as defined by DIIS. The table provides a high level description of the cost data that is relevant for conducting each level of the analysis. Appendix H1: LIEEP framework application for HEEUP presents further information on the application of this framework to the analysis of the HEEUP program.

The cost-effectiveness and cost benefits of co-contributions were calculated separately and the results are presented below and in Appendix H4: Non-LIEEP contributions – co-contributions by households, VEET and STC, in-kind contributions.

Table 28: Four levels of analysis – LIEEP framework

Cost level	Cost data analysed
Direct Trial approach (Level 1)	**a. Cost of delivering the trial approach to a participant** • The calculated cost of delivering: o The retrofit hardware and install cost per participant o The home energy audit and coaching cost per participant o The education program per person • Staff costs o Percentage of: energy engagement officers, admin, loan, management • Non-staff costs

[44] Small scale technology certificates (STC) are created per system, based on the MWh that are generated by the system (solar, wind or hydro; in the HEEUP case, only solar was available) or displaced by the solar HWS over the life of the system.

Cost level	Cost data analysed
	o OEH o Cars • May include: Household contribution/Total cost of hot water system, STC/VEET
Trial Component (Level 2)	a) Cost of delivering the trial approach to a participant, **and** **b) Costs associated with:** **i. Recruiting a participant, and** **ii. Maintaining a participant** **iii. Delivery** • For example, media and advertising, staff time, conducting interviews, screening applicants, maintaining resources to support ongoing participation etc.) • Staff cost i. Percentage of: EEO (engaging follow up), admin (higher maintenance/intake), loans admin, management (partner relations) • Non-staff costs i. Percentage of AGL (recruitment), loans
Total Business (Level 3)	The delivery of an outcome for: a) Cost of delivering the trial approach to a participant, **and** b) Costs associated with: i. Recruiting a participant, and ii. Maintaining a participant, **and** **c) Cost of running an organisation to do the above** • For example, renting office space, IT infrastructure, energy costs, running costs, over-heads, etc.) • Staff cost i. Percentage of Management overheads, loans • Indirect staff costs i. Percentage of Rent, IT Energy
Total Trial (Level 4)	The delivery of an outcome for: a) Cost of delivering the trial approach to a participant, **and** b) Costs associated with: i. Recruiting a participant, and ii. Maintaining a participant, **and** c) Cost of running an organisation to do the above, **and** **d) Cost of participating in a government funded trial**[45] • For example, total cost of the trial, including funding, and administrative and compliance costs associated with participating in a government funded trial - e.g. Costs associated with preparing milestone and financial reports)

[45] Although stated in the guidelines, we excluded co-contributions from the cost analyses as we only considered costs that were directly funded through LIEEP payments. However, co-contributions were considered as an additional calculation in the section Non-LIEEP contributions

Cost level	Cost data analysed
	• Staff cost i. Percentage of management • Non-staff costs i. All research costs (BSL, MSI), AGL • Non-staff costs

Source: LIEEP

LIEEP contribution allocation methodology

The *LIEEP* contribution was used for:

- Staff costs, i.e. salaries to BSL staff for administration, recruitment and home visits
- Associated on-costs
- Subsidies for the purchase of HWS upgrades, i.e. BSL and community housing

Staff costs and associated on-cost

The staff costs were accounted for in an accounting staffing expenses format. The cost allocations for staff expenses in this format needed to be disaggregated and aligned with the relevant cost levels for the four-cost analysis.[46]

Thus, these proportions represent the relative degree of participation in the delivery of the program. The program is divided into the three financial years it ran for (FY 2013/14, FY 2014/15 and FY 2015/16).

The allocated proportions account for the time spent by staff at different levels for the delivery of the program. The annual four program costs are allocated across staff levels in this fashion. In the first year of HEEUP, only the program and technical manager, EEO and admin loan staff were involved in the delivery of the program. Year 2 involved administration and data processing. In the last year, all staff levels (i.e. program manager, EEO, admin loan, technical manager, EEO & recruitment, admin and data processing) were involved in the delivery of the program. Appendix H5: Weighting for direct and indirect staff costs provides a comprehensive presentation of the allocation matrix for step 1 as well as step 2.

Direct program delivery cost – BSL subsidies and Community Housing subsidies

Cost level 1 also includes the cost of subsidies. Subsidies help the householder with the initial investment cost of the upgrade and were either paid directly to the householder (BSL subsidies) or as a $1,200 flat rate for each HWS upgrade through community housing providers. BSL subsidies differed in delivery mode across the program's life span, depending on the timing as described in Table 27 above.

[46] BSL staff provided approximate costs for each staff level and percentage allocations for the participation of each staff level across the four cost levels.

Both BSL and community housing subsidies are included in the cost allocation for cost level 1. Due to the different treatment of community housing during the HEEUP trial period, it was deemed appropriate to separate the community housing and BSL subsidies. Appendix H3: Direct staff costs – subsidies, BSL and Community Housing shows that from a total of $1,316,147 in subsidies, $188,100 were related to subsidies made through community housing providers and $1,128,047 were made directly through BSL. Community housing subsidies were only delivered during the last year of the program (FY 2015/16).

The calculations for BSL subsidies and community housing subsidies contain two cost parts:

- The monetary value of the subsidies
- The BSL staff costs necessary to administer these subsidies to the participants and to community housing providers

The direct staff costs for the FY 2015/16 were weighted to apportion the amount of time spent on BSL subsidies and community housing subsidies.

The costs for both subsidies are allocated based on the same allocation matrix. This matrix is also the same allocation matrix that is used to allocate direct and indirect staff costs.[47]

For comparison, Table 29 illustrates the total cost by cost Level, cumulatively, inclusive of the BSL and community housing subsidies, added to cost Level 1. Appendix H2: Disaggregated four-level cost analysis shows the disaggregated allocations of the incremental and cumulative annual costs, inclusive of subsidies, as well as a separate estimate showing results inclusive of household contributions (see Table 37–39).

Table 29: Total annual cost by cost Level 1, 2, 3 and 4 - cumulative

Staff cost FY	Total cost excl. household-contributions	Total cost incl. household contributions
Cost level 1	$ 1,575,908	$ 2,533,669
Cost level 1, 2	$ 2,012,032	$ 2,969,793
Cost level 1, 2, 3	$ 2,839,063	$ 3,796,824
Cost level 1, 2, 3, 4	$3,552,007	$4,509,768

Non-LIEEP contributions – household co-contributions, in-kind co-contributions, VEET and STC

Co-contributions include:

- Contributions made by households to fill the gap between subsidies by BSL to the household for the HWS
- In-kind contributions by external stakeholders

[47] The allocation matrix was provided to OGW by BSL staff.

- VEET and STC payments, which reduce the cost of the HWS at the time of installation.

The total sum of all co-contribution was $2,048,286[48]. These are costs that are not financed through the LIEEP and represent costs that are additional to the cost of the LIEEP funding.

These costs are not included in the four-cost-level analysis and are presented separately[49]. Table 30 and Table 31 present the co-contributions by household, VEET + STC and in-kind contributions, as well the percentage of its contribution within the total amount of co-contributions. The cumulative in-kind co-contributions are presented in Table 31. In-kind co-contributions were allocated according to the LIEEP guidelines.

In-kind contributions were allocated using a matrix that apportioned them based on time spent by the co-contributor on activities associated with each of the four cost levels[50]. A detailed list of co-contribution costs is presented in the Appendix.

Table 30: Co-contributions – Total households' co-contribution and VEET + STC

Co-contributions	Total non-LIEPP funded co-contributions	Percentage of total co-contributions
Household contributions	$ 957,761	47%
VEET + STC	$ 145,160	7%

Table 31 Total annual in-kind contributions by cost Level 1, 2, 3 and 4 – cumulative

Staff cost	Total cost by cost level	Percentage of total co-contributions
Cost level 1	$0	
Cost level 1, 2	$282,217	
Cost level 1, 2, 3	$570,262	
Cost level 1, 2, 3, 4	$945,366	46%

Cost-effectiveness analysis and cost-benefit analysis

Overview

The cost-effectiveness (C-E) analysis measures the cost for each unit of energy saved under each of the various technology pathways and for the program as a whole. This is in contrast to the cost benefit analysis, which also accounts for monetized benefits in dollar terms, but does so in terms of the either or both (a) the degree to which the

[48] Note: due to time and contractual constraints, the cost benefit and cost effectiveness analysis were undertaken prior to the finalisation of the program budget. As a result there are some differences between the figures used in the CBA and CEA and the program final budget.
[49] We only included funding that could be directly associated with money coming from LIEEP. However, we do recognize the importance of co-contributions to the successful delivery of the program; therefore, we undertook separate analysis of the non-LIEEP contributions.
[50] The matrix for the allocation of in-kind contributions was provided by BSL staff.

present value of the benefits of the program (primarily the stream of dollar savings over the life of the post-intervention technology) exceed the applicable program costs associated with those benefits), and/or the ratio of those savings to those costs.

At a minimum, BSL is obliged under the funding provided by DIIS, to provide a cost-effectiveness analysis of the HEEUP, based on the four cost-level approach as outlined in the LIEEP Guidelines.

The LIEEP Guidelines state that both analyses should only include quantifiable benefits and costs that can be directly attributed to the HEEUP. Thus, both analyses take those subsidies into account that were provided directly from LIEEP funding, but exclude co-contributions (i.e. householder's co-contributions for the purchase of a HWS, in-kind contributions and VEET and STCs).

In addition, we estimated an upper and lower bound based on different estimates for household energy savings before and after the intervention. As discussed above, the lower bound was estimated based on the HEEUP data that was collected throughout the course of the program and estimated by MSI. In contrast, the upper bound savings are based on a deemed approach using estimates developed by DEDJTR for the VEET data. The objective is to provide a robust range for the C-E and CBA results, given the uncertainties surrounding the different estimation methodologies as outlined in the data section above.

Thus, the two analyses outlined below and in the cost-benefit analysis of HEEUP, were undertaken for both data sets, the MSI estimates of energy saving based on the HEEUP data and the VEET savings.

The C-E is performed based on the following assumptions:

- The total cost-effectiveness for each upgrade pathway is weighted for each cost level.
- The costs are based on the full cumulated cost of the HEEUP, including the subsidies (i.e. BSL and community housing subsidies)[51].

The CBA is performed for each of the eight pathways, based on two scenarios.

- Firstly, based on total cumulative program cost, including the subsidies (i.e. BSL and community housing subsidies). The cost of the HWS upgrade is included in the form of the subsidies. The following scenarios were considered:
    - Cost and benefits based on residential tariff
    - Cost and benefits based on controlled-load tariff
- Secondly, the CBA was performed based on the cost of the technology only. Here, the costs were represented by the subsidies to upgrade the HWS, exclusive of

[51] Appendix H2: Disaggregated four-level cost analysis provides a comparison of the program cost based on the full cost of the upgrade, inclusive of contributions by the householder.

program on-cost. The purpose was to answer the question as to what the cost and benefits of the technology itself were, based on the energy and the dollar-value of the savings that can be achieved by that technology[52]. We analyzed the following scenarios:

- *HWS costs[53]:* the technological upgrade costs as invoiced, including contributions made by households towards the purchase of the HWS, but excluding VEET and STC[54]
- *LIEEP contribution to HWS costs:* the technological upgrade costs exclusive of contributions made by households. The costs are based on the BSL and community housing (i.e. subsidies paid directly through LIEEP funding) only, representing the cost/benefits of the technology pathway to DIIS.
- *Household contribution to HWS costs:* the technological upgrade costs based only on the contributions by the householder (excluding VEET + STC and BSL and community housing subsidies). This represents a technology analysis from the householder's perspective after government's policy impacts.

Lower-bound energy savings – MSI data

Table 32 and Table 33 show the energy savings used in the cost-effectiveness and cost-benefit analyses for the eight pathways whose results were statistically or practically significant[55]. The tables show the average pre- and post-intervention daily consumption (in either kWh or MJ, depending on the pathway) for the households that participated in each of the pathways, as well as the average total savings calculated to accrue for households over a 15-year period, which was taken as the likely useful lifetime of the measures installed under the HEEUP.[56]

Table 32: Daily energy-savings for electricity pathways by household (MSI)[57]

	Pathway	Pre-intervention (kWh)	Post-intervention (kWh)	Net daily saving (kWh)	Total savings (kWh) after 15 years
1	Electric (storage) to heat	8.21	5.82	2.39	13,080

[52] The energy savings as well as the $-value savings were provided to BSL by Monash for the lower bound energy savings estimate and based on VEET for the upper bound estimates.
[53] These costs reflect the invoice cost after adjustment for VEET and STC
[54] Total HWS costs = Invoice costs = BSL/community housing subsidies + contributions by households
[55] We considered the pathways storage to electric heat pump and gas instant to solar gas to be practically significant. The reason was that the results for the switch to heat pump were considered by MSI to be only marginally non-significant, due to a small sample size, and the switch to solar gas was one of the VEET pathways that were used for comparison. Again, the reason for non-significant outcome was a small sample size in the MSI study.
[56] MSI estimated the upgrade pathway gas storage to gas storage with a significant increase in consumption of 16 percent. We did not include this pathway in the analysis as the reasons for this increase are unknown and may relate to a change in the size of the new HWS or some other reason that we could not account for within the timeframe and scope of this analysis.
[57] Pathways 2, 4 and 8 account for increased gas/electricity consumption after the fuel switch

	Pathway	Pre-intervention (kWh)	Post-intervention (kWh)	Net daily saving (kWh)	Total savings (kWh) after 15 years
	pump				
2	Electric (instant or storage) to gas instant or storage (net)	7.11	7.20	(0.09)	(509)
3	Electric (instant or storage) to solar electric	9.11	8.76	0.348	1,912
4	Electric (instant or storage) to solar gas (net)	7.11	5.33	0.46	2,520

Table 33: Daily energy-savings for gas pathways by household (MSI)

	Pathway	Pre-intervention (MJ)	Post-intervention (MJ)	Net daily saving (MJ)	Total net savings (MJ) after 15 years
5	Gas instant or storage to solar gas	106.91	92.94	13.97	76,469
6	Gas instant to solar gas	123	108.3	14.67	80,302
7	Gas storage to gas instant	105.43	89.75	15.68	85,837
8	Gas instant or storage to heat pump	99	79.22	19.76	108,208

The largest daily savings for the electricity pathway per household were achieved by upgrading from electric (instant or storage) to heat pump. The largest savings in the gas pathways were achieved through an upgrade from instant or storage gas to heat pumps.

Upper-bound energy savings – VEET data

Pathways 1, 2, 3 and 5 in the MSI study were found to be comparable with the pathways estimated for the VEET scheme. Table 34 shows the annual net savings and the total savings at the end of the useful life of the HWS. The useful life for the solar electric upgrade (pathway 3) was considered to be 6.5 years in the VEET analysis, compared to 15 years in our analysis. For comparison, we reported both (pathway 3a = savings after 6.5 years, and pathway 3b = savings after 15 years).

Table 34: Annual energy-savings for electricity and gas pathways by household (VEET)

	Pathway	MSI: Net saving (annually)	VEET: Net saving (annually)	MSI: Total savings (kWh) after 15 years	VEET: Total savings (kWh) after 15 years
1	Electric (storage) to heat pump (kWh)	872	2,381	13,080	35,721
2	Electric (instant or storage) to gas instant or storage (net) (kWh)	(34)	(2,74)	(509)	(24,888)
3a	Electric (instant or storage) to solar electric (kWh) (6.5 years' useful life)	n/a	3,403	n/a	22,122

3b	Electric (instant or storage) to Solar electric (kWh) (15 years' useful life)	127	3,403	1,912	51,050
5	Gas instant or storage to solar gas (MJ)	5,098	9,601	76,469	144,015

Results

The upper and lower bound energy savings range is considerably large. The reason for such wide differences in energy savings data may include:

- Overstatement of energy savings in the VEET analysis[58]
- Understatement of the household energy savings in the HEEUP data set, due to the small sample size
- Changes in household composition before and after the intervention
- Difference in the energy savings estimation methodology – the HEEUP estimate was based on the total energy bill, not limited to HWS consumption changes. In contrast, the VEET analysis bases its algorithms on engineering data related to the HWS only.

Cost-effectiveness analysis

The cost-effectiveness analysis asks the question: how much did each unit of energy save under the HEEUP cost in LIEEP funding (i.e. $LIEEP/kWh saved). The lower the cost, the more cost-effective the program.

Table 35 and Table 36 show the lower and upper bound results of the cost-effectiveness analysis for each of the four cost levels specified in the LIEEP Guidelines for each of the upgrade pathways (Table 35 shows the results for the electricity upgrade pathways, and Table 36 for the gas upgrade pathways).

These tables also show the proportion of participants in each pathway[59]. These proportions are used to weight the cost-effectiveness of each pathway in the calculation of the cost-effectiveness of the program overall.

Table 37 compares the results of the cost-effectiveness analysis based on HEEUP vs VEET energy savings estimates.

Specific assumptions for the cost-effectiveness analysis are the following:

- The cost-effectiveness analysis by cost-level assumes that the technology costs are already included in cost level 1 in the form of BSL and community housing subsidies (co-contributions are excluded). Appendix H7: Cost-effectiveness results: electricity and gas pathways inclusive of contributions by householdsprovides a sensitivity

[58] DEDJTR, 'Modelling the future VEET certificate market for residential-type measures', p. 9.
[59] Most participants did not have a 'free choice' of upgrade pathway, and rather chose what was suitable for their given circumstances, current HWS and housing situation.

analysis to show the implications for the cost-effectiveness of the program, if contributions from households are included within cost level 1.

- The cost-effectiveness analysis by cost-level is performed based on the cumulative cost levels as outlined in the LIEEP Guidelines.
- The daily consumption data pre-and post-intervention is an average across participants in each pathway.

Table 35 Cost-effectiveness results: electricity pathways

Cost level	Electric (instant or storage) to heat pump ($/kWh)	Electric (instant or storage) to gas instant or storage ($/kWh)	Electric (instant or storage) to solar electric ($/kWh)	Electric (instant or storage) to solar gas ($/kWh)
Level 1	0.16	(4.05)	1.08	0.82
Level 2	0.20	(5.17)	1.38	1.05
Level 3	0.28	(7.30)	1.94	1.47
Level 4	0.36	(9.13)	2.43	1.84
Total program effectiveness	**0.36**	**(9.13)**	**2.43**	**1.84**
Proportion of participants by pathway	12%	8%	3%	3%

Table 36 Cost-effectiveness results: gas pathways

Cost level	Gas instant or storage to solar gas($/MJ)	Gas instant to solar gas ($/MJ)	Gas storage to instant gas ($/MJ)	Gas instant or storage to heat pump ($/MJ)
Level 1	0.027	0.026	0.024	0.019
Level 2	0.034	0.033	0.031	0.024
Level 3	0.049	0.046	0.043	0.034
Level 4	0.061	0.058	0.054	0.043
Total program effectiveness	**0.061**	**0.058**	**0.054**	**0.043**
% of participants by pathway	46%	7%	6%	16%

Table 37 HEEUP C-E comparing MSI and VEET savings data

	Electric (storage) to heat pump ($/kWh)		Electric (instant or storage) to gas instant or storage (net) ($/kWh))2		Electric (instant or storage) to solar electric ($/kWh)) (6.5 years' useful life)		Gas instant or storage to solar gas (net) ($/MJ)	
Cost level	MSI	VEET	MSI	VEET	MSI	VEET	MSI	VEET
Level1	0.16	0.06	(4.05)	(0.08)	1.08	0.04	0.03	0.01
Level2	0.20	0.07	(5.17)	(0.11)	1.38	0.05	0.03	0.02
Level3	0.28	0.10	(7.30)	(0.15)	1.94	0.07	0.05	0.03
Level4	0.36	0.13	(9.13)	(0.19)	2.43	0.09	0.06	0.03
Program effectiveness	0.36	0.13	(9.13)	(0.19)	2.43	0.09	0.06	0.03

Results

The HEEUP results show that within the electricity pathways, switching from electricity to heat pump (pathway 1) is the most cost-effective pathway. This is because in comparison with the other pathways, it exhibits the lowest cost/energy savings ratio. This pathway also accounts for the largest proportion of participants among the electricity pathways.

Pathway 2 produces a negative result in terms of energy consumption (for both HEEUP and VEET). The reason for this is that the decrease in kWh due to the switch from electricity to gas results in a net increase in energy consumption. The household is still able to achieve a cost saving as a result of the upgrade, as (at the moment) gas prices are lower than electricity prices.

Within the gas pathways in the HEEUP results, the most cost-effective pathway is the upgrade from instant gas or storage to solar gas. This means that this pathway achieves one more unit of energy savings (here, one more MJ) for the least cost.

This is also the most common pathway used in the program. The greatest electricity savings are achieved through the electricity (instant to storage) to heat pump pathway.

The results from HEEUP and VEET reveal that switching from electric instantaneous or storage HWS to a solar storage system is the most cost-effective electricity pathway, with the lowest cost/energy savings ratios.

Cost-benefit analysis of HEEUP

For the cost-benefit analysis we applied the average daily $-savings by household as estimated by MSI and VEET and distinguished between the following two scenarios, as described below:

- **Scenario 1:** Analysis based on total program cost (this analyses the costs and benefits of the LIEEP funding for HEEUP), this scenario analyzed the following two categories:
  - **A)** Total program cost by cost level (cumulatively), this analysis is inclusive of BSL and Community Housing subsidies to account for the cost of the upgrade, based on residential tariff
  - **B)** As above based on the assumption that a proportion of the population is on controlled-load tariff
- **Scenario 2:** Analysis based on the cost and benefits of the technology only, exclusive of any other program costs, this scenario analyzed the following four categories:
  - **A)** Cost of technology assumed to be HEEUP subsidies (through BSL and community housing) and the benefits were estimated based on the $-savings using the residential tariff
  - **B)** Cost of technology assumed to be HEEUP subsidies (through BSL and community housing) and the benefits were estimated using $-savings assumed to represent a proportion of the population being on controlled tariffs
  - **C)** Cost of technology based on household's contributions and the benefits were estimated based on the $-savings using the residential tariff
  - **D)** Cost of technology based on household's contributions and the benefits were estimated using $-savings assumed to represent a proportion of the population being on controlled tariffs
  - **E)** Cost of technology is based on invoice costs[60] (after the application of any applicable VEET and STC subsidies) and the benefits were estimated based on the $-savings using the residential tariff
  - **F)** Cost of technology is based on invoice costs (after the application of any applicable VEET and STC subsidies) and the benefits were estimated using $-savings assumed to represent a proportion of the population being on controlled tariffs

The technology costs were estimated for two sets of daily savings, (a) all households were assumed to be on a residential tariff, (b) the daily savings were based on a weighted average, reflecting the proportion of households on controlled-loads. We made the following specific assumptions:[61]

- We calculated a weighted daily saving based on the average household unit savings (i.e. kWh, MJ) with the assumed controlled-load tariff

[60] In this case, it represents the cost of the technology, inclusive of subsidies and household contributions, after VEET and STC subsidies are applied.
[61] This adjustment did not need to be made for the gas pathways, as there are no controlled load gas tariffs.

- We weighted the new daily savings with the proportion of participants on controlled-load tariff vs. residential tariff
- We assume that the new daily savings are based on the controlled-load tariff, reducing the cost of electricity to run the HWS from $0.28/kWh (average estimated electricity tariff) to $0.18[62].
- We assume that the savings were achieved through the HWS upgrade only and applied the controlled load tariff to the daily savings

A more holistic estimate would include changes in water consumption after the intervention, where increases in water use would indicate a possible benefit in comfort and possibly hygiene at the expense of additional water use. But because hot water is now relatively cheaper, householders may have been more likely to use more of it.

The following sections present the results of the cost-benefit analysis by pathway, based on the two scenarios as outlined above.

The CBAs are based on the following technical assumptions:

- A 7 percent[63] discount rate for the NPV was applied, based on a 15-year useful life of the upgraded technology.
- The benefits represent the annual discounted savings to the household over the 15-year life of the asset.
- The savings are calculated based on the average daily household savings as represented in the Monash analysis.
- Households did not change tariffs after the intervention. This means that households on off-peak tariffs before the intervention continued to be on off-peak tariffs after the intervention[64]

CBA results

The cost benefit analysis answers the question of how much benefit (in dollar terms) each of the pathways produces per dollar of money spent that is directly attributable to the program. A cost-benefit analysis compares the outcomes with the counterfactual base case. In this case, the counterfactual or base case would be a scenario that accounts for business as usual, i.e. energy consumption if the householder kept the current (pre-intervention) HWS. The results of the CBA express the implied changes from the base case. A CBA result greater than 1 means the benefits of the program exceed its costs.

For robustness, we also compared these results with the results of the four comparable pathways in the VEET analysis. The objective is to provide an upper and lower bound as

[62] MSI report, see Chapter 4 of this report
[63] DTF 'Economic evaluation for business cases: technical guidelines', August 2013.
[64] The allocations are estimated for each pathway and presented in Appendix H6: Households on controlled load tariffs.

well as high level confirmation of the most cost-effective pathway. For example, if both estimates point to the same pathway to create the highest benefit/cost ratio, our conclusion will be more robust.

Results for Scenario 1 – Analysis based on LIEEP program cost

The analysis is based on the cost of the program, using the four-cost level framework. It includes only costs that are directly attributable to LIEEP funding and excludes any non-LIEEP funding such as householder's co-contributions, VEET+STCs and in-kind contributions. The cost of the technology is accounted for by applying the subsidy that was paid through the LIEEP funding (either BSL subsidies or subsidies through Community Housing) to the cost of Level 1. Appendix H8: CBA results based on total program cost, including household contributions shows the results of the CBA based on the total program cost, taking the full cost of the HWS into account, applying the invoice cost to the cost of Level 1 and as such including householder's co-contributions.

The benefits are based on the net energy savings and the residential tariff, and account for the daily saving by pathways. For example, electric (instant or storage) to heat pump generates a daily saving of $0.66. In contrast the benefits for the controlled load tariff are based on the net energy savings and the controlled load tariff. Here, the daily savings for the same pathway account for $0.40.

The results account for an increase in the consumption and hence cost of gas and electricity, when switching fuel. The savings for residential and controlled-load as provided by MSI for each pathway are presented in Table 38. The highest monetary savings can be achieved through upgrading from electric (instant or storage.) to heat pump. This is in line with the results of the C-E.

Table 38 daily saving by pathway (residential and controlled-load tariff)

	Pathway	Daily savings ($) (residential tariff)	Daily savings ($) (controlled load tariff)
1	Electric (instant or storage.) to heat pump	$0.68	$0.43
2	Electric (instant or storage.) to gas instant or storage	$0.62	$0.31
3	Electric (instant or storage.) to solar electric	$0.10	$0.06
4	Electric (instant or storage) to solar gas	$0.65	$0.35
5	Gas instant or storage to solar gas	$0.28	n/a
6	Gas instant to solar gas	$0.29	n/a
7	Gas storage to instant gas	$0.31	n/a
8	Gas instant or storage to heat pump	$0.40	n/a

Table 39 compares the NPVs and Benefit Cost Ratios (BCR) by pathway based on the savings presented in Table 38. The costs are based on the cumulative program costs, excluding non-LIEEP co-contributions. The costs for the technology are incorporated into cost Level 1, in form of BSL and Community Housing subsidies.

Table 39 CBA results based on total program cost: cumulated four-level cost analysis (excl. co-contribution)

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	$ (2,397)	0.48	$ (3,133)	0.33
2	Electric (instant or storage.) to gas instant or storage	$ (2,580)	0.45	$ (3,406)	0.27
3	Electric (instant or storage.) to solar electric	$ (4,321)	0.07	$ (4,389)	0.06
4	Electric (instant or storage) to solar gas	$ (2,504)	0.46	$ (3,319)	0.29
5	Gas instant or storage to solar gas	$ (3,721)	0.20	n/a	n/a
6	Gas instant to solar gas	$ (3,674)	0.21	n/a	n/a
7	Gas storage to instant gas	$ (3,607)	0.22	n/a	n/a
8	Gas instant or storage to heat pump	$ (3,670)	0.21	n/a	n/a

The results show that none of the pathways produce a positive NPV or BCR > 1, even if we assume that all electricity participants are on the more expensive full residential tariff.

However, it is worth noting that the benefits above are based on energy savings only. There may be other, flow-on benefits from the program. These benefits are challenging to measure and there is a lack of data to do so. However, potential additional benefits that may result as a consequence of this program include (but are not limited to):

- Improved comfort, health and well-being (hygiene) benefits because householders may have longer showers/baths due to less expensive hot water and/ have increased their energy consumption overall
- Employment benefits, due to a large influx of demand for HWS during the delivery of the program
- Increased money in householder’s pockets, which may be spent to improve individual’s wellbeing.

Because of the uncertainties related to the energy saving estimates, we compared our results with results based on energy savings data from the VEET analysis.

Table 40 on the following page compares the CBA results in NPV and BCR terms for each of the technology pathways based on both the MSI and VEET energy savings estimates.

Table 40 CBA results based on total program cost: cumulative four level cost analysis comparing results based on HEEUP and VEET data

		HEEUP				VEET			
		residential tariff		controlled load tariff		residential tariff		controlled load tariff	
	Pathway	NPV	BCR	NPV	BCR	NPV	BCR	NPV	BCR
1	Electric (instant or storage.) to heat pump	($2,397)	0.48	($3,133)	0.33	$1,503	1.32	($895)	0.81
2	Electric (instant or storage.) to gas instant or storage	($2,580)	0.45	($3,406)	0.27	$874	1.19	($2,542)	0.45
3a	Electric (instant or storage.) to solar electric 15 years	($4,321)	0.07	($4,389)	0.06	$4,143	1.89	$1,977	1.43
3b	Electric (instant or storage.) to solar electric 6.5 years	n/a	n/a	n/a	n/a	$253	1.05	($955)	0.79
5	Gas instant or storage to solar gas (MJ)	($2,504)	0.46	n/a	n/a	($2,904)	0.38	n/a	n/a

Based on the higher energy savings in the VEET analysis, the results are more favorable compared to the HEEUP results. The highest BCR (and the only pathway with BCR>1 under both the controlled and non-controlled tariffs) is achieved when switching from electric (instant or storage.) to solar electric, assuming a 15-year useful life of the HWS. However, if assuming a useful life of 6.5 years, as reported in the VEET analysis, pathway 1, switching from electric to heat pump becomes the most beneficial upgrade pathway (but is only cost-beneficial on the non-controlled tariff). This is in line with the previous C-E, and also with the HEEUP data. Although the HEEUP results do not produce a positive BCR, the closest BCR (and thus the most beneficial) is the pathway 1.

Results for scenario 2 – Analysis based on the cost and benefits of the technology only

This scenario answers the question whether the dollar savings create a large enough benefit to cover the cost of the initial investment of the HWS, either in full (i.e. invoice cost), or in reduced form, based on subsidies (i.e. BSL and Community Housing) or based on contributions by householders to the initial investment.

Therefore, we analyzed this question from three different view-points:

- The LIEEP, here the costs are based on only the BSL and Community Housing subsidies

- The householder, here the costs are based on only the co-contribution that the householder made to purchase the HWS
- The total cost of the technology (excl. VEET + STC), which considers the full cost of the technology as invoiced (i.e., LIEEP and householder costs)

This analysis was also conducted based on controlled and non-controlled electricity tariffs.

The results show again that the benefits are greater when the $-savings are based on the residential tariff. The results show, that considering the view point of the LIEEP program, the electric (instant or storage) to heat pump and electric (instant or storage) to gas (instant or storage) generate a positive NPV and a BCR > 1 for $-savings based on the residential tariff. In addition, the pathway electric (instant or storage) to gas (instant or storage) also shows a positive NPV and a BCR > 1, based on the controlled-load tariff.

These two pathways also generate a positive outcome based on the residential tariff when considering co-contributions by households while VEET+STC[65] generate a BCR of 1.02 for the electric (instant or storage) to gas (instant or storage).

All other pathways fail to generate enough dollar savings for a BCR > 1.

Table 41, Table 42, and Table 43 present the CBA results for scenario 2.

Table 41 Technology cost only: based on BSL and community housing subsidies only

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	$492	1.28	($244)	0.86
2	Electric (instant or storage.) to gas instant or storage	$1,107	2.15	$377	1.39
3	Electric (instant or storage.) to solar electric	($1,798)	0.15	($1,918)	0.10
4	Electric (instant or storage) to solar gas	($425)	0.83	($1,422)	0.45
5	Gas instant or storage to solar gas	($1,977)	0.32	n/a	n/a
6	Gas instant to solar gas	($1,810)	0.35	n/a	n/a
7	Gas storage to instant gas	($43)	0.96	n/a	n/a
8	Gas instant or storage to heat pump	($1,529)	0.39	n/a	n/a

[65] See Appendix I, Table 80 Total cost of the technology (excl. VEET + STC).

Table 42 Technology cost only: Based on contributions by households only

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	$357	1.19	($379)	0.80
2	Electric (instant or storage.) to gas instant or storage	$803	1.63	($563)	0.70
3	Electric (instant or storage.) to solar electric	($1,711)	0.16	($1,831)	0.10
4	Electric (instant or storage) to solar gas	$206	1.11	($791)	0.59
5	Gas instant or storage to solar gas	($963)	0.49	n/a	n/a
6	Gas instant to solar gas	($1,033)	0.49	n/a	n/a
7	Gas storage to instant gas	($672)	0.61	n/a	n/a
8	Gas instant or storage to heat pump	($787)	0.55	n/a	n/a

Table 43 Technology cost only: Based on BSL and community housing subsidies + contributions by households = invoice costs (excl. of VEET and STC)

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	($1,404)	0.62	($2,227)	0.39
2	Electric (instant or storage.) to gas instant or storage	($118)	0.95	($851)	0.61
3	Electric (instant or storage.) to solar electric	($3,837)	0.08	($3,905)	0.06
4	Electric (instant or storage) to solar gas	($2,368)	0.48	($3,184)	0.29
5	Gas instant or storage to solar gas	($3,869)	0.19	n/a	n/a
6	Gas instant to solar gas	($3,818)	0.20	n/a	n/a
7	Gas storage to instant gas	($1,777)	0.37	n/a	n/a
8	Gas instant or storage to heat pump	($3,295)	0.23	n/a	n/a

7 Conclusion

The Home Energy Efficiency Upgrade Program (HEEUP) was a Low Income Energy Efficiency Program (LIEEP) trial funded by the Department of Industry, Innovation and Science, which assisted 793 households in greater Melbourne and regional Victoria to upgrade to more efficient hot water systems.

This report outlined the delivery of the HEEUP trial and the related research. This is important because there has been little study of programs designed to increase the uptake of higher cost household fixtures, such as more efficient hot water systems, by low-income households.

The trial sought to address information, trust and capital barriers to upgrades in low income households. It showed that owner occupier households will change their purchasing decision to a more efficient hot water system if they are provided with independent information, a subsidy, and the offer of a no interest loan.

Other significant barriers to energy efficiency upgrades in low income households were not addressed including the landlord-tenant split incentive barrier in private rental households.

Major recommendations

Recommendation 1: New program to address barriers to energy efficiency and energy savings in low-income households

HEEUP showed that:

- *with information, a subsidy and the option of a no interest loan, low-income home owners will switch to a more efficient hot water system;*
- *households have varying levels of need;*
- *high-needs households require greater support.*

The HEEUP This approach can be applied to other major energy efficiency upgrades.

Recommendation:

Introduce a program to assist low-income Australians improve the energy efficiency of their homes and so lower their energy bills. The program should:

3. Provide three critical enablers:
    - targeted information from trusted sources on energy efficiency upgrades and residential solar photovoltaics (solar pv)

  - subsidies for efficient hot water (solar, heat pump and instant gas), residential solar pv, and selected other upgrades (including insulation and highly efficient appliances such as refrigerators)
  - access to low-cost loans.

4. Provide graduated levels of support according to household need:

  - base level: all households should have access to relevant information on energy upgrades and this should be tailored for segments of the low-income population including pensioners and CALD communities
  - intermediate level: access a subsidy to reduce the up-front cost of an upgrade, a no interest loan to help manage the out-of-pocket expense, and the option of in-depth, independent decision support
  - high level: increased subsidies with minimal or no co-payments, where clear hardship can be established. This may be needed for households with high energy consumption relative to income, or in energy billing hardship, or with specific health or disabilities that may place them in energy hardship, or who are low income and have specific energy efficiency needs, such as a highly inefficient hot water system

Recommendation 2: Accelerate action in community housing

Community housing providers and tenants wanted energy efficiency upgrades and considerable scope exists to engage them further. Information and brokerage may be needed to do this.

Recommendation:

Introduce an incentive scheme to accelerate the uptake of energy efficiency upgrades in community housing. Funding could focus on the marginal additional cost of installing more efficient fixtures as part of regular maintenance.

Consideration should be given to identifying a broker to assist community housing providers plan a transition to efficiency upgrades of existing housing.

Other recommendations

Recommendation 3: Subsidise solar and heat pump to keep householder contributions low.

Upgrades to solar and heat pump systems were achieved in 65% of participating households with the following subsidy mix:

- *$2,300 to $2,900 for upgrades to solar (with a householder contribution around $2,000)*

- *$2,000 to $2,300 for upgrades to heat pumps (with a householder contribution between $1,600 and $1,800)*

Recommendation:

Provide subsidies of up to $2,900 to keep householder contributions for solar hot water below $2,000 and for heat pump below $1,800.

Recommendation 4: Widen the options available for improving energy productivity

Many HEEUP participants reported they were interested in upgrades other than hot water: rooftop solar photovoltaics (solar PV) was identified as a particular interest.

Recommendation:

Future policy and programs should facilitate householders' access to the most appropriate solutions for reducing their costs and improve energy efficiency including:

- energy efficiency upgrades in existing dwellings
- rooftop solar.

Recommendation 5: Facilitate low cost financing

Low cost financing through NILS was an important enabler for some HEEUP participants. Concessional loans are particularly suitable for low-income home owners when used in conjunction with a subsidy.

Recommendation:

Future programs or policy should fund concessional loans that enable low-income households to improve the efficiency of their homes. Consideration should be given to existing schemes such as the No Interest Loans Scheme (NILS) and council concessional loans (such as Darebin Solar Savers).

Recommendation 6: Quantify the multiple benefits of energy efficiency upgrades

HEEUP found participants had a range of motivations for improving energy efficiency. The program also contributed to a series of non-energy benefits including greenhouse gas emissions reductions, improved amenity, improvements and wellbeing and reduced stress; however, these were not quantified.

Recommendation:

Further research should be funded to quantify the multiple benefits of residential energy efficiency upgrades and develop valid and reliable assessment tools. Specific attention should be given to the benefits for health, wellbeing, and reduced stress.

Recommendation 7: Partner with not-for-profits

The BSL was trusted by HEEUP participants because it is a known, not-for-profit community services provider. This had two benefits described by participants: a demonstrated capacity in engaging with low-income households and communities and a commitment to the best interests of the householder, unlike for-profit service providers.

Recommendation

Opportunities for not-for-profit organisations to provide energy efficiency services to low-income and vulnerable households should be developed. This will expand the reach of energy efficiency programs and address trust barriers.

8 Appendices

Appendix A: HEEUP program materials

Figure 23 Sample hot water tool output letter

Brotherhood of St Laurence

Dear

Your Hot Water System Options

As a part of the Household Energy Efficiency Upgrade Program (HEEUP), I visited your home on Friday 24 October and conducted an assessment of your hot water consumption.

Based on your answers during our meeting, the table below provides hot water replacement options compared to your current system.

Hot Water System	Cost to you *	Saving on retail price *	Estimated first year saving ^	Estimated annual GHG emissions (kgCO2)
Natural Gas (storage tank) 1 star	$0	$0	$0	985
Natural gas storage 4-star	$1,290	$0	$82	720
Natural gas instantaneous 6-star	$2,361	$0	$212	542
Natural gas storage 6-star	$1,499	$0	$182	557
Natural gas boosted solar	$3,795	$0	$327	216

('Cost to you' is based on the installed cost of the system net of available government subsidy.)*
(^ 'Estimated first year saving' is compared to your existing system.)

Please call the Brotherhood of St Laurence HEEUP team if you would like further information on (03) 9445 2471.

Yours sincerely

BSL Energy Engagement Officer.

Please note that the information provided by the Hot Water Calculator is specifically designed for Victorian households only using applicable rebate rules and energy prices in Victoria. This information provided should be treated as a guide only.

Figure 24 Sample AGL / BSL HEEUP recruitment letter

Energy in action®

Since 1837 AGL

Brotherhood of St Laurence

Australian Government
Department of Industry

This activity received funding from the Department of Industry as part of the Low Income Energy Efficiency program.

<XX Month 2014>

<Mr Sam Sample>
<123 Sample Street>
<SAMPLETOWN NSW 2000>

Access big subsidies on a new, efficient hot water system.

Dear <Sam>

Does your hot water system need replacing? The Brotherhood of St Laurence can help pay for a new one

We'll help you access a new hot water system.

The Brotherhood of St Laurence is working together with AGL and Good Shepherd Microfinance to help eligible homeowners upgrade their hot water systems by providing access to:

> a subsidy of up to $3,500* for a solar hot water system or up to $500 for a gas hot water system

> a low or no interest loan for the remaining cost.

Enjoy a more efficient system for less.

An efficient new hot water system can help you:

> avoid being left with no hot water when your old system breaks down

> avoid expensive repairs to your old system

> reduce the energy used to heat your hot water.

Interested? Find out more today.

To find out if you are eligible for the subsidies, and to get expert advice on the right system for your home, please complete and return the enquiry form in the enclosed reply paid envelope, or simply call AGL on **1800 304 763 (8am-6pm, Monday to Friday)** and select Option 1.

Yours sincerely

Mark Brownfield
General Manager Marketing & Retail Sales
AGL

Tony Nicholson
Executive Director
Brotherhood of St Laurence

*This includes a Brotherhood of St Laurence subsidy, Victorian Energy Efficiency Certificates and Small-scale Technology Certificates.

AGL Sales Pty Limited
ABN 88 090 538 337

L22 120 Spencer Street
Melbourne VIC 3000

agl.com.au

AGLME15323 (0115)

AGL4433

Figure 25 Sample AGL / BSL HEEUP recruitment letter – reply form

How to access big subsidies on a new hot water system.

You must be an owner of your property to apply.

Please complete this form to help us determine your eligibility for a subsidy on a new gas or solar hot water system.
Return the form in the reply paid envelope provided and we will contact you, or simply call **1800 304 763** (8am-6pm Monday to Friday).

1. Your name.

Title: <Mr> First name: <Sam> Surname: <Sample>

Account number: <Account number> Concession type: <Concession type>

2. Your location.

Street number: <123> Street name: <Sample Street>

Suburb: <SAMPLETOWN> State: <NSW> Postcode: <2> <0> <0> <0>

Are you an owner of this property? Yes No

Is this residence your principal address? Yes No

Approximate age of the property: years

3. Your contact details.

I would like free expert advice to access the subsidy and choose a cost effective hot water system for my home.

My daytime phone number is:

My preferred language is:

AGLMF15321 (0115)

Energy in action.®

Since 1837 AGL

Australian Government
Department of Industry

Brotherhood of St Laurence

AGL4433

Figure 26 Sample AGL / BSL HEEUP recruitment letter – envelope

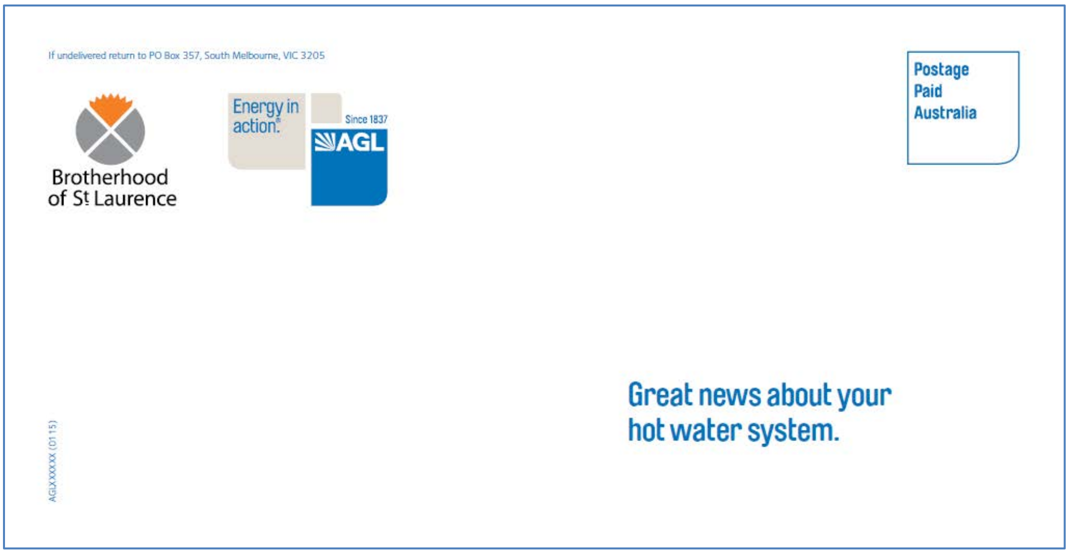


Figure 27 Sample AGL / BSL HEEUP recruitment letter – reply paid envelope

Figure 28 Sanden advertisement

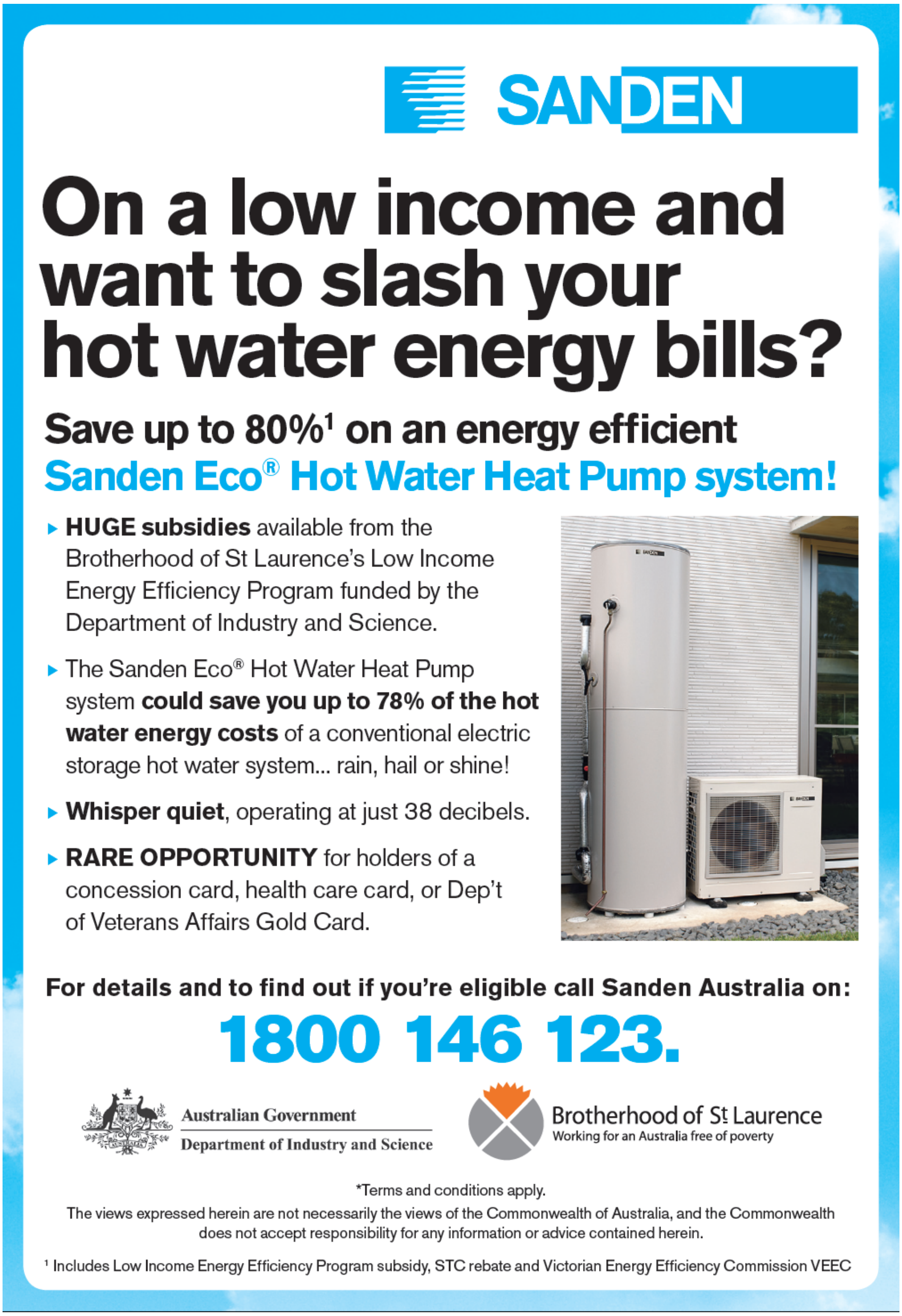


Figure 29 BSL HEEUP A4 flyer

Appendix B: HEEUP steering committee

Home Energy Efficiency Upgrade Program Steering Committee

Establishment and Purpose

In accordance with the funding agreement between the Commonwealth Department of Resources, Energy & Tourism (DRET) and the Brotherhood of St Laurence (BSL) a Steering Committee has been established to oversee the management and delivery of the Home Energy Efficiency Upgrade Program and ensure it meets its objectives and key deliverables.

Name

The name of the Steering Committee will be Home Energy Efficiency Upgrade Program Steering Committee. It will also be referred to as the HEEUP Steering Committee.

Membership

The HEEUP Steering Committee (**Steering Committee**) will be made up of two Brotherhood of St Laurence representatives and a representative appointed by each other Program Partner (each a **SC Member***). The Steering Committee may determine that other program partner representatives participate in the proceedings of the Steering Committee. The Steering Committee may also invite representatives of other organisations be invited to attend and participate in the proceedings of the Steering Committee where such attendance and participation advances the purpose of the Steering Committee.

*The SC Members appointed by each of the Program Partners and who hold office as at the date of this Agreement are listed in Annexure A (**Current Membership of the HEEUP Steering Committee**).

Program Partners

Program partners in the Home Energy Efficiency Upgrade Program are:

- Brotherhood of St Laurence (BSL)
- AGL Energy Sales & Marketing Limited (AGL)
- Monash Sustainability Institute (Monash University) (MSI)
- Alternative Technology Association (ATA)
- NSW Office of Environment and Heritage (NSWOEH or OEH)

Functions

The HEEUP Steering Committee will oversee the management and implementation of the Home Energy Efficiency Upgrade Program. Steering Committee Members will be responsible within their own organisation for the implementation and delivery of the program.

Specific functions and duties of the Steering Committee are to:

- develop a HEEUP Action Plan that details the implementation and delivery of the program;
- monitor the performance of the program relative to the Action Plan;
- ensure the ongoing maintenance of the quality and integrity of the program;

- receive quarterly progress reports including key project metrics from the HEEUP Program Manager (to be used as the basis for BSL reporting to DRET);
- receive recommendations from the HEEUP Program Manager concerning proposed changes to the Action Plan;
- discuss and offer advice on relevant operational issues in respect of the program including household recruitment;
- provide advice on program research needs;
- consider the results of any research conducted in relation to the program;
- receive regular reports from Program Manager about any systemic problems which may require a change to the program delivery;
- provide advice on a communication strategy for the program;
- establish, receive reports from and request relevant monitoring, verification and evaluation work be undertaken by the Monitoring, Verification & Evaluation Sub-Committee;
- establish any other sub-committees deemed appropriate;
- provide the opportunity for Members to raise issues relevant to the program.

HEEUP Financial Management

BSL is the HEEUP funding recipient and consortium lead as per the funding agreement with the Commonwealth of Australia, as part its Low Income Energy Efficiency Program. As such BSL is responsible for managing HEEUP project funds and adhering to Part 4 of the funding agreement which outlines:

4.1. Use of Funding
4.2. Keeping of Funding
4.3. Financial Records
4.4. Use as security
4.5. Refunds
4.6. Budget
4.7. Budget Flexibility
4.8. No Additional Funding

Regulation of proceedings

(Truncated)

Appendix C: Administrative data – client monitoring system (CMS)

The CMS was the primary administrative tool for managing the program. The administrative data provided to the CSIRO is outlined below. This data was collected from the household during the intake process (over the phone or via mail), or was entered via program staff in the course of the program operations.

Question	Answer
Home Ownership	Owned
	Rented
Drop Out	
Drop Out Reason	Already had system replaced
	ECG Still too expensive
	Illness
	Lack of household consensus
	Misunderstood the offer
	Not eligible
	Not interested (unspecified reason)
	Other
	Too expensive
Intake	
Concession Card	Health Care Card
	Pension Card
	DVA Gold Card
DVA Goldcard	DVA pensioner concession card
	DVA gold card (except those specifying Dependent or Specific)
	DVA gold card specifying War Widow
	DVA gold card specifying TPI
Ownership Status	Owned outright (Owned)
	Owned with a mortgage (Mortgaged)
	Being occupied rent free (Rent Free)
	Being purchased under a rent buy scheme (Rent Buy)
	Being occupied under a life tenure scheme (Life Tenure)
	Other
	Rented
EOI Source	AGL
	BSL
	HUME City Council
	Word of Mouth
EEO Staff Name	HB
	CB
	ID
	MS
Booking Status	Call Back
	Calls Exhausted
	Drop out
	HV Booked
	Install Booked
	Install Completed

	Language Issues
	Msg left
	Quote Booked
	Quote Completed
	Trouble Shoot
	Uncalled
Home Visit	
Preferred Hot Water Type	Gas Storage
	Heat Pump
	Instant Gas
	Solar Electric
	Solar Gas
Supplier Name	AGL
	Enviroshop
Number in household	1
	2
	3
	4
	5
	6
	>6
Hot Water System Location	Inside
	Inside in roof
	Outside
	Outside near bedroom
Finance	
Repayment Method	Centrepay
	Direct Debit
	Recurring Bank Transfer
Loan Period	1 to 36 months
Hot Water Type (is used to calculate BSL subsidy)	Gas Storage
	Heat Pump
	Instant Gas
	Solar Electric
	Solar Gas
Upfront Payment Type	Cheque
	Bank Transfer
Capital Source	BSL Nils
	NAB Nils
HWS Installation	
Hot Water Type	Gas Storage
	Heat Pump
	Instant Gas
	Solar Electric
	Solar Gas

Appendix D: Questionnaire – demographic and dwelling data

Data collected during the home visit. The data list was primarily derived from the CSIRO / DIIS LIEEP schema.

The data list includes all data collected during the home visit. Initially this data was collected separately through a questionnaire and the hot water tool. When the hot water tool was retired from the program one single integrated questionnaire was collected with all questions included (other than those removed or asked at intake – see above).

Questions highlighted grey and with italic text were originally in the hot water tool.

Question	Answer	Date provided if removed
About the hot water program		
How did you hear about the HEEUP program (this program)	AGL letter A	
	AGL letter B	
	AGL letter C	
	Word of mouth	
	Other	
If other, please specify		
About your home		
How many people live in your house?	1; 2; 3; 4; 5; 6; over 6	
Age 00 - 09		
Age 10 - 19		
Age 20 - 29		
Age 30 - 39		
Age 40 - 49		
Age 50 - 59		
Age 60 - 69		
Age 70 - 79		
Age 80 - 89		
Age 90 - 99		
Age > 99		
How old is your home (approximately)?	0 to 4	
	5 to 9	
	10 to 14	
	15 to 19	
	20 to 29	
	30 to 39	
	40 to 49	
	50 to 59	
	60 and over	
	Not known	
What is the type of your home?	Semi detach one	
	Semi detach more	

	Unit one or two storey	
	Unit three storey	
	Unit four more storey	
	Unit attached	
	Other car cab HB	
	Other IMP tent	
	Other attached	
	House	
How many storeys is your dwelling?	Single storey	
	Two storeys	
	Three or more storeys	
How many bedrooms does your dwelling have?		
How many bathrooms does your dwelling have?		
How many weeks per year is the house unoccupied? (empty)		
Which best describes the available source(s) of energy in your dwelling?	Electricity only	
	Electricity and natural gas	
	Electricity and LPG	
	Electricity & natural gas and LPG	
What size of LPG gas bottles in kilograms (kg) did you purchase in the last 12 months?	45 kg	
	90 kg	
How many LPG bottles did you purchase in the last 12 months?		
How much did you pay for each bottle in the last 12 months including GST?		
Does your home have rooftop photovoltaics?	Yes	
	No	
Does your home have rooftop photovoltaics?	Yes	
	No	
If yes, what is the PV capacity (in KW)?		
If yes, approximately when was it installed?		
Do you have other source of energy (for example a wood stove or solar hot water) that might affect your energy use at home		
If yes, please specify		

Changes to your home		
Has there been changes to who lives at home for example someone moved out, or someone came to stay for over two months) [in the past 2 years]	Yes	
	No	
If yes, when	[date]	
If yes, please specify		
Has there been any home modifications such as a renovation, or a major new appliance purchase (e.g. plasma TV) [in the past 2 years]	Yes	
	No	
If Yes, when	[date]	
If Yes, describe		
Have you participated in any energy efficiency programs (in the past 2 years)	Yes	
	No	
If Yes, when	[date]	
If Yes, describe		
About your hot water replacement decision		
If not for the HEEUP program (this program), when do you think you would have replaced your hot water system?	This year	
	1-2 years	
	3-4 years	
	5-6 years	
	If it broke down	
	Don’t know	
If not for this program, what type of hot water system would you have replaced your existing system with (taking into account what you know of the existing prices and with no additional rebates)?	Replace it with a similar system to what I currently have	
	Instantaneous gas hot water	
	Gas storage	
	Electric storage (off peak)	
	Electric storage (peak)	
	Solar - gas	
	Solar - electric	
	Heat pump	
	LPG gas storage	
	Other	

If other, please describe		
Cost aside, what would be your preferred hot water replacement?	Replace it with a similar system to what I currently have	
	Instantaneous gas hot water	
	Gas storage	
	Electric storage (off peak)	
	Electric storage (peak)	
	Solar - gas	
	Solar - electric	
	Heat pump	
	LPG gas storage	
	Other	
If other, please describe		
About your hot water system	(Integrated Questionnaire)	(Questionnaire)
What type of hot water system do you have?	Natural Gas (instantaneous)	Gas
	Natural Gas (storage tank)	Electric
	Electric (instantaneous)	Don't know
	Electric Storage (continuous tariff)	
	Electric Storage (off-peak tariff)	
	LPG (instantaneous)	
	LPG (storage tank)	
	Solar (gas boosted)	
	Solar (electric boosted)	
	Electric heat pump	
	Don't know	
Do you know the make and model of your hot water system?	Yes	
	No	
If yes, please specify		
What is the efficiency of your gas instantaneous/storage hot water system?	Don't know	
	1 star (default - gas storage)	
	2 stars	
	3 stars	
	4 stars	
	5 stars	
	6 stars	
What is the size of your hot water tank?	Don't know	
	Small approx 160 L (default)	
	Medium approx 250L	
	Large approx 350 L	
How old is your current hot water system (years)	Don't know	
	01;02;03;04;05;06;07;08;09;10	
	11;12;13;14;15;16;17;18;19;20	

	21;22;23;24;25	
Location of the system?	Don't know	
	Indoor	
	Outdoor near bedroom window(s)	
	Outdoor away from bedroom window(s)	
About your hot water usage		
How many showers does this household take in a week?	1-100	
How long do people in your home usually spend in the shower?	1 to 2 mins	Removed 22/10/2015
	3 to 4mins	
	5 to 6 mins	
	7 to 8 mins	
	9 to10 mins	
	11 to 12 mins	
	13 to 14 mins	
	15 to 16 mins	
	17 to 18 mins	
	19 to 20 mins	
	> 20 mins	
What star rating is your showerhead?	Don't know	Removed 22/10/2015
	0 star	
	1 star (default)	
	2 stars	
	3 stars	
How many baths are taken in a week?		
How many baths are taken each week that are one quarter full?	0 - 20	Removed 22/10/2015
How many baths are taken each week that are half full?	0 - 20	Removed 22/10/2015
How many baths are taken each week that are three quarters full?	0 - 20	Removed 22/10/2015
How many baths are taken each week that are full?	0 - 20	Removed 22/10/2015
Do your hand basin taps have flow regulators or aerators?	Yes	Removed 22/10/2015
	No	
How often are dishes hand washed in the sink per day? (count sinks of hot water)?		

Are the dishes rinsed under hot running water before or after washing?	Yes	
	No	
Do the kitchen taps have flow regulators or aerators?	Yes	Removed 22/10/2015
	No	
What type of washing machine does your home have?	Don't know	Removed 22/10/2015
	Top loader	
	Front loader	
	None (default)	
What wash temperature do you use?	Don't know	
	Cold	
	Warm (default)	
	Hot	
What size is the washing machine?	Don't know	
	Very small (less than 5 kg)	
	Small (5 kg<=size<6.5 kg)	
	Medium (6.5 kg<=size<7.5 kg)	
	Large (greater than or equal to 7.5 kg)	
How many times is the machine used in a typical week?	Don't know	
	0	
	1 to 2	
	3 to 4	
	5 to 6	
	7 (once per day) (default)	
	8 to 9	
	10 to 15	
	Over 15	
What wash program is normally used?	Don't know	Removed 22/10/2015
	Quick (economy)	
	Normal (default)	
	Heavy	
To which water taps is the machine connected to?	Don't know	Removed 22/10/2015
	Cold only	
	Hot and cold (default)	
What is the energy efficiency of the washing machine?	Don't know	
	1 star or very old (default)	
	1.5 star	
	2 star	
	3 star	

	3.5 star (maximum plausible rating for a top loader)	
	4 star	
	4.5 star	
	5 star	
How many times a week are clothes hand washed in the laundry tub?	Don't know	Removed 22/10/2015
	7 or more	
	3 to 6	
	1 to 2 (default)	
	Less than once	
	Never	
What wash temperature is typically used to hand wash?	Don't know	Removed 22/10/2015
	Cold	
	Warm (default)	
	Hot	
About those who live at the house		
Are you of Aboriginal or Torres Strait Islander origin?	Non-Indigenous	
	Aboriginal	
	Torres Strait Islander	
	Both Aboriginal and Torres Strait Islander	
	Not stated	
Are you currently employed, unemployed, retired?	Employed - working full-time	
	Employed - working part-time	
	Employed - away from work	
	Unemployed - looking for full-time work	
	Unemployed - looking for part-time work	
	Retired	
	Conducting unpaid work (care/home duties)	
	Unable to work	
	Studying	
	Other	
Could you estimate for us, the total income of all household members (before tax)	Negative Income	
	Nil Income	
	$1-$199 ($1-$10399)	
	$200-$299 ($10400-$15599)	
	$300-$399 ($15600-$20799)	
	$400-$599 ($20800-$31199)	

	$600-$799 ($31200-$41599)	
	$800-$999 ($41600-$51999)	
	$1000-$1249 ($52000-$64999)	
	$1250-$1499 ($65000-$77999)	
	$1500-$1999 ($78000-$103999)	
	$2000-$2499 ($104000-$129999)	
	$2500-$2999 ($130000-$155999)	
	$3000-$3499 ($156000-$181999)	
	$3500-$3999 ($182000-$207999)	
	$4000-$4999 ($208000-$259999)	
	$5000 or more ($260000 or more)	
	All incomes not stated	
What is the highest level of education completed by anyone in the household?	Not of school age	
	Primary school	
	High school - Year 10	
	High school - Year 12	
	TAFE	
	Teriary	
	Unknown	
Does anyone in your household identify as having a disability or chronic illness?	Yes	
	No	
If yes, does this disability or chronic illness impact on hot water use in the home?	Yes	
	No	
If yes, can you describe		
About energy efficiency		
1. Energy efficiency is too much hassle	1. Strongly disagree	
	2. Disagree	
	3. Neither	
	4. Agree	

	5. Strongly agree	
2. Energy efficiency means I have to live less comfortably	1. Strongly disagree	
	2. Disagree	
	3. Neither	
	4. Agree	
	5. Strongly agree	
3. My quality of life will decrease when I reduce my energy use	1. Strongly disagree	
	2. Disagree	
	3. Neither	
	4. Agree	
	5. Strongly agree	
4. Energy efficiency will restrict my freedom	1. Strongly disagree	
	2. Disagree	
	3. Neither	
	4. Agree	
	5. Strongly agree	
5. Energy efficiency is not very enjoyable	1. Strongly disagree	
	2. Disagree	
	3. Neither	
	4. Agree	
	5. Strongly agree	
How much has the householder's behaviours changed over the last 2 years?	1. Not energy efficient	
	2	
	3	
	4	
	5. Very energy efficient	
How empowered do you feel in relation to their energy consumption?	1. Very empowered	
	2	
	3	
	4	
	5. Not empowered	
How interested are you in conserving energy in the home?	1. Not interested	
	2	
	3	
	4	
	5. Very interested	
How in control of your finances do you feel?	1. Not in control	
	2	
	3	

	4	
	5. In control	
How comfortable do you feel in the home? (heating / cooling / lighting / etc)	1. Not comfortable	
	2	
	3	
	4	
	5. Very comfortable	
About your electricity bills		
How much electricity is purchased as accredited Green Power?	None	
	5%	
	10%	
	20%	
	25%	
	50%	
	75%	
	100%	
Do your Green Power purchases include off-peak electricity? (including off peak hot water system if using one)	Don’t know	
	No - my Green Power is only for standard electricity use - not including off peak	
	Yes - my Green Power covers both standard electricity use and off peak	
What is the additional charge in cents per kilowatt-hour including GST for Green Power (leave blank if unknown)		
Does the house have controlled load electricity (formerly off peak for hot water or another major appliances)?	Yes	
	No	
What is the main ELECTRICITY Meter number - Continuous Tariff (Peak) National Meter Identifier?		
What is your ELECTRICITY SUPPLY or FIXED CHARGE (STANDARD CHARGE)?		
What is the name of your energy retailer?	AGL	
	Alinta Energy	
	Aurora Energy	
	Australian Power and Gas	
	Blue Energy	
	Click Energy	
	Diamond Energy	
	Dodo Power and Gas	

	Energy Australia	
	Erm Power Retail	
	Lumo Energy	
	Momentum Energy	
	Neighbourhood Energy	
	Origin Energy	
	Pacific Hydro	
	People Energy	
	PowerDirect	
	PowerShop	
	Red Energy	
	Simply Energy	
	Sun Retail	
What is the name of the TARIFF you are on?		
OFF PEAK		
Charge		
Unit		
Which days of the week does the tariff apply (if it is only applicable on certain days of the week)?		
What TIME does the tariff period START?		
What TIME does the tariff period END?		
What DATE does the tariff period START?		
What DATE does the tariff period END?		
What CONSUMPTION AMT does the tariff period START?		
What CONSUMPTION AMT does the tariff period END?		
SHOULDER		
Charge		
Unit		
Which days of the week does the tariff apply (if it is only applicable on certain days of the week)?		
What TIME does the tariff period START?		
What TIME does the tariff period END?		
What DATE does the tariff period START?		

What DATE does the tariff period END?		
What CONSUMPTION AMT does the tariff period START?		
What CONSUMPTION AMT does the tariff period END?		
PEAK		
Charge		
Unit		
Which days of the week does the tariff apply (if it is only applicable on certain days of the week)?		
What TIME does the tariff period START?		
What TIME does the tariff period END?		
What DATE does the tariff period START?		
What DATE does the tariff period END?		
What CONSUMPTION AMT does the tariff period START?		
What CONSUMPTION AMT does the tariff period END?		
CONTROLLED LOAD electricity tariffs		
What is the CONTROLLED LOAD (ELECTRICITY) Tariff National Meter Identifier?		
What is your controlled load electricity in cents per kilowatt-hour including GST (leave blank if unknown)?		
GAS tariffs		
What is the name of your gas retailer?	AGL	
	Alinta Energy	
	Aurora Energy	
	Australian Power and Gas	
	Dodo Power and Gas	
	Energy Australia	
	Lumo Energy	
	Origin Energy	
	Red Energy	
	Simply Energy	
What is the name of the TARIFF you are on?		

What is the Gas meter identifier?		
What is your GAS SUPPLY or FIXED CHARGE (STANDARD CHARGE)?		
What is the current GAS tariff in cents per megajoule including GST - BLOCK 1?		
Block 1 consumption starting megajoule		
Block 1 consumption ending megajoule		
What is the current GAS tariff in cents per megajoule including GST - BLOCK 2?		
Block 2 consumption starting megajoule		
Block 2 consumption ending megajoule		
What is the current GAS tariff in cents per megajoule including GST - BLOCK 3?		
Block 3 consumption starting megajoule		
Block 3 consumption ending megajoule		
LIST		
Confirm Audio consent - RECORDED	Yes	
	No	
Confirm PARTICIPATION letter - signed (and EEO has the copy)	Yes	
	No	
Confirm ELECTRICITY permission - signed (and EEO has the copy)	Yes	
	No	
Confirm GAS permission - signed (and EEO has the copy)	Yes	
	No	
Confirm NILS documents - signed (and EEO has the copy)	Yes	
	No	
Confirmed NEXT STEPS document provided and explained	Yes	
	No	

Appendix E: Demographic and dwelling data

All participants

a) Installation groups

Installation groups	Frequency	Percent
Standard HEEUP installation	531	69.5
Community housing	171	22.4
Independent installation	45	5.9
Emergency replacement	16	2.1
Missing	1	0.1
Total	**764**	**100.0**

b) Postcodes where program was delivered

Postcodes	Frequency	Percent
3011	2	0.3
3012	5	0.7
3013	2	0.3
3015	3	0.4
3016	1	0.1
3018	1	0.1
3020	4	0.5
3021	7	0.9
3022	1	0.1
3023	2	0.3
3024	2	0.3
3025	1	0.1
3028	2	0.3
3029	3	0.4
3030	7	0.9
3031	21	2.7
3032	7	0.9
3033	2	0.3
3034	4	0.5
3037	7	0.9
3039	2	0.3
3040	3	0.4
3041	2	0.3
3042	4	0.5
3043	13	1.7
3044	7	0.9
3046	16	2.1

3047	8	1.0
3048	6	0.8
3049	1	0.1
3054	2	0.3
3058	10	1.3
3059	3	0.4
3060	5	0.7
3061	1	0.1
3064	24	3.1
3066	1	0.1
3068	1	0.1
3070	3	0.4
3071	1	0.1
3072	8	1.0
3073	41	5.4
3075	4	0.5
3078	1	0.1
3079	5	0.7
3081	6	0.8
3082	3	0.4
3083	6	0.8
3084	4	0.5
3085	32	4.2
3088	5	0.7
3093	2	0.3
3094	1	0.1
3095	7	0.9
3099	2	0.3
3101	11	1.4
3102	1	0.1
3103	1	0.1
3106	2	0.3
3107	1	0.1
3108	1	0.1
3111	1	0.1
3121	1	0.1
3127	1	0.1
3128	1	0.1
3129	3	0.4
3130	11	1.4
3131	6	0.8
3132	2	0.3
3133	6	0.8

3134	1	0.1
3135	1	0.1
3136	4	0.5
3138	1	0.1
3139	1	0.1
3140	5	0.7
3141	1	0.1
3144	1	0.1
3145	2	0.3
3146	1	0.1
3147	1	0.1
3149	4	0.5
3150	9	1.2
3151	3	0.4
3152	3	0.4
3153	2	0.3
3154	2	0.3
3155	3	0.4
3156	3	0.4
3158	2	0.3
3160	1	0.1
3162	1	0.1
3163	5	0.7
3165	3	0.4
3167	4	0.5
3168	2	0.3
3169	5	0.7
3170	2	0.3
3171	3	0.4
3172	5	0.7
3174	5	0.7
3175	4	0.5
3177	1	0.1
3181	1	0.1
3182	4	0.5
3183	2	0.3
3185	1	0.1
3186	2	0.3
3187	2	0.3
3188	3	0.4
3189	3	0.4
3190	1	0.1
3191	1	0.1

3192	8	1.0
3193	4	0.5
3194	10	1.3
3195	11	1.4
3196	15	2.0
3197	6	0.8
3198	6	0.8
3199	24	3.1
3200	5	0.7
3201	3	0.4
3204	9	1.2
3216	2	0.3
3219	1	0.1
3226	1	0.1
3228	1	0.1
3337	5	0.7
3338	1	0.1
3340	2	0.3
3350	1	0.1
3352	1	0.1
3370	2	0.3
3377	1	0.1
3419	1	0.1
3429	14	1.8
3431	1	0.1
3434	5	0.7
3437	3	0.4
3442	6	0.8
3444	1	0.1
3448	1	0.1
3450	13	1.7
3451	8	1.0
3458	1	0.1
3460	1	0.1
3461	3	0.4
3463	1	0.1
3465	3	0.4
3472	1	0.1
3523	1	0.1
3550	8	1.0
3551	1	0.1
3555	3	0.4
3556	2	0.3

3564	1	0.1
3620	1	0.1
3630	1	0.1
3646	1	0.1
3666	1	0.1
3677	2	0.3
3723	1	0.1
3752	1	0.1
3757	1	0.1
3765	2	0.3
3793	1	0.1
3799	1	0.1
3802	4	0.5
3806	1	0.1
3810	1	0.1
3874	1	0.1
3910	5	0.7
3912	2	0.3
3915	5	0.7
3929	1	0.1
3930	2	0.3
3931	15	2.0
3933	1	0.1
3936	6	0.8
3939	9	1.2
3940	2	0.3
3942	1	0.1
3976	2	0.3
3977	8	1.0
Missing	3	0.4
Total	**764**	**100.0**

a) Participants' employment status (combined 'Not in the labour force' and 'Retired')

Employment status	Frequency	Percent
Employed - working full-time	24	3.1
Employed - working part-time	77	10.1
Employed - away from work	3	0.4
Retired / Not in the labour force	474	62.0
Conducting unpaid work (care/home duties)	40	5.2
Studying	8	1.0
Unable to work	73	9.6

Unemployed - looking for full-time work	20	2.6
Unemployed - looking for part-time work	30	3.9
Other	4	0.5
Missing	11	1.4
Total	**764**	**100.0**

b) Indigenous participants

Indigenous status	Frequency	Percent
Non-Indigenous	735	96.2
Aboriginal	9	1.2
Both Aboriginal and Torres Strait Islander	1	0.1
Not stated	6	0.8
Missing	13	1.7
Total	**764**	**100.0**

3) Household information:

a) Number of people in the home (mean: 2.18)

Number of people in the home	Frequency	Percent
One	280	36.6
Two	270	35.3
Three	101	13.2
Four	50	6.5
Five	34	4.5
Six	13	1.7
Seven	5	0.7
Eight	2	0.3
Nine	2	0.3
Thirteen	1	0.1
Missing	6	0.8
Total	**764**	**100.0**

b) Age groups across all households (Please note: Due to some data entry errors total number in table 3a does not equal total number in table 3b)

Age groups of all household members	Frequency	Percent
Number of occupants aged 0-9	124	7.5
Number of occupants aged 10-19	168	10.2
Number of occupants aged 20-29	119	7.2
Number of occupants aged 30-39	103	6.3
Number of occupants aged 40-49	169	10.3
Number of occupants aged 50-59	205	12.5
Number of occupants aged 60-69	301	18.3
Number of occupants aged 70-79	262	15.9

Number of occupants aged 80-89	168	10.2
Number of occupants aged 90-99	27	1.6
Total	**1646**	**100.0**

c) Household income

Household income	Frequency	Percent
Nil income	2	0.3
$200-$299 ($10400-$15599)	4	0.5
$300-$399 ($15600-$20799)	43	5.6
$400-$599 ($20800-$31199)	176	23.0
$600-$799 ($31200-$41599)	160	20.9
$800-$999 ($41600-$51999)	167	21.9
$1000-$1249 ($52000-$64999)	56	7.3
$1250-$1499 ($65000-$77999)	66	8.6
$1500-$1999 ($78000-$103999)	39	5.1
$2000-$2499 ($104000-$129999)	20	2.6
$2500-$2999 ($130000-$155999)	3	0.4
$3500-$3999 ($182000-$207999)	1	0.1
$4000-$4999 ($208000-$259999)	1	0.1
Missing	26	3.4
Total	**764**	**100.0**

d) Household education

Household education	Frequency	Percent
Primary school	33	4.3
High school - Year 10	187	24.5
High school - Year 12	139	18.2
TAFE	127	16.6
Tertiary	238	31.2
Missing	40	5.2
Total	**764**	**100.0**

e) Language spoken at home

Language spoken at home	Frequency	Percent
English	268	35.1
Language other than English	41	5.4
Missing	455	59.6
Total	**764**	**100.0**

4) Dwelling information:

a) Home ownership

Home ownership	Frequency	Percent

Owned outright (Owned)	429	56.2
Owned with a mortgage (Mortgaged)	129	16.9
Rented	166	21.7
Being occupied under a life tenure scheme (Life Tenure)	1	0.1
Being purchased under a rent buy scheme (Rent Buy)	1	0.1
Other	1	0.1
Missing	37	4.8
Total	**764**	**100.0**

b) Ages of homes

Ages of homes	Frequency	Percent
0 - 4 years	4	0.5
5 - 9 years	23	3.0
10 - 14 years	91	11.9
15 - 19 years	83	10.9
20 - 29 years	90	11.8
30 - 39 years	119	15.6
40 - 49 years	115	15.1
50 - 59 years	78	10.2
60+ years	105	13.7
Missing	56	7.3
Total	**764**	**100.0**

c) Number of bedrooms (mean: 2.81) **(one participant actually had 0 entered)**

Number of bedrooms	Frequency	Percent
Zero	1	0.1
One	50	6.5
Two	204	26.7
Thee	359	47.0
Four	116	15.2
Five	17	2.2
Six	1	0.1
Seven	1	0.1
Eight	1	0.1
Missing	14	1.8
Total	**764**	**100.0**

d) Number of bathrooms (mean: 1.38)

Number of bathrooms	Frequency	Percent
One	492	64.4
One and a half	1	0.1
Two	234	30.6
Thee	20	2.6

Four	3	0.4
Missing	14	1.8
Total	**764**	**100.0**

5) Hot water system information:

a) Old hot water system

Old hot water system	Frequency	Percent
Electric	2	0.3
Electric Storage	2	0.3
Electric Storage (continuous tariff)	22	2.9
Electric Storage (off-peak tariff)	159	20.8
Electric (instantaneous)	4	0.5
Gas	9	1.2
Gas Storage	3	0.4
Natural Gas (storage tank)	430	56.3
Natural Gas (instantaneous)	85	11.1
LPG (instantaneous)	6	0.8
Solar (electric boosted)	11	1.4
Solar (gas boosted)	9	1.2
Solar (wood boosted)	1	0.1
Missing	21	2.7
Total	**764**	**100.0**

b) Hot water system upgrades

New hot water system	Frequency	Percent
Solar Gas	238	31.2
Gas Storage	193	25.3
Heat Pump	152	19.9
Instant Gas	149	19.5
Solar electric	32	4.2
Total	**764**	**100.0**

d) When would participants have replaced their hot water system?

Replacement time	Frequency	Percent
This year	60	7.9
1-2 years	56	7.3
3-4 years	6	0.8
5-6 years	2	0.3
If it broke down	529	69.2
Don't know	68	8.9
Missing	43	5.6
Total	**764**	**100.0**

e) What type of hot water system would participants have replaced their existing system with?

Replacement type	Frequency	Percent
Electric storage (off peak)	29	3.8
Electric storage (peak)	1	0.1
Gas storage	168	22.0
Heat pump	34	4.5
Instantaneous gas hot water	160	20.9
Solar - electric	24	3.1
Solar - gas	85	11.1
Replace it with a similar system to what I currently have	205	26.8
Other	6	0.8
Missing	52	6.8
Total	**764**	**100.0**

f) Cost aside, what would be the preferred hot water system replacement?

Replacement type (cost aside)	Frequency	Percent
Electric storage (off peak)	3	0.4
Gas storage	71	9.3
Heat pump	78	10.2
Instantaneous gas hot water	125	16.4
Solar - electric	33	4.3
Solar - gas	280	36.6
Replace it with a similar system to what I currently have	114	14.9
Other	4	0.5
Missing	56	7.3
Total	**764**	**100.0**

g) Age of hot water system

Age of hot water system	Frequency	Percent
0 - 2 years	13	1.7
3 - 5 years	24	3.1
6 - 8 years	34	4.5
9 - 12 years	165	21.6
13 - 16 years	238	31.2
17 - 20 years	81	10.6
21+ years	138	18.1
Missing	71	9.3
Total	**764**	**100.0**

6) Energy information:

a) Participants with controlled load (some participants had 'false' for controlled load but an entry for controlled load NMI or tariff, they are included as 'yes')

Controlled load	Frequency	Percent
No	675	88.4
Yes	70	9.2
Missing	19	2.5
Total	**764**	**100.0**

b) Participants' energy source (only based on entries in HWT and Int.Q. not on obtained NMIs/MIRNs)

Energy source	Frequency	Percent
Electricity only	89	11.6
Electricity and natural gas	653	85.5
Electricity and LPG	13	1.7
Electricity, natural gas and LPG	1	0.1
Missing	8	1.0
Total	**764**	**100.0**

c) Rooftop photovoltaics (only based on entries in Questionnaire and Int.Q. not on obtained energy data)

PV	Frequency	Percent
No	573	75.0
Yes	183	24.0
Missing	8	1.0
Total	**764**	**100.0**

Standard HEEUP installation

b) Postcodes with 5 or more installations

Postcodes	Frequency	Percent
3021	6	1.129943503
3030	6	1.129943503
3037	7	1.31826742
3043	11	2.071563089
3044	6	1.129943503
3046	11	2.071563089
3047	7	1.31826742
3058	8	1.506591337
3060	5	0.941619586
3064	11	2.071563089
3072	6	1.129943503
3073	11	2.071563089
3095	5	0.941619586
3130	10	1.883239171
3131	5	0.941619586
3133	5	0.941619586
3150	7	1.31826742
3169	5	0.941619586
3172	5	0.941619586
3174	5	0.941619586
3192	8	1.506591337
3193	4	0.753295669
3194	8	1.506591337
3195	10	1.883239171
3196	15	2.824858757
3197	5	0.941619586
3198	5	0.941619586
3199	23	4.331450094
3200	5	0.941619586
3204	6	1.129943503
3429	12	2.259887006
3450	13	2.448210923
3451	8	1.506591337
3910	5	0.941619586
3915	5	0.941619586
3931	14	2.63653484
3936	6	1.129943503
3939	9	1.694915254
3977	6	1.129943503

Standard HEEUP installation

a) Participants' employment status (combined 'Not in the labour force' and 'Retired')

Employment status	Frequency	Percent
Employed - working full-time	22	4.143126177
Employed - working part-time	61	11.48775895
Employed - away from work	3	0.564971751
Retired / Not in the labour force	346	65.16007533
Conducting unpaid work (care/home duties)	28	5.27306968
Studying	5	0.941619586
Unable to work	22	4.143126177
Unemployed - looking for full-time work	11	2.071563089
Unemployed - looking for part-time work	25	4.708097928
Other	3	0.564971751
Missing	5	0.941619586
Total	**531**	**100**

b) Indigenous participants

Indigenous status	Frequency	Percent
Non-Indigenous	513	96.61016949
Aboriginal	8	1.506591337
Both Aboriginal and Torres Strait Islander	1	0.188323917
Not stated	4	0.753295669
Missing	5	0.941619586
Total	**531**	**100**

3) Household information:

a) Number of people in the home (mean: 2.31)

Number of people in the home	Frequency	Percent
One	155	29.19020716
Two	209	39.35969868
Three	81	15.25423729
Four	40	7.532956685
Five	28	5.27306968
Six	9	1.694915254
Seven	4	0.753295669

Eight	2	0.376647834
Nine	1	0.188323917
Thirteen	0	0
Missing	2	0.376647834
Total	**531**	**100**

b) Age groups across all households (Please note: Due to some data entry errors total number in table 3a does not equal total number in table 3b)

Age groups of all household members	Frequency	Percent
Number of occupants aged 0-9	85	6.961506962
Number of occupants aged 10-19	123	10.07371007
Number of occupants aged 20-29	95	7.780507781
Number of occupants aged 30-39	67	5.487305487
Number of occupants aged 40-49	125	10.23751024
Number of occupants aged 50-59	146	11.95741196
Number of occupants aged 60-69	232	19.000819
Number of occupants aged 70-79	218	17.85421785
Number of occupants aged 80-89	113	9.254709255
Number of occupants aged 90-99	17	1.392301392
Total	**1221**	**100**

c) Household income

Household income	Frequency	Percent
Nil income	2	0.376647834
$200-$299 ($10400-$15599)	2	0.376647834
$300-$399 ($15600-$20799)	22	4.143126177
$400-$599 ($20800-$31199)	125	23.54048964
$600-$799 ($31200-$41599)	120	22.59887006
$800-$999 ($41600-$51999)	88	16.57250471
$1000-$1249 ($52000-$64999)	51	9.604519774
$1250-$1499 ($65000-$77999)	52	9.792843691
$1500-$1999 ($78000-$103999)	30	5.649717514
$2000-$2499 ($104000-$129999)	19	3.578154426

$2500-$2999 ($130000-$155999)	3	0.564971751
$3500-$3999 ($182000-$207999)	1	0.188323917
$4000-$4999 ($208000-$259999)	1	0.188323917
Missing	15	2.824858757
Total	**531**	**100**

d) Household education

Household education	Frequency	Percent
Primary school	20	3.766478343
High school - Year 10	109	20.52730697
High school - Year 12	92	17.32580038
TAFE	102	19.20903955
Tertiary	189	35.59322034
Missing	19	3.578154426
Total	**531**	**100**

e) Language spoken at home

Language spoken at home	Frequency	Percent
English	229	43.12617702
Language other than English	35	6.5913371
Missing	267	50.28248588
Total	**531**	**100**

4) Dwelling information:

a) Home ownership

Home ownership	Frequency	Percent
Owned outright (Owned)	386	72.69303202
Owned with a mortgage (Mortgaged)	118	22.22222222
Rented	0	0
Being occupied under a life tenure scheme (Life Tenure)	0	0
Being purchased under a rent buy scheme (Rent Buy)	0	0
Other	1	0.188323917
Missing	26	4.896421846
Total	**531**	**100**

b) Ages of homes

Ages of homes	Frequency	Percent
0 - 4 years	2	0.376647834

5 - 9 years	21	3.95480226
10 - 14 years	31	5.838041431
15 - 19 years	34	6.403013183
20 - 29 years	70	13.1826742
30 - 39 years	83	15.63088512
40 - 49 years	92	17.32580038
50 - 59 years	63	11.86440678
60+ years	92	17.32580038
Missing	43	8.097928437
Total	**531**	**100**

c) Number of bedrooms (mean: 3.03) **(one participant actually had 0 entered)**

Number of bedrooms	Frequency	Percent
Zero	1	0.188323917
One	5	0.941619586
Two	104	19.58568738
Thee	296	55.74387947
Four	104	19.58568738
Five	13	2.448210923
Six	0	0
Seven	0	0
Eight	1	0.188323917
Missing	7	1.31826742
Total	**531**	**100**

d) Number of bathrooms (mean: 1.46)

Number of bathrooms	Frequency	Percent
One	305	57.43879473
One and a half	1	0.188323917
Two	198	37.28813559
Thee	16	3.013182674
Four	3	0.564971751
Missing	8	1.506591337
Total	**531**	**100**

5) Hot water system information:

a) Old hot water system

Old hot water system	Frequency	Percent
Electric	2	0.376647834
Electric storage	2	0.376647834
Electric Storage (continuous tariff)	16	3.013182674

Electric Storage (off-peak tariff)	109	20.52730697
Electric (instantaneous)	3	0.564971751
Gas	8	1.506591337
Gas storage	3	0.564971751
Natural Gas (storage tank)	306	57.62711864
Natural Gas (instantaneous)	47	8.851224105
LPG (instantaneous)	5	0.941619586
Solar (electric boosted)	10	1.883239171
Solar (gas boosted)	7	1.31826742
Solar (wood boosted)	1	0.188323917
Missing	12	2.259887006
Total	**531**	**100**

b) Hot water system upgrades

New hot water system	Frequency	Percent
Solar Gas	228	42.93785311
Gas Storage	56	10.54613936
Heat Pump	118	22.22222222
Instant Gas	102	19.20903955
Solar electric	27	5.084745763
Total	**531**	**100**

d) When would participants have replaced their hot water system?

Replacement time	Frequency	Percent
This year	57	10.73446328
1-2 years	55	10.35781544
3-4 years	6	1.129943503
5-6 years	2	0.376647834
If it broke down	388	73.06967985
Don’t know	14	2.63653484
Missing	9	1.694915254
Total	**531**	**100**

e) What type of hot water system would participants have replaced their existing system with?

Replacement type	Frequency	Percent
Electric storage (off peak)	25	4.708097928
Electric storage (peak)	0	0
Gas storage	109	20.52730697
Heat pump	33	6.214689266
Instantaneous gas hot water	126	23.72881356

Solar - electric	24	4.519774011
Solar - gas	78	14.68926554
Replace it with a similar system to what I currently have	124	23.35216573
Other	4	0.753295669
Missing	8	1.506591337
Total	**531**	**100**

f) Cost aside, what would be the preferred hot water system replacement?

Replacement type (cost aside)	Frequency	Percent
Electric storage (off peak)	3	0.564971751
Gas storage	34	6.403013183
Heat pump	74	13.93596987
Instantaneous gas hot water	89	16.76082863
Solar - electric	31	5.838041431
Solar - gas	240	45.19774011
Replace it with a similar system to what I currently have	48	9.039548023
Other	2	0.376647834
Missing	10	1.883239171
Total	**531**	**100**

g) Age of hot water system

Age of hot water system	Frequency	Percent
0 - 2 years	3	0.564971751
3 - 5 years	20	3.766478343
6 - 8 years	31	5.838041431
9 - 12 years	106	19.96233522
13 - 16 years	150	28.24858757
17 - 20 years	69	12.99435028
21+ years	118	22.22222222
Missing	34	6.403013183
Total	**531**	**100**

6) Energy information:

a) Participants with controlled load (some participants had ‘false’ for controlled load but an entry for controlled load NMI or tariff, they are included as ‘yes’)

Controlled load	Frequency	Percent
No	452	85.12241055
Yes	64	12.0527307
Missing	15	2.824858757
Total	**531**	**100**

b) Participants' energy source (only based on entries in HWT and Int.Q. not on obtained NMIs/MIRNs)

Energy source	Frequency	Percent
Electricity only	46	8.662900188
Electricity and natural gas	468	88.13559322
Electricity and LPG	12	2.259887006
Electricity, natural gas and LPG	1	0.188323917
Missing	4	0.753295669
Total	**531**	**100**

c) Rooftop photovoltaics (only based on entries in Questionnaire and Int.Q. not on obtained energy data)

PV	Frequency	Percent
No	358	67.41996234
Yes	169	31.826742
Missing	4	0.753295669
Total	**531**	**100**

Community housing

b) Postcodes with 5 or more installations

Postcodes	Frequency	Percent of all community housing installs
3031	19	11.11111111
3064	9	5.263157895
3073	28	16.37426901
3085	31	18.12865497
3101	10	5.847953216
3442	6	3.50877193
3550	5	2.923976608

2) Participant information:

a) Participants' employment status

Employment status	Frequency	Percent
Employed - working full-time	2	1.169590643
Employed - working part-time	10	5.847953216
Employed - away from work	0	0
Retired	88	51.4619883
Conducting unpaid work (care/home duties)	9	5.263157895
Studying	1	0.584795322

Unable to work	47	27.48538012
Unemployed - looking for full-time work	6	3.50877193
Unemployed - looking for part-time work	3	1.754385965
Other	0	0
Missing	5	2.923976608
Total	**171**	**100**

b) Indigenous participants

Indigenous status	Frequency	Percent
Non-Indigenous	161	94.15204678
Aboriginal	1	0.584795322
Both Aboriginal and Torres Strait Islander	0	0
Not stated	2	1.169590643
Missing	7	4.093567251
Total	**171**	**100**

3) Household information:

a) Number of people in the home (mean: 1.62)

Number of people in the home	Frequency	Percent
One	109	63.74269006
Two	36	21.05263158
Three	11	6.432748538
Four	4	2.339181287
Five	3	1.754385965
Six	3	1.754385965
Seven	1	0.584795322
Eight	0	0
Nine	0	0
Thirteen	0	0
Missing	4	2.339181287
Total	**171**	**100**

b) Age groups across all households (Please note: Due to some data entry errors total number in table 3a does not equal total number in table 3b)

Age groups of all household members	Frequency	Percent
Number of occupants aged 0-9	22	8.239700375
Number of occupants aged 10-19	29	10.86142322
Number of occupants aged 20-29	12	4.494382022
Number of occupants aged 30-39	24	8.988764045

Number of occupants aged 40-49	31	11.61048689
Number of occupants aged 50-59	39	14.60674157
Number of occupants aged 60-69	37	13.8576779
Number of occupants aged 70-79	25	9.36329588
Number of occupants aged 80-89	39	14.60674157
Number of occupants aged 90-99	9	3.370786517
Total	**267**	**100**

c) Household income

Household income	Frequency	Percent
Nil income	0	0
$200-$299 ($10400-$15599)	2	1.169590643
$300-$399 ($15600-$20799)	18	10.52631579
$400-$599 ($20800-$31199)	37	21.6374269
$600-$799 ($31200-$41599)	23	13.4502924
$800-$999 ($41600-$51999)	66	38.59649123
$1000-$1249 ($52000-$64999)	1	0.584795322
$1250-$1499 ($65000-$77999)	9	5.263157895
$1500-$1999 ($78000-$103999)	5	2.923976608
$2000-$2499 ($104000-$129999)	1	0.584795322
$2500-$2999 ($130000-$155999)	0	0
$3500-$3999 ($182000-$207999)	0	0
$4000-$4999 ($208000-$259999)	0	0
Missing	9	5.263157895
Total	**171**	**100**

d) Household education

Household education	Frequency	Percent
Primary school	10	5.847953216
High school - Year 10	70	40.93567251
High school - Year 12	33	19.29824561

TAFE	16	9.356725146
Tertiary	24	14.03508772
Missing	18	10.52631579
Total	**171**	**100**

e) Language spoken at home

Language spoken at home	Frequency	Percent
English	23	13.4502924
Language other than English	1	0.584795322
Missing	147	85.96491228
Total	**171**	**100**

4) Dwelling information:

a) Home ownership

Home ownership	Frequency	Percent
Owned outright (Owned)	3	1.754385965
Owned with a mortgage (Mortgaged)	0	0
Rented	166	97.07602339
Being occupied under a life tenure scheme (Life Tenure)	1	0.584795322
Being purchased under a rent buy scheme (Rent Buy)	1	0.584795322
Other	0	0
Missing	0	0
Total	**171**	**100**

b) Ages of homes

Ages of homes	Frequency	Percent
0 - 4 years	1	0.584795322
5 - 9 years	0	0
10 - 14 years	57	33.33333333
15 - 19 years	44	25.73099415
20 - 29 years	14	8.187134503
30 - 39 years	25	14.61988304
40 - 49 years	11	6.432748538
50 - 59 years	4	2.339181287
60+ years	4	2.339181287
Missing	11	6.432748538
Total	**171**	**100**

c) Number of bedrooms (mean: 1.98)

Number of bedrooms	Frequency	Percent
Zero	0	0

One	44	25.73099415
Two	91	53.21637427
Thee	24	14.03508772
Four	3	1.754385965
Five	2	1.169590643
Six	1	0.584795322
Seven	0	0
Eight	0	0
Missing	6	3.50877193
Total	**171**	**100**

d) Number of bathrooms (mean: 1.08)

Number of bathrooms	Frequency	Percent
One	154	90.05847953
One and a half	0	0
Two	10	5.847953216
Thee	2	1.169590643
Four	0	0
Missing	5	2.923976608
Total	**171**	**100**

5) Hot water system information:

a) Old hot water system

Old hot water system	Frequency	Percent
Electric	0	0
Electric storage	0	0
Electric Storage (continuous tariff)	4	2.339181287
Electric Storage (off-peak tariff)	44	25.73099415
Electric (instantaneous)	1	0.584795322
Gas	0	0
Gas storage	0	0
Natural Gas (storage tank)	80	46.78362573
Natural Gas (instantaneous)	32	18.71345029
LPG (instantaneous)	1	0.584795322
Solar (electric boosted)	1	0.584795322
Solar (gas boosted)	1	0.584795322
Solar (wood boosted)	0	0
Missing	7	4.093567251
Total	**171**	**100**

b) Hot water system upgrades

New hot water system	Frequency	Percent
Solar Gas	7	4.093567251
Gas Storage	86	50.29239766
Heat Pump	34	19.88304094
Instant Gas	39	22.80701754
Solar electric	5	2.923976608
Total	**171**	**100**

d) When would participants have replaced their hot water system?

Not applicable for community housing

e) What type of hot water system would participants have replaced their existing system with?

Not applicable for community housing

f) Cost aside, what would be the preferred hot water system replacement?

Not applicable for community housing

g) Age of hot water system

Age of hot water system	Frequency	Percent
0 - 2 years	3	1.754385965
3 - 5 years	2	1.169590643
6 - 8 years	1	0.584795322
9 - 12 years	57	33.33333333
13 - 16 years	71	41.52046784
17 - 20 years	4	2.339181287
21+ years	5	2.923976608
Missing	28	16.37426901
Total	**171**	**100**

6) Energy information:

a) Participants with controlled load (some participants had 'false' for controlled load but an entry for controlled load NMI or tariff, they are included as 'yes')

Controlled load	Frequency	Percent
No	161	94.15204678
Yes	6	3.50877193
Missing	4	2.339181287
Total	**171**	**100**

b) Participants' energy source (only based on entries in HWT and Int.Q. not on obtained

NMIs/MIRNs)

Energy source	Frequency	Percent
Electricity only	42	24.56140351
Electricity and natural gas	125	73.0994152
Electricity and LPG	0	0
Electricity, natural gas and LPG	0	0
Missing	4	2.339181287
Total	**171**	**100**

c) Rooftop photovoltaics (only based on entries in Questionnaire and Int.Q. not on obtained energy data)

PV	Frequency	Percent
No	165	96.49122807
Yes	2	1.169590643
Missing	4	2.339181287
Total	**171**	**100**

Independent installation

3) Household information:

a) Number of people in the home (mean: 2.53)

Number of people in the home	Frequency	Percent
One	12	26.66666667
Two	16	35.55555556
Three	8	17.77777778
Four	4	8.888888889
Five	3	6.666666667
Six	1	2.222222222
Seven	0	0
Eight	0	0
Nine	1	2.222222222
Thirteen	0	0
Missing	0	0
Total	**45**	**100**

c) Household income

Household income	Frequency	Percent
Nil income	0	0
$200-$299 ($10400-$15599)	0	0
$300-$399 ($15600-$20799)	2	4.444444444
$400-$599 ($20800-$31199)	7	15.55555556
$600-$799 ($31200-$41599)	14	31.11111111
$800-$999 ($41600-$51999)	10	22.22222222
$1000-$1249 ($52000-$64999)	3	6.666666667
$1250-$1499 ($65000-$77999)	5	11.11111111
$1500-$1999 ($78000-$103999)	3	6.666666667
$2000-$2499 ($104000-$129999)	0	0
$2500-$2999 ($130000-$155999)	0	0

$3500-$3999 ($182000-$207999)	0	0
$4000-$4999 ($208000-$259999)	0	0
Missing	1	2.222222222
Total	**45**	**100**

4) Dwelling information:

a) Home ownership

Home ownership	Frequency	Percent
Owned outright (Owned)	29	64.44444444
Owned with a mortgage (Mortgaged)	7	15.55555556
Rented	0	0
Being occupied under a life tenure scheme (Life Tenure)	0	0
Being purchased under a rent buy scheme (Rent Buy)	0	0
Other	0	0
Missing	9	20
Total	**45**	**100**

b) Ages of homes

Ages of homes	Frequency	Percent
0 - 4 years	1	2.222222222
5 - 9 years	2	4.444444444
10 - 14 years	2	4.444444444
15 - 19 years	4	8.888888889
20 - 29 years	5	11.11111111
30 - 39 years	7	15.55555556
40 - 49 years	9	20
50 - 59 years	9	20
60+ years	4	8.888888889
Missing	2	4.444444444
Total	**45**	**100**

5) Hot water system information:

a) Old hot water system

Old hot water system	Frequency	Percent
Electric	0	0

Electric storage	0	0
Electric Storage (continuous tariff)	2	4.444444444
Electric Storage (off-peak tariff)	2	4.444444444
Electric (instantaneous)	0	0
Gas	0	0
Gas storage	0	0
Natural Gas (storage tank)	36	80
Natural Gas (instantaneous)	2	4.444444444
LPG (instantaneous)	0	0
Solar (electric boosted)	0	0
Solar (gas boosted)	1	2.222222222
Solar (wood boosted)	0	0
Missing	2	4.444444444
Total	**45**	**100**

b) Hot water system upgrades

New hot water system	Frequency	Percent
Solar Gas	0	0
Gas Storage	41	91.11111111
Heat Pump	0	0
Instant Gas	4	8.888888889
Solar electric	0	0
Total	**45**	**100**

g) Age of hot water system

Age of hot water system	Frequency	Percent
0 - 2 years	6	13.33333333
3 - 5 years	2	4.444444444
6 - 8 years	1	2.222222222
9 - 12 years	1	2.222222222
13 - 16 years	13	28.88888889
17 - 20 years	5	11.11111111
21+ years	9	20
Missing	8	17.77777778
Total	**45**	**100**

b) Participants' energy source (only based on entries in HWT and Int.Q. not on obtained NMIs/MIRNs)

Energy source	Frequency	Percent
Electricity only	1	2.222222222
Electricity and natural gas	43	95.55555556
Electricity and LPG	1	2.222222222
Electricity, natural gas and LPG	0	0

Missing	0	0
Total	**45**	**100**

c) Rooftop photovoltaics (only based on entries in Questionnaire and Int.Q. not on obtained energy data)

PV	Frequency	Percent
No	37	82.22222222
Yes	8	17.77777778
Missing	0	0
Total	**45**	**100**

Emergency replacement

3) Household information:

a) Number of people in the home (mean: 2.63)

Number of people in the home	Frequency	Percent
One	4	25
Two	9	56.25
Three	1	6.25
Four	1	6.25
Five	0	0
Six	0	0
Seven	0	0
Eight	0	0
Nine	0	0
Thirteen	1	6.25
Missing	0	0
Total	**16**	**100**

c) Household income

Household income	Frequency	Percent
Nil income	0	0
\$200-\$299 (\$10400-\$15599)	0	0
\$300-\$399 (\$15600-\$20799)	1	6.25
\$400-\$599 (\$20800-\$31199)	6	37.5
\$600-\$799 (\$31200-\$41599)	3	18.75
\$800-\$999 (\$41600-\$51999)	3	18.75
\$1000-\$1249 (\$52000-\$64999)	1	6.25
\$1250-\$1499 (\$65000-\$77999)	0	0
\$1500-\$1999 (\$78000-\$103999)	1	6.25
\$2000-\$2499 (\$104000-\$129999)	0	0
\$2500-\$2999 (\$130000-\$155999)	0	0

\$3500-\$3999 (\$182000-\$207999)	0	0
\$4000-\$4999 (\$208000-\$259999)	0	0
Missing	1	6.25
Total	**16**	**100**

4) Dwelling information:

a) Home ownership

Home ownership	Frequency	Percent
Owned outright (Owned)	11	68.75
Owned with a mortgage (Mortgaged)	3	18.75
Rented	0	0
Being occupied under a life tenure scheme (Life Tenure)	0	0
Being purchased under a rent buy scheme (Rent Buy)	0	0
Other	0	0
Missing	2	12.5
Total	**16**	**100**

b) Ages of homes

Ages of homes	Frequency	Percent
0 - 4 years	0	0
5 - 9 years	0	0
10 - 14 years	1	6.25
15 - 19 years	1	6.25
20 - 29 years	1	6.25
30 - 39 years	3	18.75
40 - 49 years	3	18.75
50 - 59 years	2	12.5
60+ years	5	31.25
Missing	0	0
Total	**16**	**100**

5) Hot water system information:

a) Old hot water system

Old hot water system	Frequency	Percent
Electric	0	0

Electric storage	0	0
Electric Storage (continuous tariff)	0	0
Electric Storage (off-peak tariff)	4	25
Electric (instantaneous)	0	0
Gas	1	6.25
Gas storage	0	0
Natural Gas (storage tank)	7	43.75
Natural Gas (instantaneous)	4	25
LPG (instantaneous)	0	0
Solar (electric boosted)	0	0
Solar (gas boosted)	0	0
Solar (wood boosted)	0	0
Missing	0	0
Total	**16**	**100**

b) Hot water system upgrades

New hot water system	Frequency	Percent
Solar Gas	3	18.75
Gas Storage	9	56.25
Heat Pump	0	0
Instant Gas	4	25
Solar electric	0	0
Total	**16**	**100**

g) Age of hot water system

Age of hot water system	Frequency	Percent
0 - 2 years	1	6.25
3 - 5 years	0	0
6 - 8 years	1	6.25
9 - 12 years	1	6.25
13 - 16 years	3	18.75
17 - 20 years	3	18.75
21+ years	6	37.5
Missing	1	6.25
Total	**16**	**100**

b) Participants' energy source (only based on entries in HWT and Int.Q. not on obtained NMIs/MIRNs)

Energy source	Frequency	Percent
Electricity only	0	0
Electricity and natural gas	16	100
Electricity and LPG	0	0

Electricity, natural gas and LPG	0	0
Missing	0	0
Total	**16**	**100**

c) Rooftop photovoltaics (only based on entries in Questionnaire and Int.Q. not on obtained energy data)

PV	Frequency	Percent
No	13	81.25
Yes	3	18.75
Missing	0	0
Total	**16**	**100**

Upgrade pathways: all HEEUP participants

Old hot water system	Hot water system upgrade	Frequency	Percent
Total		**764**	**100.0**
Natural Gas (storage tank)	Solar Gas	163	21.3
Natural Gas (storage tank)	Gas Storage	147	19.2
Electric Storage (off-peak tariff)	Heat Pump	76	9.9
Natural Gas (storage tank)	Instant Gas	65	8.5
Natural Gas (storage tank)	Heat Pump	51	6.7
Natural Gas (instantaneous)	Instant Gas	41	5.4
Electric Storage (off-peak tariff)	Instant Gas	29	3.8
Natural Gas (instantaneous)	Solar Gas	25	3.3
Electric Storage (off-peak tariff)	Solar Gas	19	2.5
Electric Storage (off-peak tariff)	Solar electric	18	2.4
Electric Storage (off-peak tariff)	Gas Storage	17	2.2
Natural Gas (instantaneous)	Gas Storage	11	1.4
Missing information on old system	Gas Storage	8	1.0
Missing information on old system	Solar Gas	8	1.0
Natural Gas (instantaneous)	Heat Pump	8	1.0
Solar (gas boosted)	Solar Gas	7	0.9
Electric Storage (continuous tariff)	Heat Pump	6	0.8
Electric Storage (continuous tariff)	Instant Gas	6	0.8
Electric Storage (continuous tariff)	Solar electric	5	0.7
Gas	Solar Gas	4	0.5
LPG (instantaneous)	Solar Gas	4	0.5
Natural Gas (storage tank)	Solar electric	4	0.5
Solar (electric boosted)	Solar electric	4	0.5
Electric Storage (continuous tariff)	Gas Storage	3	0.4

Solar (electric boosted)	Heat Pump	3	0.4
Electric storage	Heat Pump	2	0.3
Electric Storage (continuous tariff)	Solar Gas	2	0.3
Gas	Heat Pump	2	0.3
Gas	Instant Gas	2	0.3
Missing information on old system	Heat Pump	2	0.3
Missing information on old system	Instant Gas	2	0.3
Solar (electric boosted)	Solar Gas	2	0.3
Solar (gas boosted)	Gas Storage	2	0.3
Electric	Instant Gas	1	0.1
Electric	Solar Gas	1	0.1
Electric (instantaneous)	Gas Storage	1	0.1
Electric (instantaneous)	Heat Pump	1	0.1
Electric (instantaneous)	Instant Gas	1	0.1
Electric (instantaneous)	Solar Gas	1	0.1
Gas	Gas Storage	1	0.1
Gas storage	Gas Storage	1	0.1
Gas storage	Instant Gas	1	0.1
Gas storage	Solar Gas	1	0.1
LPG (instantaneous)	Gas Storage	1	0.1
LPG (instantaneous)	Heat Pump	1	0.1
Missing information on old system	Solar electric	1	0.1
Solar (electric boosted)	Gas Storage	1	0.1
Solar (electric boosted)	Instant Gas	1	0.1
Solar (wood boosted)	Solar Gas	1	0.1

Upgrade pathways: Standard HEEUP installation

Old hot water system	Hot water system upgrade	Frequency	Percent
Total		**531**	**100.0**
Natural Gas (storage tank)	Solar Gas	157	29.6
Electric Storage (off-peak tariff)	Heat Pump	50	9.4
Natural Gas (storage tank)	Gas Storage	50	9.4
Natural Gas (storage tank)	Instant Gas	49	9.2
Natural Gas (storage tank)	Heat Pump	46	8.7
Electric Storage (off-peak tariff)	Instant Gas	25	4.7
Natural Gas (instantaneous)	Solar Gas	22	4.1
Electric Storage (off-peak tariff)	Solar Gas	18	3.4
Natural Gas (instantaneous)	Instant Gas	16	3.0
Electric Storage (off-peak tariff)	Solar electric	14	2.6
Missing information on old system	Solar Gas	8	1.5
Natural Gas (instantaneous)	Heat Pump	8	1.5

Solar (gas boosted)	Solar Gas	7	1.3
Electric Storage (continuous tariff)	Instant Gas	5	0.9
Electric Storage (continuous tariff)	Heat Pump	4	0.8
Electric Storage (continuous tariff)	Solar electric	4	0.8
Gas	Solar Gas	4	0.8
LPG (instantaneous)	Solar Gas	4	0.8
Natural Gas (storage tank)	Solar electric	4	0.8
Solar (electric boosted)	Solar electric	4	0.8
Solar (electric boosted)	Heat Pump	3	0.6
Electric storage	Heat Pump	2	0.4
Electric Storage (continuous tariff)	Solar Gas	2	0.4
Electric Storage (off-peak tariff)	Gas Storage	2	0.4
Gas	Heat Pump	2	0.4
Gas	Instant Gas	2	0.4
Solar (electric boosted)	Solar Gas	2	0.4
Electric	Instant Gas	1	0.2
Electric	Solar Gas	1	0.2
Electric (instantaneous)	Heat Pump	1	0.2
Electric (instantaneous)	Instant Gas	1	0.2
Electric (instantaneous)	Solar Gas	1	0.2
Electric Storage (continuous tariff)	Gas Storage	1	0.2
Gas storage	Gas Storage	1	0.2
Gas storage	Instant Gas	1	0.2
Gas storage	Solar Gas	1	0.2
LPG (instantaneous)	Heat Pump	1	0.2
Missing information on old system	Gas Storage	1	0.2
Missing information on old system	Heat Pump	1	0.2
Missing information on old hot water system	Instant Gas	1	0.2
Missing information on old hot water system	Solar electric	1	0.2
Natural Gas (instantaneous)	Gas Storage	1	0.2
Solar (electric boosted)	Instant Gas	1	0.2
Solar (wood boosted)	Solar Gas	1	0.2

Upgrade pathways: community housing

Old hot water system	Hot water system upgrade	Frequency	Percent
Total		**171**	**100.0**
Natural Gas (storage tank)	Gas Storage	54	31.6
Electric Storage (off-peak tariff)	Heat Pump	26	15.2
Natural Gas (instantaneous)	Instant Gas	21	12.3
Natural Gas (storage tank)	Instant Gas	16	9.4

Electric Storage (off-peak tariff)	Gas Storage	12	7.0
Natural Gas (instantaneous)	Gas Storage	9	5.3
Missing information on old hot water system	Gas Storage	6	3.5
Natural Gas (storage tank)	Heat Pump	5	2.9
Natural Gas (storage tank)	Solar Gas	5	2.9
Electric Storage (off-peak tariff)	Solar electric	4	2.3
Electric Storage (continuous tariff)	Heat Pump	2	1.2
Electric Storage (off-peak tariff)	Instant Gas	2	1.2
Natural Gas (instantaneous)	Solar Gas	2	1.2
Electric (instantaneous)	Gas Storage	1	0.6
Electric Storage (continuous tariff)	Gas Storage	1	0.6
Electric Storage (continuous tariff)	Solar electric	1	0.6
LPG (instantaneous)	Gas Storage	1	0.6
Missing information on old hot water system	Heat Pump	1	0.6
Solar (electric boosted)	Gas Storage	1	0.6
Solar (gas boosted)	Gas Storage	1	0.6

Upgrade pathways: independent installations

Old hot water system	Hot water system upgrade	Frequency	Percent
Electric Storage (continuous tariff)	Gas Storage	1	2.2
Electric Storage (continuous tariff)	Instant Gas	1	2.2
Electric Storage (off-peak tariff)	Gas Storage	2	4.4
Missing information on old hot water system	Gas Storage	1	2.2
Missing information on old hot water system	Instant Gas	1	2.2
Natural Gas (instantaneous)	Instant Gas	2	4.4
Natural Gas (storage tank)	Gas Storage	36	80.0
Solar (gas boosted)	Gas Storage	1	2.2
Total		**45**	**100.0**

Upgrade pathways: emergency replacemen

Old hot water system	Hot water system upgrade	Frequency	Percent
Electric Storage (off-peak tariff)	Gas Storage	1	6.3
Electric Storage (off-peak tariff)	Instant Gas	2	12.5
Electric Storage (off-peak tariff)	Solar Gas	1	6.3
Gas	Gas Storage	1	6.3
Natural Gas (instantaneous)	Gas Storage	1	6.3
Natural Gas (instantaneous)	Instant Gas	2	12.5

Natural Gas (instantaneous)	Solar Gas	1	6.3
Natural Gas (storage tank)	Gas Storage	6	37.5
Natural Gas (storage tank)	Solar Gas	1	6.3
Total		**16**	**100.0**

Appendix F: Effect of HEEUP on household energy consumption

Appendix F1

Home Type

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	House	103	32.5	74.6	74.6
		Unit or Flat	35	11.0	25.4	100.0
		Total	138	43.5	100.0	
	Missing	System	179	56.5		
	Total		317	100.0		
Gas	Valid	House	90	33.8	78.9	78.9
		Unit or Flat	24	9.0	21.1	100.0
		Total	114	42.9	100.0	
	Missing	System	152	57.1		
	Total		266	100.0		

Home ownership status

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Owned or mortgaged	254	80.1	95.5	95.5
		Community Housing	12	3.8	4.5	100.0
		Total	266	83.9	100.0	
	Missing	System	51	16.1		
	Total		317	100.0		
Gas	Valid	Owned or mortgaged	219	82.3	96.5	96.5
		Community Housing	8	3.0	3.5	100.0
		Total	227	85.3	100.0	
	Missing	System	39	14.7		
	Total		266	100.0		

Home Age

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	< 10 years	12	3.8	4.2	4.2
		10 to 20 years	33	10.4	11.6	15.8
		> 20 years	239	75.4	84.2	100.0
		Total	284	89.6	100.0	
	Missing	System	33	10.4		
	Total		317	100.0		
Gas	Valid	< 10 years	13	4.9	5.6	5.6
		10 to 20 years	32	12.0	13.7	19.2
		> 20 years	189	71.1	80.8	100.0
		Total	234	88.0	100.0	
	Missing	System	32	12.0		
	Total		266	100.0		

Number of household occupants

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Single persons	101	31.9	32.2	32.2
		Two persons	122	38.5	38.9	71.0
		Three persons	43	13.6	13.7	84.7
		Four persons	17	5.4	5.4	90.1
		Five or more p.	31	9.8	9.9	100.0
		Total	314	99.1	100.0	
	Missing	System	3	.9		
	Total		317	100.0		
Gas	Valid	Single persons	80	30.1	30.2	30.2
		Two persons	111	41.7	41.9	72.1
		Three persons	35	13.2	13.2	85.3
		Four persons	12	4.5	4.5	89.8
		Five or more p.	27	10.2	10.2	100.0
		Total	265	99.6	100.0	
	Missing	System	1	.4		
	Total		266	100.0		

Number of bathrooms

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	1.0	200	63.1	63.9	63.9
		2.0	107	33.8	34.2	98.1
		3.0	5	1.6	1.6	99.7
		4.0	1	.3	.3	100.0
		Total	313	98.7	100.0	
	Missing	System	4	1.3		
	Total		317	100.0		
Gas	Valid	1.0	160	60.2	60.8	60.8
		2.0	97	36.5	36.9	97.7
		3.0	5	1.9	1.9	99.6
		4.0	1	.4	.4	100.0
		Total	263	98.9	100.0	
	Missing	System	3	1.1		
	Total		266	100.0		

Existing household energy sources

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	electricity and natural gas only	289	91.2	94.4	94.4
		electricity only	16	5.0	5.2	99.7
		electricity natural gas and LPG	1	.3	.3	100.0
		Total	306	96.5	100.0	
	Missing	System	11	3.5		
	Total		317	100.0		
Gas	Valid	electricity and natural gas only	256	96.2	99.2	99.2
		electricity only	1	.4	.4	99.6
		electricity natural gas and LPG	1	.4	.4	100.0
		Total	258	97.0	100.0	
	Missing	System	8	3.0		
	Total		266	100.0		

Wood energy source

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	No	303	95.6	96.5	96.5
		Yes	11	3.5	3.5	100.0
		Total	314	99.1	100.0	
	Missing	System	3	.9		
	Total		317	100.0		
Gas	Valid	No	258	97.0	97.4	97.4
		Yes	7	2.6	2.6	100.0
		Total	265	99.6	100.0	
	Missing	System	1	.4		
	Total		266	100.0		

Dwelling has Controlled Load Electricity?

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	No	259	81.7	89.9	89.9
		Yes	29	9.1	10.1	100.0
		Total	288	90.9	100.0	
	Missing	System	29	9.1		
	Total		317	100.0		
Gas	Valid	No	224	84.2	92.6	92.6
		Yes	18	6.8	7.4	100.0
		Total	242	91.0	100.0	
	Missing	System	24	9.0		
	Total		266	100.0		

Existing HWS tank size

Energy source			Frequency	Percent	Valid Percent	Cumulative %
Electricity	Valid	small approx 160L	172	54.3	69.1	69.1
		medium appr. 250L	43	13.6	17.3	86.3
		Large approx 350L	34	10.7	13.7	100.0
		Total	249	78.5	100.0	
	Missing	System	68	21.5		
	Total		317	100.0		
Gas	Valid	small approx 160L	145	54.5	71.1	71.1
		medium appr. 250L	35	13.2	17.2	88.2
		Large approx 350L	24	9.0	11.8	100.0
		Total	204	76.7	100.0	
	Missing	System	62	23.3		
	Total		266	100.0		

Age of existing HWS

Energy source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	0-2 years	2	.6	.7	.7
		3-5 years	6	1.9	2.0	2.7
		6-8 years	16	5.0	5.5	8.2
		9-12 years	64	20.2	21.8	30.0
		13-16 years	79	24.9	27.0	57.0
		17-20 years	46	14.5	15.7	72.7
		21 and older	80	25.2	27.3	100.0
		Total	293	92.4	100.0	
	Missing	System	24	7.6		
	Total		317	100.0		
Gas	Valid	0-2 years	2	.8	.8	.8
		3-5 years	4	1.5	1.6	2.4
		6-8 years	16	6.0	6.5	8.9
		9-12 years	55	20.7	22.4	31.3
		13-16 years	69	25.9	28.0	59.3
		17-20 years	40	15.0	16.3	75.6
		21 and older	60	22.6	24.4	100.0
		Total	246	92.5	100.0	
	Missing	System	20	7.5		
	Total		266	100.0		

Washing machine size

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	very small < 5kg	5	1.6	2.5	2.5
		small 5-6.5kg	61	19.2	30.3	32.8
		medium 6.5-7.5kg	95	30.0	47.3	80.1
		large 7.5kg or larger	40	12.6	19.9	100.0
		Total	201	63.4	100.0	
	Missing	System	116	36.6		
	Total		317	100.0		
Gas	Valid	very small < 5kg	4	1.5	2.4	2.4
		small 5-6.5kg	52	19.5	30.6	32.9
		medium 6.5-7.5kg	79	29.7	46.5	79.4
		large 7.5kg or larger	35	13.2	20.6	100.0
		Total	170	63.9	100.0	
	Missing	System	96	36.1		
	Total		266	100.0		

Dwelling has Rooftop Photo-Voltaics?

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	No	228	71.9	72.8	72.8
		Yes	85	26.8	27.2	100.0
		Total	313	98.7	100.0	
	Missing	System	4	1.3		
	Total		317	100.0		
Gas	Valid	No	197	74.1	74.9	74.9
		Yes	66	24.8	25.1	100.0
		Total	263	98.9	100.0	
	Missing	System	3	1.1		
	Total		266	100.0		

Number of showers per week

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	0 to 7 showers	117	36.9	37.5	37.5
		8 to 14 showers	102	32.2	32.7	70.2
		15 to 21 showers	50	15.8	16.0	86.2
		22+ showers	43	13.6	13.8	100.0
		Total	312	98.4	100.0	
	Missing	System	5	1.6		
	Total		317	100.0		
Gas	Valid	0 to 7 showers	97	36.5	37.0	37.0
		8 to 14 showers	95	35.7	36.3	73.3
		15 to 21 showers	35	13.2	13.4	86.6
		22+ showers	35	13.2	13.4	100.0
		Total	262	98.5	100.0	
	Missing	System	4	1.5		
	Total		266	100.0		

Number of washes per week

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	1 to 4 washes	89	28.1	43.8	43.8
		5 to 9 washes	105	33.1	51.7	95.6
		10 or more washes	9	2.8	4.4	100.0
		Total	203	64.0	100.0	
	Missing	System	114	36.0		
	Total		317	100.0		
Gas	Valid	1 to 4 washes	74	27.8	43.5	43.5
		5 to 9 washes	90	33.8	52.9	96.5
		10 or more washes	6	2.3	3.5	100.0
		Total	170	63.9	100.0	
	Missing	System	96	36.1		
	Total		266	100.0		

Average shower time

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Short 6 minutes or less	170	53.6	54.8	54.8
		Medium 7 to 12 minutes	116	36.6	37.4	92.3
		Long 13 or more minutes	24	7.6	7.7	100.0
		Total	310	97.8	100.0	
	Missing	System	7	2.2		
	Total		317	100.0		
Gas	Valid	Short 6 minutes or less	141	53.0	54.2	54.2
		Medium 7 to 12 minutes	98	36.8	37.7	91.9
		Long 13 or more minutes	21	7.9	8.1	100.0
		Total	260	97.7	100.0	
	Missing	System	6	2.3		
	Total		266	100.0		

Employment status of householder

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Umployed (pt or ft)	48	15.1	15.4	15.4
		Unemployed	20	6.3	6.4	21.8
		Retired	163	51.4	52.2	74.0
		Not in workforce	81	25.6	26.0	100.0
		Total	312	98.4	100.0	
	Missing	System	5	1.6		
	Total		317	100.0		
Gas	Valid	Umployed (pt or ft)	43	16.2	16.3	16.3
		Unemployed	15	5.6	5.7	22.0
		Retired	141	53.0	53.4	75.4
		Not in workforce	65	24.4	24.6	100.0
		Total	264	99.2	100.0	
	Missing	System	2	.8		
	Total		266	100.0		

Weekly household income

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Low income (< $1000)	227	71.6	73.9	73.9
		Middle income ($1000 - $2000)	64	20.2	20.8	94.8
		High income (>$2000)	16	5.0	5.2	100.0
		Total	307	96.8	100.0	
	Missing	System	10	3.2		
	Total		317	100.0		
Gas	Valid	Low income (< $1000)	187	70.3	72.2	72.2
		Middle income ($1000 - $2000)	56	21.1	21.6	93.8
		High income (>$2000)	16	6.0	6.2	100.0
		Total	259	97.4	100.0	
	Missing	System	7	2.6		
	Total		266	100.0		

Highest education level

Energy Source			Frequency	Percent	Valid Percent	Cumulative Percent
Electricity	Valid	Primary	17	5.4	5.5	5.5
		Secondary	123	38.8	40.1	45.6
		TAFE of Uni	167	52.7	54.4	100.0
		Total	307	96.8	100.0	
	Missing	System	10	3.2		
	Total		317	100.0		
Gas	Valid	Primary	15	5.6	5.8	5.8
		Secondary	100	37.6	38.8	44.6
		TAFE of Uni	143	53.8	55.4	100.0
		Total	258	97.0	100.0	
	Missing	System	8	3.0		
	Total		266	100.0		

Appendix F2

Fuel type = Electricity			Pre		Post			
Factor	Level	N	Obs	Marginal Mean	Obs	Marginal Mean	Post-Pre	p-value
Home Type	House	102	2558	9.287	622	7.982	-1.305	0.025
	Unit or Flat	35	869	7.947	112	7.434	-0.513	0.620
Home ownership status	Owned or mortgaged	253	6465	9.764	1931	9.497	-0.267	0.740
	Community Housing	12	277	9.396	39	10.200	0.804	0.479
Home Age	< 10 years	12	313	11.333	109	11.556	0.223	0.848
	10 to 20 years	33	794	11.276	305	10.218	-1.058	0.344
	> 20 years	238	6017	9.287	1503	8.626	-0.660	0.295
Number of household occupants	Single person household	101	2578	6.736	706	6.499	-0.237	0.659
	Two person household	121	3086	9.821	890	9.928	0.108	0.906
	Three person household	43	1053	10.939	250	9.913	-1.026	0.287
	Four person household	17	431	11.378	131	10.230	-1.148	0.423
	Five of more person household	31	770	15.938	218	15.902	-0.037	0.982
number of bathrooms	1	199	5003	9.011	1343	8.776	-0.235	0.768
	2	107	2726	10.577	809	10.080	-0.497	0.530
	3	5	135	10.788	30	9.093	-1.695	0.270
	4	1	26	31.752	7	28.095	-3.657	**0.021**
existing household energy sources	electricity and LPG only	0						
	electricity and natural gas only	288	7259	9.569	2031	9.482	-0.088	0.908
	electricity only	16	412	11.589	112	8.398	-3.192	0.046
	electricity natural gas and LPG	1	26	8.540	10	9.562	1.022	0.067
wood energy source	No	302	7644	9.602	2152	9.445	-0.158	0.831
	Yes	11	274	10.893	43	6.822	-4.071	0.015
Dwelling has Controlled Load Electricity?	No	258	6581	9.487	1746	9.536	0.050	0.953
	Yes	29	708	9.611	263	7.557	-2.055	**0.029**
existing HWS tank size	small approx 160L	171	4326	8.915	1209	8.946	0.031	0.972
	medium approx 250L	43	1123	10.432	340	9.848	-0.584	0.564
	Large approx 350L	34	865	10.788	204	10.072	-0.716	0.602
exising age of HWS	0-2 years	2	43	18.510	11	14.466	-4.044	**0.000**
	3-5 years	6	160	10.502	45	9.419	-1.082	0.493
	6-8 years	16	407	9.859	117	10.195	0.336	0.728
	9-12 years	64	1621	11.010	497	11.405	0.395	0.749
	13-16 years	78	1953	9.589	528	9.734	0.145	0.860
	17-20 years	46	1199	8.797	335	8.028	-0.769	0.358
	21 and older	80	2025	8.884	562	8.510	-0.374	0.699
washing machine size	very small < 5kg	5	131	6.953	39	5.611	-1.342	0.029
	small 5-6.5kg	61	1542	8.732	360	7.882	-0.850	0.306
	medium 6.5-7.5kg	94	2351	8.845	551	7.311	-1.534	**0.005**
	large 7.5kg or larger	40	998	12.921	256	12.539	-0.382	0.795
Dwelling has Rooftop Photo-Voltaics?	No	227	5703	10.241	1562	10.149	-0.092	0.901
	Yes	85	2188	8.134	610	7.687	-0.448	0.607
Number of showers per week	0 to 7 showers	116	2897	7.279	730	6.627	-0.651	0.210
	8 to 14 showers	102	2649	9.306	780	9.104	-0.203	0.803
	15 to 21 showers	50	1242	11.960	336	11.657	-0.303	0.804
	22+ showers	43	1074	14.489	340	12.587	-1.902	0.141
No washes per week	1 to 4 washes	89	2249	8.296	531	7.325	-0.971	0.088
	5 to 9 washes	104	2599	10.002	657	9.259	-0.743	0.399
	10 or more washes	9	210	17.641	42	14.235	-3.406	0.141
Average shower time	Short 6 minutes or less	170	4358	9.081	1315	8.758	-0.323	0.645
	Medium 7 to 12 minutes	116	2897	10.418	714	10.605	0.187	0.876
	Long 13 or more minutes	24	584	9.479	149	11.148	1.669	0.303
Employment status of householder	Umployed (pt or ft)	47	1157	11.595	322	9.787	-1.809	0.050
	Unemployed	20	475	10.282	150	10.539	0.257	0.829
	Retired	163	4149	8.484	852	7.065	-1.419	**0.001**
	Not in workforce	81	2087	11.257	843	10.523	-0.734	0.362
Weekly household income	Low income (< $1000)	226	5676	8.532	1625	8.469	-0.063	0.926
	Middle income ($1000 - $2000)	64	1658	12.203	421	12.798	0.595	0.709
	High income (>$2000)	16	423	12.901	97	13.703	0.802	0.748
Highest education level	Primary	17	423	6.543	116	4.917	-1.626	0.087
	Secondary	123	3100	9.622	832	9.858	0.236	0.817
	TAFE of Uni	166	4205	10.010	1207	9.577	-0.433	0.557

Table 8: The impact of Demographic Factors on Intervention effect for Energy Source = Electricity

Fuel type = Gas			Pre		Post			
Factor	Level	N	Obs	Marginal Mean	Obs	Marginal Mean	Post-Pre	p-value
Home Type	House	90	2200	136.902	412	122.919	-13.982	0.192
	Unit or Flat	24	577	72.123	50	73.141	1.018	0.941
Home ownership status	Owned or mortgaged	218	5397	132.583	1288	111.190	-21.393	**0.003**
	Community Housing	8	152	127.653	15	110.191	-17.462	0.426
Home Age	< 10 years	13	308	129.068	88	108.392	-20.676	0.291
	10 to 20 years	32	774	132.901	235	102.072	-30.829	**0.000**
	> 20 years	188	4635	130.552	879	111.735	-18.817	0.015
Number of household occupants	Single person household	80	2009	96.339	422	90.214	-6.125	0.460
	Two person household	110	2723	135.395	609	115.455	-19.940	0.006
	Three person household	35	785	151.925	165	113.855	-38.071	0.009
	Four person household	12	280	128.701	83	121.111	-7.590	0.675
	Five of more person household	27	705	178.021	149	158.592	-19.429	0.225
number of bathrooms	1	160	3929	117.055	787	100.090	-16.965	0.021
	2	96	2370	151.080	592	125.369	-25.711	**0.003**
	3	5	130	164.097	22	122.042	-42.056	**0.000**
	4	1	26	139.808	11	118.201	-21.606	**0.000**
existing household energy sources	electricity and LPG only	0						
	electricity and natural gas only	255	6270	129.204	1378	110.839	-18.364	0.008
	electricity only	1	26	78.973	7	78.522	-0.451	0.884
	electricity natural gas and LPG	1	26	246.923	8	266.460	19.536	0.051
wood energy source	No	257	6321	129.975	1403	112.603	-17.372	0.011
	Yes	7	181	119.066	25	79.811	-39.256	0.170
Dwelling has Controlled Load Electricity?	No	223	5457	131.385	1154	113.213	-18.172	0.014
	Yes	18	459	101.985	135	95.306	-6.679	0.591
existing HWS tank size	small approx 160L	144	3461		803		0.000	
	medium approx 250L	35	853		190		0.000	
	Large approx 350L	24	645		109		0.000	
exising age of HWS	0-2 years	2	51	129.346	6	137.694	8.349	0.051
	3-5 years	4	110	212.925	33	189.445	-23.480	0.021
	6-8 years	16	392	114.505	89	80.615	-33.890	0.012
	9-12 years	55	1302	155.793	357	127.155	-28.638	0.026
	13-16 years	68	1652	131.116	336	119.545	-11.571	0.251
	17-20 years	40	1007	134.469	240	88.810	-45.660	**0.000**
	21 and older	60	1510	107.757	290	96.675	-11.082	0.170
washing machine size	very small < 5kg	4	105		16		0.000	
	small 5-6.5kg	52	1196		208		0.000	
	medium 6.5-7.5kg	78	1967		360		0.000	
	large 7.5kg or larger	35	861		167		0.000	
Dwelling has Rooftop Photo-Voltaics?	No	197	4908	132.275	1029	118.046	-14.230	0.065
	Yes	65	1557	123.937	378	95.397	-28.541	**0.001**
Number of showers per week	0 to 7 showers	97	2382	114.072	459	104.291	-9.781	0.292
	8 to 14 showers	94	2332	131.411	514	105.035	-26.376	**0.001**
	15 to 21 showers	35	840	147.567	198	120.225	-27.342	0.014
	22+ showers	35	873	157.380	239	133.813	-23.568	0.052
No washes per week	1 to 4 washes	74	1827	128.100	330	122.238	-5.862	0.605
	5 to 9 washes	89	2133	138.992	416	128.998	-9.994	0.303
	10 or more washes	6	168	172.633	18	223.580	50.947	0.096
Average shower time	Short 6 minutes or less	140	3402	124.436	865	109.878	-14.558	0.037
	Medium 7 to 12 minutes	98	2434	139.763	440	111.674	-28.089	**0.004**
	Long 13 or more minutes	21	537	124.315	97	137.819	13.505	0.401
Employment status of householder	Umployed (pt or ft)	43	1002	153.810	211	134.583	-19.227	0.112
	Unemployed	15	338	111.767	75	107.415	-4.352	0.735
	Retired	141	3518	123.126	530	107.436	-15.690	0.035
	Not in workforce	64	1617	134.693	597	107.203	-27.490	**0.000**
Weekly household income	Low income (< $1000)	186	4586	121.798	1016	107.327	-14.471	0.045
	Middle income ($1000 - $2000)	56	1362	152.295	302	123.923	-28.372	0.008
	High income (>$2000)	16	417	142.195	73	129.871	-12.324	0.357
Highest education level	Primary	15	356	79.100	77	97.847	18.747	0.123
	Secondary	99	2424	126.922	542	96.602	-30.320	**0.001**
	TAFE of Uni	143	3535	137.857	783	125.568	-12.290	0.109

Table 9: The impact of Demographic Factors on Intervention effect for Energy Source = Gas

Appendix G: Discrete choice experiment

Survey as provided to market research firm for online programming

This project is part of a wider study by Monash University on residential energy efficiency. The purpose is to understand how costs and subsidies affect the purchases of energy efficient hot water systems. It is expected that this questionnaire will take no longer than 20 minutes.

The questionnaire asks about the upfront and running costs of hot water systems. The results may be published, and participants will be given the option to see a summary report of the study.

No personally identifying details will be requested or obtained by anyone at Monash and all data will be kept confidentially on password-protected computers. Participation is strictly voluntary, and participants may withdraw at any time up to the final stage of the analysis of the results.

This research operates under the research ethics protocol of the University, and any questions or complaints can be forwarded to:

Dr. Souheir Houssami
Executive Officer – Human Ethics
Monash University
[phone and email details supplied]

Thank you for your help with this research. If you have further questions please do not hesitate to contact me at [email supplied]:

Kind regards,
Dr. Daniel Brent

The questionnaire is divided into 4 sections:

Section 1: Questions about you

Section 2: Questions about energy use

Section 3: Questions about purchasing hot water systems

Section 4: Questions about decisions over time and risk

In this section you can earn extra panel points and one person will receive at least $1000 cash.

(START NEW PAGE)

Section 1: Questions about you

Q1. What is your living situation?

1. Own a detached house
2. Own a townhouse/duplex
3. Own a flat
4. Renting/sharing accommodation

(Auto-forward (move respondent forward without requiring them to click 'Next'))

(START NEW PAGE)

Q2. Are you usually involved in major purchase decisions for your household?

1. Yes
2. No

(Auto-forward)

(START NEW PAGE)

Q3. What is your sex?

1. Male
2. Female

(Auto-forward)

(START NEW PAGE)

Q4. How old are you?

1. _______
2. Prefer not to answer

(START NEW PAGE)

Q5. Do you hold a either a Pensioner Concession Card, a Health Care Card, or a DVA Gold Card?

1. Yes
2. No

(Auto-forward)

(START NEW PAGE)

Q6. How much is your monthly mortgage payment?

1. ________
2. No mortgage
3. Prefer not to answer

(Auto-forward if answer is 2 or 3)

(START NEW PAGE)

Q7. Is English the primary language spoken in your household?

1. Yes
2. No, specify _________

(Auto-forward if yes)

(START NEW PAGE)

Q8. Do you support government placing a price on carbon in Australia?

1. Yes
2. No
3. Don't know

(Auto-forward)

(START NEW PAGE)

Section 2: Questions about your household's energy use

Q9. Do you have a gas connection?

1. Yes
2. No

Q10. What do you use gas for?

(select all that apply)

1. Heating
2. Cooking
3. Hot water
4. Other (please specify) ________

(START NEW PAGE)

Q11. What type of hot water system do you have?

1. Gas storage
2. Gas instantaneous
3. Electric
4. Solar
5. Heat pump
6. Other (please specify) __________
7. Don't know

Q12. How many hot water systems have you purchased (not part of a house sale)?

(if none enter '0')

1. In this home ___
2. In other homes ____

(START NEW PAGE)

Q13. What would be the four most important factors to you in choosing a new hot water system?

Select exactly 4 answers

1. Plumbers recommendation
2. Fuel type (electricity, gas, solar, heat pump)
3. Flow rate
4. Lifetime
5. Noise/quietness
6. Upfront cost
7. Simple installation process
8. Sitting position (e.g. indoor/outdoor, roof/ground)
9. Temperature control
10. Least chance of running out of water

11. Tank material (e.g. stainless steel)
12. Low running cost
13. Environmental friendliness
14. Warranty
15. Brand
16. Other (please specify) _________

(START NEW PAGE)

Q14. Also, what would be the three least important factors in choosing a new hot water system?

(remove top four choices)

Select exactly 3 answers

1. Plumbers recommendation
2. Fuel type (electricity, gas, solar, heat pump)
3. Flow rate
4. Lifetime
5. Noise/quietness
6. Upfront cost
7. Simple installation process
8. Sitting position (e.g. indoor/outdoor, roof/ground)
9. Temperature control
10. Least chance of running out of water
11. Tank material (e.g. stainless steel)
12. Low running cost
13. Environmental friendliness
14. Warranty
15. Brand
16. Other (please specify) _________

(START NEW PAGE)

Q15. How old is your current hot water system?

1. 1-2 years
2. 3-5 years
3. 6-10 years
4. More than 10 years
5. Don't know

Q16. Are you considering replacing your current hot water system?

1. Yes
2. No
3. If Yes, why?_______________________

(START NEW PAGE)

Q17. Without looking up your energy bill, what is your best guess of how much money you spend on energy each month?

1. $_____ (gas)
2. $_____ (electricity)
3. Don't know

Q18. Many energy providers offer an opportunity to pay extra (roughly $1/week) to increase the use of renewable energy resources. Do you participate in such a 'green energy' program?

1. Yes
2. No
3. Don't know

(START NEW PAGE)

Q19. How much do you expect electricity prices to change over the next 10 years?

1. No significant change (same as inflation)
2. Decrease by 5% or more
3. Increase by less than 10%
4. Increase between 10-25%
5. Increase by more than 25%
6. Don't know

Q20. How much do you expect gas prices to change over the next 10 years?

1. No significant change (same as inflation)
2. Decrease by 5% or more
3. Increase by less than 10%
4. Increase between 10-25%
5. Increase by more than 25%
6. Don't know

(START NEW PAGE)

Q21. Did you participate in any of the following energy or water rebate programs?

1. Rainwater tank
2. Other water efficiency rebate
3. Home Energy Saver Scheme (Commonwealth program)
4. Victorian Energy Efficiency Target scheme
5. Other (please specify) ________

Q22. If you received a letter from a non-profit offering a rebate of up to $____ for a gas hot water system or up to $_____ for a solar hot water system would you call the listed number to find out more information?

1. Yes
2. No, I don't need a new hot water system
3. No, other reason, please specify_________

(We will vary the '$___'s with several numbers in different survey versions. Skip pattern to next question if 'No, I don't need a new hot water system'.)

(START NEW PAGE)

Q23. If you need to replace your system in the next __ years, would you call to find out more about the rebate?

1. Yes
2. No

(We will vary the '___' with several numbers in different survey versions.)

(START NEW PAGE)

Section 3: Questions about purchasing hot water systems

Next we will ask you some questions about choosing a new hot water system. These questions are hypothetical, and we have observed that sometimes people give different answers to hypothetical questions than when faced with a real decision. This survey will inform energy efficiency policy so please answer as though you were actually purchasing a new hot water system.

Consider the following scenario. You noticed signs that your hot water system was not working properly. Your plumber informed you that you need to replace your hot water system soon. A consultant from a non-profit was able to provide estimates of the unsubsidized upfront costs and running costs customized for your home. The options displayed are all based on calculations of the cost of various systems for real households. In some choice sets the running costs may be systematically higher because that household had more occupants. Please answer each choice set as if these were the numbers the consultant provided **your** household.

You need to read and understand the following points in order to answer the next set of questions.

There are several models that you can choose from. They have different upfront costs and annual running costs.

- Installation costs are included in upfront costs, which can vary depending on the particular layout of the house, as well as the technology used.
- Annual costs are estimates based on current energy prices.
- All the models have similar quality and reliability and only vary based on the listed attributes.
- All the models are under warranty for 10 years.
- You have access to a zero interest loan up to $2000 and a 5% interest loan for amounts greater than $2000. All loans need to be repaid in equal amounts over 3 years.
- There are two certificate programs, Small-scale Technology Certificates (STC) and Victorian Energy Efficiency Certificates (VEEC) available for some hot water systems. The upfront costs account for these certificate programs. These programs are well established and are expected to continue after one year.

In contrast to STC and VEEC, there is a separate **temporary** government rebate program to specifically subsidize certain energy efficient hot water systems. This program is run by a non-profit that also assists in the purchase and installation process. The program will expire in one year.

(START NEW PAGE)

Tests for understanding

Q24. How many years is each system under warranty?

1. ________

Q25. Does the upfront cost include installation costs?

1. Yes
2. No

Please select your preferred model given the information. You will see 5 versions of this decision where we vary the costs and rebates to reflect different options available in the market and differences in installation costs.

To help you make this decision we calculate the payback period relative to the system with the lowest upfront cost. The payback period is the number of years it will take to pay back higher upfront costs through savings in running costs. To find out the payback periods for the systems with higher upfront costs click the 'Payback Period' button for each option.

(If answer to Q24 does not equal '10' make them go back to previous page. And if the answer to Q25 does not equal 'Yes' make them go back to previous page.)

(START NEW PAGE)

Choice Experiment 1

		Payback Period	Payback Period
	New system A	**New system B**	**New system C**
Upfront cost	1300	2900	5500
Rebate amount	0	400	2300
Upfront cost after rebate	1300	2500	3200
Annual running cost	400	275	175
Preferred option	☐	☐	☐

(Please visually set apart (minimize the emphasis) the upfront cost row since it is actually redundant, but we want the information there. Please number these questions CE1-CE5.

If the respondent clicks the 'Payback Period' button please show a pop up box with the follow text and calculation (where 'XX' is either A, B or C, and 'YY' is the New System with the lowest upfront cost):

'Payback period for New system XX relative to New system YY is (*annual running cost of 'New system YY' – annual running cost of 'New system XX') /(Upfront cost of 'New system XX' - Upfront cost of 'New system YY') years.'*

Please store whether a respondent clicked on the 'Payback Period' button in a questions PP1a-PP5a with the following codes:

Only A = 1
Only B = 2
Only C = 3
A + B = 12
B + C = 23
A + B + C = 123)

(START NEW PAGE)

Questions about purchasing specific types of hot water systems

Previously we asked you to decide between three generic hot water systems. Now we will provide a selection of six different technologies and you have the option to keep your current system. We ask for your first and second most preferred options. Please recall some of the features of the decision.

Consider the following scenario. A non-profit organization informed you about a temporary rebate program for hot water systems, and your hot water system is **two years away from the rated service life**. A consultant from the non-profit was able to provide estimates of the unsubsidized upfront costs and running costs customized for your home. The options displayed are all based on calculations of the cost of various systems for real households. In some choice sets the running costs may be systematically higher because that household had more occupants. Please answer each choice set as if these were the numbers the consultant provided **your** household.

You need to read and understand the following points in order to answer the next set of questions.

There are several models that you can choose from. They have different upfront costs and annual running costs.

- Installation costs are included in upfront costs, which can vary depending on the particular layout of the house, as well as the technology used.
- Annual costs are estimates based on current energy prices.
- All the models are under warranty for 10 years.
- You have access to a zero interest loan up to $2000 and a 5% interest loan for amounts greater than $2000. All loans need to be repaid in equal amounts over 3 years.
- There are two certificate programs, Small-scale Technology Certificates (STC) and Victorian Energy Efficiency Certificates (VEEC) available for some hot water systems. The upfront costs account for these certificate programs. These programs are well established and are expected to continue after one year.

In contrast to STC and VEEC, there is a separate **temporary** government rebate program to specifically subsidize certain energy efficient hot water systems. This program is run by a non-profit that also assists in the purchase and installation process. The program will expire in one year. If you choose to keep your current system the subsidy may not be available when purchasing your next hot water system.

The payback period is calculated for all systems relative to electric storage. There is not a standard method to calculate the payback period relative to your current system since it will need to be replaced in the next several years.

(START NEW PAGE)

Choice Experiment 6

	Keep current system (2 years away from rated service life)	**Electric storage**	**Gas storage** Payback	**Gas instantaneous** Payback	**Solar gas** Payback	**Solar electric** Payback	**Heat pump** Payback
Upfront cost	0	1000	1100	2400	5300	5400	3300
Rebate amount	0	0	0	300	2200	2000	800

Net cost	0	1000	1100	2100	3100	3400	2500
Annual running cost	800	400	325	275	200	150	250
Most preferred option	☐	☐	☐	☐	☐	☐	☐
Second-most preferred option	☐	☐	☐	☐	☐	☐	☐

(**Please visually set apart (minimize the emphasis) the upfront cost row since it is actually redundant, but we want the information there. Please number these questions CE6-CE10.**

If the respondent clicks the 'Payback Period' button please show a pop up box with the follow text and calculation (where 'XX' is either gas storage, gas instantaneous, solar electric, solar gas, or heat pump):

'Payback period for the 'XX' system relative to the electric system is (*annual running cost of electric – annual running cost of 'New system XX') /(Upfront cost of 'New system XX' - Upfront cost of electric) years.'*

Please store whether a respondent clicked on the 'Payback Period' button in a questions PP6-PP10 with the following codes:

Clicked 'Payback Period' button = 1
Clicked 'Payback Period' buttons = 2
Clicked 'Payback Period' buttons = 3
Clicked 'Payback Period' buttons = 4
Clicked 'Payback Period' buttons = 5)

(START NEW PAGE)

Section 4: Questions about decisions over time and risk

Thank you for your participation so far; you're almost done. In these last few questions you can earn some extra rewards.

A hot water system is a large purchase for a household that will impact energy bills for 10 years or more. Households need to decide whether to pay more money now in order to save money in the future. There are also risks involved with the purchase decision such as future energy prices and deciding whether to delay the replacement of an old hot water system.

Now we will ask you to make decisions in three separate tasks. These tasks will measure your attitudes towards money in the future, risk, and investment decisions.

For Tasks 1 and 2 one participant will be randomly selected to earn the money explained in each task, which may exceed $1,000. Treat these as real choices because you may actually receive your chosen option in cash.

In Task 3 you will be able to earn extra panel points based on your answers in these tasks. The three tasks are as follows:

Task 1: Decisions about money now or money later

Task 2: Decisions about risk

Task 3: Decisions about investments

(START NEW PAGE)

Instructions for Task 1

- This task will ask you to make decision about having money now or money later.
- On the next screen you will be asked whether you prefer $1000 in one month or some amount more than $1000 in seven months. You will be given several such options where we gradually increase the amount of extra money you receive in seven months.
- For each row choose whether you prefer the $1000 now (Choice A) or the $1000 plus some extra (Choice B) in seven months, or indicate that you are indifferent between the two options.

How you will be paid:

- We will randomly choose one respondent who will earn money based on their decision.
- If you are selected the money will be mailed to you either in one month or seven months.
- To determine your earnings we will randomly choose a number from 1-12 with equal probability that selects which of the 12 decision rows will determine your payoff.

(START NEW PAGE)

Task 1

			Decision (buttons)		
Row number	**Credit A (in 1 month)**	**Credit B (in 7 months)**	**I prefer A**	**I prefer B**	**I am indifferent**
1	$1,000	$1,010			
2	$1,000	$1,025			
3	$1,000	$1,038			
4	$1,000	$1,051			
5	$1,000	$1,064			
6	$1,000	$1,077			
7	$1,000	$1,091			
8	$1,000	$1,104			
9	$1,000	$1,132			
10	$1,000	$1,160			

11	$1,000	$1,217			
12	$1,000	$1,278			

(Must select one of the last three columns (I prefer A, I prefer B, or I am indifferent) for each of the 12 rows. Should select one of three buttons for each row.)

(START NEW PAGE)

Instructions for Task 2

- Task 2 will help us understand your attitudes towards risky decisions.
- In this part of the study you will select from among seven different lotteries the one lottery you would like to play. The seven different lotteries are listed on the next screen. You must select one and only one of these lotteries. Each lottery has two possible monetary rewards that are equally likely. If you are selected your compensation for this part of the study will be determined by: 1) which of the seven lotteries you select; and 2) which of the two possible rewards are drawn.

How you will be paid:

- We will randomly choose one respondent who will earn money based on their decision. The selection of a respondent will be separate from Task 1.
- If you are selected we will base your payment on your preferred lottery.
- For example: if are chosen and you select Lottery 4 and Outcome A occurs, you will be paid $150. If Outcome B occurs, you will be paid $600.
- For every lottery each event has a 50% chance of occurring.

(START NEW PAGE)

Task 2 (alternate with 7 options)

Lottery	**Outcome A (50%)**	**Outcome B (50%)**	**Decision (select one row for your preferred lottery)**
Lottery 1	$300	$300	
Lottery 2	$250	$375	
Lottery 3	$200	$475	
Lottery 4	$150	$600	
Lottery 5	$100	$725	
Lottery 6	$50	$800	
Lottery 7	$0	$850	

(Last columns should be a button where they must select only one of the rows.)

(START NEW PAGE)

Instructions for Task 3

- The final task asks factual questions about several investment decisions.
- In all the prior tasks there were no correct or incorrect answers, but in this task there are correct answers.
- These questions are intended to be straightforward; there are no hidden tricks.

How you will be paid: (Slightly different wording for external sample – 'Kindly note that the standard panel reward scheme will apply for the survey and an additional token will be provided based on the following:')

- You will earn 25c in panel points for each correct answer.
- Please select the 'Don't know' option if you do not know how to answer the question.
- In order to discourage completely random guessing we will pay 5c panel points if you select the 'Don't know' option.
- The total number of panel points you can earn will range from $0-$1.50. You will earn zero if you answer all questions incorrectly, and you will earn $1.50 panel points if you answer all answers correctly.

(START NEW PAGE)

Task 3

Q28. Suppose you had $100 in a free savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow:

1. More than $102
2. Exactly $102
3. Less than $102
4. Do not know

Q29. Suppose that the interest rate on your free savings account was 1% per year and inflation was 2% per year. After 1 year, with the money in this account would you be able to buy:

1. More than today
2. Exactly the same as today
3. Less than today
4. Do not know

Q30. Do you think that the following statement is true or false? 'Buying a single company stock usually provides a safer return than a stock mutual fund.'

1. True
2. False
3. Do not know

(START NEW PAGE)

Q31. A hot water system has an upfront cost of $1500 and annual running costs of $400. If the hot water system lasts 10 years which costs are larger in total dollar terms over the full 10 years?

1. Upfront cost
2. Running costs
3. Do not know

Q32. Hot water system A that has an upfront cost of $1500 and annual running costs of $400. Hot water system B has an upfront cost of $3500 and annual running costs of $200. How long

will it take to pay back the extra upfront costs of system B through savings in running costs? Assume a 0% interest rate for this question.

1. 1-2 years
2. 3-4 years
3. 5-6 years
4. 7-8 years
5. 9-10 years
6. More than 10 years
7. Do not know

(START NEW PAGE)

Q33. You have $5000 dollars in your savings account. You need to purchase a hot water system, and all the remaining money will purchase a risk-free government bond that earns 10% interest per year. Hot water system A that has an upfront cost of $1500 and annual running costs of $400. Hot water system B has an upfront cost of $3500 and annual running costs of $200. Which system should you buy in order to earn the most money possible after accounting for purchasing the system, running costs, and interest payments?

1. System A
2. System B
3. Do not know

(START NEW PAGE)

Q34.Comments:

Please write down any comments you have in the section below.

This is the end of the survey. Thank you for your participation.

Appendix H: Data for cost-effectiveness and cost benefit analysis

Appendix H1: LIEEP framework application for HEEUP

Table 44: Four levels of analysis – LIEEP framework application for HEEUP analysis

Cost level	Cost Data analysed
Direct Trial approach (Level 1)	**b. Cost of delivering the trial approach to a participant** • Direct staff cost (incl. of community housing expenditure) • Indirect staff costs (excl. of community housing expenditure) • Non-staff costs (excl. of community housing expenditure) • Subsidies funded through the LIEEP funding and weighted by direct staff level contribution • Subsidies for Community Housing funded through the LIEEP funding and weighted by direct staff level contribution
Trial Component (Level 2)	c) Cost of delivering the trial approach to a participant, **and** **d) Costs associated with:** **iv. Recruiting a participant, and** **v. Maintaining a participant** • Direct staff cost • Indirect staff costs • Non-staff costs
Total Business (Level 3)	The delivery of an outcome for: d) Cost of delivering the trial approach to a participant, **and** e) Costs associated with: iii. Recruiting a participant, and iv. Maintaining a participant, **and** **f) Cost of running an organisation to do the above** • Direct staff cost • Indirect staff costs • Non-staff costs
Total Trial (Level 4)	The delivery of an outcome for: e) Cost of delivering the trial approach to a participant, **and** f) Costs associated with: iii. Recruiting a participant, and iv. Maintaining a participant, **and** g) Cost of running an organisation to do the above, **and** **h) Cost of participating in a government funded trial** • Direct staff cost • Indirect staff costs • Non-staff costs

Source: OGW interpretation of LIEEP framework

Appendix H2: Disaggregated four-level cost analysis

This Appendix provides an overview of the disaggregated annual four-level cost analysis, in line with the LIEEP guidelines. It shows the outcomes for the following approaches:

- Four-level cost analysis, incremental, exclusive of household contributions
- Four-level cost analysis, cumulative, exclusive of household contributions
- Four-level cost analysis, incremental, inclusive of household contributions to the purchase of the HWS
- Four-level cost analysis, cumulative, inclusive of household contributions to the purchase of the HWS

Four-level cost analysis, incremental, exclusive of household contributions

Table 45: Cost level 1 – incremental, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs - proportion of direct staff cost used for BSL subsidy administration					
Program manager	$ -	$ -	$ -	$ -	$104,200
EEO	$15,046	$69,552	$4,178	$88,775	
Admin loan		$ -	$ -	$ -	
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$6,964	$6,964	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs - proportion of direct staff cost used for Community Housing administration					
Program manager			$ -	$ -	$12,803
EEO			$4,800	$4,800	
Admin loan			$ -	$ -	
Technical manager & EEO			$ -	$ -	
EEO & recruit			$8,002	$8,002	
Admin			$ -	$ -	
Data			$ -	$ -	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
			Community Housing subsidies		
Program manager			$ -	$ -	$188,100
EEO			$100,217	$100,217	
Admin loan			$ -	$ -	
Technical manager & EEO			$18,502	$18,502	
EEO & recruit			$69,381	$69,381	
Admin			$ -	$ -	
Data			$ -	$ -	
			Indirect staff costs		
Program manager	$ -	$ -	$ -	$ -	$63,350
EEO	$6,183	$30,019	$3,721	$39,923	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$14,967	$14,967	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
			Non-staff costs		
Property	$ -	$ -	$ -	$ -	$71,576
Transport	$8,156	$13,496	$17,606	$39,257	
Administration	$ -	$ -	$ -	$ -	
Operating cost	$ -	$ -	$ -	$ -	
General consulting	$6,375	$37	$25,907	$32,319	
AGL consulting	$ -	$ -	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$ -	$ -	$ -	$ -	
Total annual cost by cost level	**$167,634**	**$962,496**	**$437,946**	**$1,568,076**	

Table 46: Cost level 2 – incremental, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
		Direct staff cost			
Program manager	$ 29,047	$ 31,759	$32,335	$93,141	$ 204,532
EEO	$ 5,015	$ 21,401	$ 2,762	$29,178	
Admin loan	$ 7,832	$ 14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$ 4,989	$ 4,989	
Admin	$ -	$ 5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
		Indirect staff costs			
Program manager	$ 11,937	$ 13,707	$13,400	$39,044	$ 156,262
EEO	$ 2,061	$ 9,237	$ 1,145	$12,442	
Admin loan	$ 7,832	$ 14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$ 22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$ 4,989	$ 4,989	
Admin	$ -	$ 5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
		Non-staff costs			
Property	$ -	$ -	$ -	$ -	$19,181
Transport	$587	$5,510	$5,510	$11,607	
Administration	$ -	$ -	$ -	$ -	
Operating cost	$ -	$ -	$ -	$ -	
General consulting	$ -	$ -	$7,574	$7,574	
AGL consulting	$ -	$56,149	$ -		
M Ward and Monash Consulting	$ -	$ -	$ -		
Office Management and Support	$ -	$ -	$ -	$ -	
Total annual cost by cost level	**$64,311**	**$201,794**	**$170,019**	**$436,124**	

Table 47: Cost level 3 – incremental, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff cost					
Program manager	$29,047	$31,759	$32,335	$93,141	$212,528
EEO	$15,046	$ -	$ -	$15,046	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$9,978	$9,978	
Admin	$ -	$4,278	$25,638	$29,916	
Data	$ -	$5,796	$ -	$5,796	
Indirect staff costs					
Program manager	$11,937	$13,707	$13,400	$39,044	$149,569
EEO	$6,183	$ -	$ -	$6,183	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$9,978	$9,978	
Admin	$ -	$4,278	$25,638	$29,916	
Data	$ -	$5,796	$ -	$5,796	
Non-staff costs					
Property	$ 3,007	$ 774	$ 585	$ 4,366	$ 464,935
Transport	$ 2,719	$ 4,499	$ 5,869	$ 13,086	
Administration	$ 2,760	$ 15,840	$ 10,788	$ 29,388	
Operating cost	$ 1,309	$ 18,998	$ 18,998	$ 39,305	
General consulting	$ 220	$ -	$ -	$ 220	
AGL consulting	$ -	$ -	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$ 46,972	$ 225,585	$ 106,013	$ 378,570	
Total annual cost by cost level	**$ 134,863**	**$ 406,139**	**$ 346,300**	**$ 887,302**	

Table 48: Cost level 4 – incremental, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
			Direct staff cost		
Program manager	$29,047	$31,759	$32,335	$93,141	$156,092
EEO	$15,046	$16,050	$2,072	$33,168	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$16,921	$ -	$16,921	
EEO & recruit	$ -	$ -	$3,326	$3,326	
Admin	$ -	$535	$3,205	$3,740	
Data	$ -	$5,796	$ -	$5,796	
			Indirect staff costs		
Program manager	$11,937	$13,707	$13,400	$39,044	$79,470
EEO	$6,183	$6,927	$859	$13,969	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$16,921	$ -	$16,921	
EEO & recruit	$ -	$ -	$ -	$ -	
Admin	$ -	$535	$3,205	$3,740	
Data	$ -	$5,796	$ -	$5,796	
			Non-staff costs		
Property	$ -	$ -	$ -	$ -	$ 477,382
Transport	$ 587	$5,510	$5,033	$ 11,130	
Administration	$ -	$ -	$ -	$ -	
Operating cost	$ -	$ -	$ -	$ -	
General consulting	$ 25,500	$ 150	$ 12	$ 25,662	
AGL consulting	$ -	$ 56,149	$ -	$ 56,149	
M Ward and Monash Consulting	$ 46,000	$ 234,000	$ -	$ 280,000	
Office Management and Support	$ 38,400	$ 39,984	$ 26,058	$ 104,442	
Total annual cost by cost level	**$ 172,700**	**$ 450,740**	**$ 149,774**	**$ 773,214**	

Four-level cost analysis, cumulative, exclusive of household contributions

Table 49 Cost level 1 and 2, cumulative, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
		Direct staff costs - incl. a contribution used for BSL subsidy administration			
Program manager	$29,047	$31,759	$32,335	$93,141	$308,733
EEO	$20,061	$90,952	$6,940	$117,954	
Admin loan	$7,832	$14,853	$13,405	$36,090	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$11,953	$11,953	
Admin	$ -	$5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
			BSL subsidies		
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs, incl. a proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
			Community Housing subsidies		
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
			Indirect staff costs		
Program manager	$11,937	$13,707	$13,400	$39,044	$219,612
EEO	$8,244	$39,255	$4,865	$52,365	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$31,022	$ -	$31,022	
EEO & recruit	$ -	$ -	$19,956	$19,956	
Admin	$ -	$5,882	$35,253	$41,135	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Data	$ -	$ -	$ -	$ -	
			Non-staff costs		
Property	$ -	$ -	$ -	$ -	$146,905
Transport	$8,743	$19,006	$23,116	$50,864	
Administration	$ -	$ -	$ -	$ -	
Operating Cost	$ -	$ -	$ -	$ -	
General consulting	$6,375	$37	$33,481	$39,893	
AGL Consulting	$ -	$56,149	$ -	$56,149	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$ -	$ -	$ -	$ -	
Total annual cost by cost level	**$231,945**	**$1,164,290**	**$607,965**	**$2,004,200**	

Table 50 Cost levels 1, 2 and 3 cumulative, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
		Direct staff costs, incl. a contribution used for BSL subsidy administration			
Program manager	$58,094	$63,518	$64,670	$186,281	$521,261
EEO	$35,108	$90,952	$6,940	$133,000	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$31,022	$ -	$31,022	
EEO & recruit	$ -	$ -	$21,931	$21,931	
Admin	$ -	$10,160	$60,891	$71,051	
Data	$ -	$5,796	$ -	$5,796	
			BSL subsidies		
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
		Direct staff costs, incl. a proportion of direct staff cost used for Community Housing administration			
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	

EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
			Community Housing subsidies		
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
			Indirect staff costs		
Program manager	$23,874	$27,414	$26,801	$78,089	$369,181
EEO	$14,427	$39,255	$4,865	$58,548	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$53,584	$ -	$53,584	
EEO & recruit	$ -	$ -	$29,934	$29,934	
Admin	$ -	$10,160	$60,891	$71,051	
Data	$ -	$5,796	$ -	$5,796	
			Non-staff costs		
Property	$3,007	$774	$585	$4,366	$555,691
Transport	$11,461	$23,504	$28,984	$63,949	
Administration	$2,760	$15,840	$10,788	$29,388	
Operating Cost	$1,309	$18,998	$18,998	$39,305	
General consulting	$6,595	$37	$33,481	$40,113	
AGL Consulting	$ -	$56,149	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$46,972	$225,585	$106,013	$378,570	
Total annual cost by cost level	**$366,808**	**$1,570,429**	**$893,995**	**$2,831,232**	

Table 51 Cost levels 1, 2, 3 and 4 cumulative, excl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs, incl. a contribution used for BSL subsidy administration					
Program manager	$87,141	$95,276	$97,005	$279,422	$677,352
EEO	$50,154	$107,003	$9,012	$166,168	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$47,944	$ -	$47,944	
EEO & recruit	$ -	$ -	$25,257	$25,257	
Admin	$ -	$10,695	$64,096	$74,791	
Data	$ -	$11,592	$ -	$11,592	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs, incl. a proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Community Housing subsidies					
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Indirect staff costs					
Program manager	$35,810	$41,122	$40,201	$117,133	$448,651
EEO	$20,611	$46,183	$5,724	$72,517	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$70,505	$ -	$70,505	
EEO & recruit	$ -	$ -	$29,934	$29,934	
Admin	$ -	$10,695	$64,096	$74,791	
Data	$ -	$11,592	$ -	$11,592	
Non-staff costs					
Property	$3,007	$774	$585	$4,366	$1,089,222
Transport	$12,048	$29,014	$34,017	$75,079	
Administration	$2,760	$15,840	$10,788	$29,388	
Operating Cost	$1,309	$18,998	$18,998	$39,305	
General consulting	$32,095	$187	$33,493	$65,775	
AGL Consulting	$ -	$112,297	$ -	$112,297	
M Ward and Monash Consulting	$46,000	$234,000	$ -	$280,000	
Office Management and Support	$85,372	$265,569	$132,071	$483,012	
Total annual cost by cost level	**$539,508**	**$2,021,168**	**$983,499**	**$3,544,175**	

Four-level cost analysis, incremental, inclusive of household contributions

Table 52: Cost level 1 – incremental, incl. household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs - proportion of direct staff cost used for BSL subsidy administration					
Program manager	$ -	$ -	$ -	$ -	$104,200
EEO	$15,046	$69,552	$4,178	$88,775	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$6,964	$6,964	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Data	$ -	$ -	$ -	$ -	
Direct staff costs - proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Community Housing subsidies					
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Household contribution					
Program manager	$ -	$ -	$ -	$ -	$957,761
EEO	$37,580	$585,332	$138,241	$761,153	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$15,032	$108,061	$25,521	$148,615	
EEO & recruit	$ -	$ -	$47,994	$47,994	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Indirect staff costs					
Program manager	$ -	$ -	$ -	$ -	$63,350
EEO	$6,183	$30,019	$3,721	$39,923	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$14,967	$14,967	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Non-staff costs					
Property	$ -	$ -	$ -	$ -	$71,576
Transport	$8,156	$13,496	$17,606	$39,257	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Administration	$ -	$ -	$ -	$ -	
Operating Cost	$ -	$ -	$ -	$ -	
General consulting	$6,375	$37	$25,907	$32,319	
AGL Consulting	$ -	$ -	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$ -	$ -	$ -	$ -	
Total annual cost by cost level	**$220,246**	**$1,655,890**	**$649,702**	**$2,525,837**	

Table 53 Cost level 2 – incremental, incl. household contributions

Staff cost FY	Level 1,2 Jul 13 – Jun 14	Level 1,2 Jul 14 – Jun 15	Level 1,2 Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
			Direct staff costs		
Program manager	$29,047	$31,759	$32,335	$93,141	$204,532
EEO	$5,015	$21,401	$2,762	$29,178	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$4,989	$4,989	
Admin	$ -	$5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
			Indirect staff costs		
Program manager	$11,937	$13,707	$13,400	$39,044	$156,262
EEO	$2,061	$9,237	$1,145	$12,442	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$4,989	$4,989	
Admin	$ -	$5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
			Non-staff costs		
Program manager	$ -	$ -	$ -	$ -	$19,181
EEO	$587	$5,510	$5,510	$11,607	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$7,574	$7,574	
Admin	$ -	$56,149	$ -		

Staff cost FY	Level 1,2 Jul 13 – Jun 14	Level 1,2 Jul 14 – Jun 15	Level 1,2 Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Data	$ -	$ -	$ -		
Total annual cost by cost level by participant	**$64,311**	**$201,794**	**$170,019**	**$436,124**	

Table 54 Cost level 3 – incremental, incl. household contributions

Staff cost FY	Level 1,2 Jul 13 – Jun 14	Level 1,2 Jul 14 – Jun 15	Level 1,2 Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
			Direct staff costs		
Program manager	$29,047	$31,759	$32,335	$93,141	$212,528
EEO	$15,046	$ -	$ -	$15,046	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$9,978	$9,978	
Admin	$ -	$4,278	$25,638	$29,916	
Data	$ -	$5,796	$ -	$5,796	
			Indirect staff costs		
Program manager	$11,937	$13,707	$13,400	$39,044	$149,569
EEO	$6,183	$ -	$ -	$6,183	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$22,562	$ -	$22,562	
EEO & recruit	$ -	$ -	$9,978	$9,978	
Admin	$ -	$4,278	$25,638	$29,916	
Data	$ -	$5,796	$ -	$5,796	
			Non-staff costs		
Property	$3,007	$774	$585	$4,366	$464,935
Transport	$2,719	$4,499	$5,869	$13,086	
Administration	$2,760	$15,840	$10,788	$29,388	
Operating Cost	$1,309	$18,998	$18,998	$39,305	
General consulting	$220	$ -	$ -	$220	
AGL Consulting	$ -	$ -	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$46,972	$225,585	$106,013	$378,570	
Total annual cost by cost level	**$134,863**	**$406,139**	**$286,030**	**$827,032**	

Table 55 Cost level 4 – incremental, incl. household contributions

Staff cost FY	Level 1,2 Jul 13 – Jun 14	Level 1,2 Jul 14 – Jun 15	Level 1,2 Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
			Direct staff costs		
Program manager	$29,047	$31,759	$32,335	$93,141	$156,092
EEO	$15,046	$16,050	$2,072	$33,168	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$16,921	$ -	$16,921	
EEO & recruit	$ -	$ -	$3,326	$3,326	
Admin	$ -	$535	$3,205	$3,740	
Data	$ -	$5,796	$ -	$5,796	
			Indirect staff costs		
Program manager	$11,937	$13,707	$13,400	$39,044	$79,470
EEO	$6,183	$6,927	$859	$13,969	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$16,921	$ -	$16,921	
EEO & recruit	$ -	$ -	$ -	$ -	
Admin	$ -	$535	$3,205	$3,740	
Data	$ -	$5,796	$ -	$5,796	
			Non-staff costs		
Property	$ -	$ -	$ -	$ -	$477,382
Transport	$587	$5,510	$5,033	$11,130	
Administration	$ -	$ -	$ -	$ -	
Operating Cost	$ -	$ -	$ -	$ -	
General consulting	$25,500	$150	$12	$25,662	
AGL Consulting	$ -	$56,149	$ -	$56,149	
M Ward and Monash Consulting	$46,000	$234,000	$ -	$280,000	
Office Management and Support	$38,400	$39,984	$26,058	$104,442	
Total annual cost by cost level	**$172,700**	**$450,740**	**$89,504**	**$712,943**	

Four-level cost analysis, cumulative, inclusive of household contributions

Table 56: Cost level 1 and 2 – cumulative, inclusive of household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs - proportion of direct staff cost used for BSL subsidy administration					
Program manager	$29,047	$31,759	$32,335	$93,141	$308,733
EEO	$20,061	$90,952	$6,940	$117,954	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$8,461	$ -	$8,461	
EEO & recruit	$ -	$ -	$11,953	$11,953	
Admin	$ -	$5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs - proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Community Housing subsidies					
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Household contribution					
Program manager	$ -	$ -	$ -	$ -	$957,761

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
EEO	$37,580	$585,332	$138,241	$761,153	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$15,032	$108,061	$25,521	$148,615	
EEO & recruit	$ -	$ -	$47,994	$47,994	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Indirect staff costs					
Program manager	$11,937	$13,707	$13,400	$39,044	$219,612
EEO	$8,244	$39,255	$4,865	$52,365	
Admin loan	$7,832	$14,853	$13,405	$36,090	
Technical manager & EEO	$ -	$31,022	$ -	$31,022	
EEO & recruit	$ -	$ -	$19,956	$19,956	
Admin	$ -	$5,882	$35,253	$41,135	
Data	$ -	$ -	$ -	$ -	
Non-staff costs					
Property	$ -	$ -	$ -	$ -	$146,905
Transport	$8,743	$19,006	$23,116	$50,864	
Administration	$ -	$ -	$ -	$ -	
Operating Cost	$ -	$ -	$ -	$ -	
General consulting	$6,375	$37	$33,481	$39,893	
AGL Consulting	$ -	$56,149	$ -	$56,149	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$ -	$ -	$ -	$ -	
Total annual cost by cost level	**$284,557**	**$1,857,683**	**$819,721**	**$2,961,961**	

Table 57 Cost levels 1, 2 and 3 cumulative, inclusive of household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs - proportion of direct staff cost used for BSL subsidy administration					
Program manager	$58,094	$63,518	$64,670	$186,281	$521,261
EEO	$35,108	$90,952	$6,940	$133,000	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$31,022	$ -	$31,022	
EEO & recruit	$ -	$ -	$21,931	$21,931	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Admin	$ -	$10,160	$60,891	$71,051	
Data	$ -	$5,796	$ -	$5,796	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs - incl. a proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Community Housing subsidies					
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Household contribution					
Program manager	$ -	$ -	$ -	$ -	$957,761
EEO	$37,580	$585,332	$138,241	$761,153	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$15,032	$108,061	$25,521	$148,615	
EEO & recruit	$ -	$ -	$47,994	$47,994	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Indirect staff costs					
Program manager	$23,874	$27,414	$26,801	$78,089	$369,181

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
EEO	$14,427	$39,255	$4,865	$58,548	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$53,584	$ -	$53,584	
EEO & recruit	$ -	$ -	$29,934	$29,934	
Admin	$ -	$10,160	$60,891	$71,051	
Data	$ -	$5,796	$ -	$5,796	
Non-staff costs					
Property	$3,007	$774	$585	$4,366	$555,691
Transport	$11,461	$23,504	$28,984	$63,949	
Administration	$2,760	$15,840	$10,788	$29,388	
Operating Cost	$1,309	$18,998	$18,998	$39,305	
General consulting	$6,595	$37	$33,481	$40,113	
AGL Consulting	$ -	$56,149	$ -	$ -	
M Ward and Monash Consulting	$ -	$ -	$ -	$ -	
Office Management and Support	$46,972	$225,585	$106,013	$378,570	
Total annual cost by cost level	**$419,420**	**$2,263,822**	**$1,105,751**	**$3,788,992**	

Table 58 Cost level 1, 2, 3 and 4 cumulative, inclusive of household contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Direct staff costs - proportion of direct staff cost used for BSL subsidy administration					
Program manager	$87,141	$95,276	$97,005	$279,422	$677,352
EEO	$50,154	$107,003	$9,012	$166,168	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$47,944	$ -	$47,944	
EEO & recruit	$ -	$ -	$25,257	$25,257	
Admin	$ -	$10,695	$64,096	$74,791	
Data	$ -	$11,592	$ -	$11,592	
BSL subsidies					
Program manager	$ -	$ -	$ -	$ -	$1,128,047
EEO	$94,196	$702,736	$101,948	$898,880	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$37,678	$129,736	$18,821	$186,235	
EEO & recruit	$ -	$ -	$42,932	$42,932	

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Direct staff costs - incl. a proportion of direct staff cost used for Community Housing administration					
Program manager	$ -	$ -	$ -	$ -	$12,803
EEO	$ -	$ -	$4,800	$4,800	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$ -	$ -	
EEO & recruit	$ -	$ -	$8,002	$8,002	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Community Housing subsidies					
Program manager	$ -	$ -	$ -	$ -	$188,100
EEO	$ -	$ -	$100,217	$100,217	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$ -	$ -	$18,502	$18,502	
EEO & recruit	$ -	$ -	$69,381	$69,381	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Household contribution					
Program manager	$ -	$ -	$ -	$ -	$957,761
EEO	$37,580	$585,332	$138,241	$761,153	
Admin loan	$ -	$ -	$ -	$ -	
Technical manager & EEO	$15,032	$108,061	$25,521	$148,615	
EEO & recruit	$ -	$ -	$47,994	$47,994	
Admin	$ -	$ -	$ -	$ -	
Data	$ -	$ -	$ -	$ -	
Indirect staff costs					
Program manager	$35,810	$41,122	$40,201	$117,133	$448,651
EEO	$20,611	$46,183	$5,724	$72,517	
Admin loan	$15,664	$29,706	$26,809	$72,179	
Technical manager & EEO	$ -	$70,505	$ -	$70,505	
EEO & recruit	$ -	$ -	$29,934	$29,934	
Admin	$ -	$10,695	$64,096	$74,791	
Data	$ -	$11,592	$ -	$11,592	
Non-staff costs					
Property	$3,007	$774	$585	$4,366	$1,089,222

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16	Total cost by stall level	Total cost by cost type
Transport	$12,048	$29,014	$34,017	$75,079	
Administration	$2,760	$15,840	$10,788	$29,388	
Operating Cost	$1,309	$18,998	$18,998	$39,305	
General consulting	$32,095	$187	$33,493	$65,775	
AGL Consulting	$ -	$112,297	$ -	$112,297	
M Ward and Monash Consulting	$46,000	$234,000	$ -	$280,000	
Office Management and Support	$85,372	$265,569	$132,071	$483,012	
Total annual cost by cost level	**$592,120**	**$2,714,561**	**$1,195,255**	**$4,501,936**	

Appendix H3: Direct staff costs – subsidies, BSL and Community Housing

Table 59: Direct staff costs – subsidies

	Jul 13 – Jun 14 BSL HESS	Jul 14 – Feb 15 BSL	Mar 15 – May 15 BSL 1	Jun 15 – Mar 16 BSL 2	Total cost by staff level
Program manager	$ -	$ -	$ -	$ -	$ -
EEO	$ 94,196	$ 702,736	$ 39,935	$ 62,013	$ 898,880
Admin loan	$ -	$ -	$ -	$ -	$ -
Technical manager & EEO	$ 37,678	$ 129,736	$ 7,373	$ 11,449	$ 186,235
EEO & recruit	$ -	$ -	$ -	$ 42,932	$ 42,932
Admin	$ -	$ -	$ -	$ -	$ -
Data	$ -	$ -	$ -	$ -	$ -
Total (excl. Community housing)					**$ 1,128,047**

Table 60: Direct staff costs – Community Housing

Direct staff costs	Jul 15 – Mar16 Community Housing Subsidy $-value
Program manager	$ -
EEO	$ 94,196
Admin loan	$ -
Technical manager & EEO	$ 37,678
EEO & recruit	$ -
Admin	$ -
Data	$ -
Total (excl. Community housing)	**$ 188,100**

Appendix H4: Non-LIEEP contributions – co- contributions by households, VEET and STC, in-kind contributions

Co-contributions

Table 61 Non-LIEEP co-contribution – household co-contribution by upgrade type and type of subsidy

Upgrade type	Type of subsidy	Household co-contribution	Percentage of total upgrade by subsidy type
Solar gas	BSL	$ 304,213	68%
Solar gas	BSL 1	$ 50,931	11%
Solar gas	BSL 2	$ 65,624	15%
Solar gas	BSL HESS	$ 25,200	6%
Solar gas	No subsidy - Independent install	$ -	0%
Heat pump	BSL	$ 176,275	92%
Heat pump	BSL 1	$ -	0%
Heat pump	BSL 2	$ 16,253	8%
Heat pump	BSL HESS	$ -	0%
Heat pump	No subsidy - Independent install	$ -	0%
Instant gas	BSL	$ 113,392	63%
Instant gas	BSL 1	$ 15,556	9%
Instant gas	BSL 2	$ 30,261	17%
Instant gas	BSL HESS	$ 21,070	12%
Instant gas	No subsidy - Independent install	$ -	0%
Solar electric	BSL	$ 41,703	90%
Solar electric	BSL 1	$ -	0%
Solar electric	BSL 2	$ -	0%
Solar electric	BSL HESS	$ 4,800	10%
Solar electric	No subsidy - Independent install	$ -	0%
Gas storage	BSL	$ 57,811	63%
Gas storage	BSL 1	$ 15,153	16%
Gas storage	BSL 2	$ 17,978	19%
Gas storage	BSL HESS	$ 1,542	2%
Gas storage	No subsidy - Independent install	$ -	0%
Total subsidy paid		**$ 957,761**	

Table 62 Non-LIEEP co-contribution by staff level

	Jul 13-Jun 14 BSL HESS	Jul 14 – Feb 15 BSL	Mar 15 – May 15 BSL 1	Jun 15 – Mar 16 BSL 2	Total cost by staff level
Program manager	$ -	$ -	$ -	$ -	$ -
EEO	$ 37,580	$ 585,332	$68,917	$69,324	$761,153
Admin loan	$ -	$ -	$ -	$ -	$ -
Technical manager & EEO	$ 15,032	$ 108,061	$12,723	$12,798	$ 148,615
EEO & recruitment	$ -	$ -	$ -	$47,994	$ 47,993.51
Admin	$ -	$ -	$ -	$ -	$ -
Data	$ -	$ -	$ -	$ -	$ -
Total (excl. Community housing)					**$957,761**

VEET + STC

Table 63 Non-LIEEP contribution – VEET + STC by upgrade type and type of subsidy

Upgrade type	Type of subsidy	Household co-contribution	Percentage of total upgrade by subsidy type
Solar gas	BSL	$31,276	47%
Solar gas	BSL 1	$3,750	6%
Solar gas	BSL 2	$3,744	6%
Solar gas	BSL HESS	$27,466	41%
Solar gas	No subsidy - Independent install	$ -	0%
Heat pump	BSL	$44,452	89%
Heat pump	BSL 1	$ -	0%
Heat pump	BSL 2	$5,653	11%
Heat pump	BSL HESS	$ -	0%
Heat pump	No subsidy - Independent install	$ -	0%
Instant gas	BSL	$8,990	74%
Instant gas	BSL 1	$ -	0%
Instant gas	BSL 2	$1,056	9%
Instant gas	BSL HESS	$2,073	17%
Instant gas	No subsidy - Independent install	$ -	0%
Solar electric	BSL	$10,355	69%
Solar electric	BSL 1	$ -	0%

Upgrade type	Type of subsidy	Household co-contribution	Percentage of total upgrade by subsidy type
Solar electric	BSL 2	$ -	0%
Solar electric	BSL HESS	$ 4,694	31%
Solar electric	No subsidy - Independent install	$ -	0%
Gas storage	BSL	$ 1,390	82%
Gas storage	BSL 1	$ -	0%
Gas storage	BSL 2	$ 261	15%
Gas storage	BSL HESS	$ -	0%
Gas storage	No subsidy - Independent install	$ 43	3%
Total subsidy paid		**$ 145,160**	

In-kind contributions

Table 64 Cost level 1 in-kind contributions

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$0	$0	$0
Staff (B) FTE	$0	$0	$0
	BSL		
CFO	$0	$0	$0
Project accountant	$0	$0	$0
Accounts support (Braden)	$0	$0	$0
RPC	$0	$0	$0
GM	$0	$0	$0
SM FI	$0	$0	$0
ED	$0	$0	$0
John Thwaites (Consultant)	$0	$0	$0
Total in-kind contribution	**$0**	**$0**	**$0**

Table 65 Cost levels 1, 2 in-kind contributions – cumulative

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$50,787	$33,858	$33,858
Staff (B) FTE	$33,858	$22,572	$22,572
	BSL		
CFO	$2,005	$1,337	$1,337
Project accountant	$7,796	$5,198	$5,198

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
Accounts support (Braden)	$5,457	$3,638	$3,638
RPC	$7,796	$5,198	$5,198
GM	$0	$0	$0
SM FI	$15,236	$6,772	$0
ED	$4,455	$2,228	$2,228
John Thwaites (Consultant)	$0	$0	$0
Total in-kind contribution	**$127,391**	**$80,799**	**$74,027**

Table 66 Cost levels 1, 2, 3 in-kind contributions – cumulative

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$101,574	$67,716	$67,716
Staff (B) FTE	$67,716	$45,144	$45,144
	BSL		
CFO	$4,010	$2,673	$2,673
Project accountant	$15,593	$10,395	$10,395
Accounts support (Braden)	$5,457	$3,638	$3,638
RPC	$15,593	$10,395	$10,395
GM	$0	$0	$0
SM FI	$30,472	$13,543	$0
ED	$8,910	$4,455	$4,455
John Thwaites (Consultant)	$0	$0	$0
Total in-kind contribution	**$261,137**	**$161,334**	**$147,791**

Table 67 Cost levels 1, 2, 3, 4 in-kind contributions – cumulative

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$50,787	$33,858	$33,858
Staff (B) FTE	$33,858	$22,572	$22,572
	BSL		
CFO	$33,858	$22,572	$22,572
Project accountant	$7,796	$5,198	$5,198
Accounts support (Braden)	$5,457	$3,638	$3,638
RPC	$7,796	$5,198	$5,198
GM	$0	$0	$0

SM FI	$15,236	$6,772	$0
ED	$4,455	$2,228	$2,228
John Thwaites (Consultant)	$0	$0	$0
Total in-kind contribution	**$261,137**	**$161,334**	**$147,791**

Table 68: Cost level 1 in-kind contributions – incremental

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$0	$0	$0
Staff (B) FTE	$0	$0	$0
	BSL		
CFO	$0	$0	$0
Project accountant	$0	$0	$0
Accounts support (Braden)	$0	$0	$0
RPC	$0	$0	$0
GM	$0	$0	$0
SM FI	$0	$0	$0
ED	$0	$0	$0

Table 69: Cost level 2 in-kind contributions – incremental

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
	AGL		
Staff (A) FTE	$50,787	$33,858	$33,858
Staff (B) FTE	$33,858	$22,572	$22,572
	BSL		
CFO	$2,005	$1,337	$1,337
Project accountant	$7,796	$5,198	$5,198
Accounts support (Braden)	$5,457	$3,638	$3,638
RPC	$7,796	$5,198	$5,198
GM	$0	$0	$0
SM FI	$15,236	$6,772	$0
ED	$4,455	$2,228	$2,228

Table 70: Cost level 3 in-kind contributions – incremental

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
AGL			
Staff (A) FTE	$50,787	$33,858	$33,858
Staff (B) FTE	$33,858	$22,572	$22,572
BSL			
CFO	$2,005	$1,337	$1,337
Project accountant	$7,796	$5,198	$5,198
Accounts support (Braden)	$0	$0	$0
RPC	$7,796	$5,198	$5,198
GM	$0	$0	$0
SM FI	$15,236	$6,772	$0
ED	$4,455	$2,228	$2,228

Table 71: Cost level 4 in-kind contributions – incremental

Staff cost	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
AGL			
Staff (A) FTE	$50,787	$33,858	$33,858
Staff (B) FTE	$33,858	$22,572	$22,572
BSL			
CFO	$33,858	$22,572	$22,572
Project accountant	$7,796	$5,198	$5,198
Accounts support (Braden)	$5,457	$3,638	$3,638
RPC	$7,796	$5,198	$5,198
GM	$0	$0	$0
SM FI	$15,236	$6,772	$0
ED	$4,455	$2,228	$2,228

Appendix H5: Weighting for direct and indirect staff costs

Table 72 represents step 1 of the allocation procedure. This matrix was used to disaggregate the staff costs that were presented in the accounting expense files.

Table 72: Step 1 allocation matrix: Accounting cost allocation by staff level

	Jul 13 – Jun 14	Jul 14 – Jun 15	Jul 15 – Jun 16
Program manager	57%	29%	33%
EEO	33%	33%	5%
Admin loan	10%	9%	9%
Technical manager & EEO	-	22%	-
EEO & recruit	-	-	11%
Admin	-	3%	22%
Data	-	4%	-

Table 73 Step 2 allocation matrix: Cost level allocation by staff level

		Program manager	EEO	Admin loan	Technical manager & EEO	EEO & recruit	Admin	Data
Jul 13 - Jun 14	Level 1		0.3		0.12			
	Level 2	0.33	0.1	0.5	0.32			
	Level 3	0.33	0.3	0.5	0.32			
	Level 4	0.33	0.3		0.24			
Jul 14 - Jun 15	Level 1		0.65		0.12			
	Level 2	0.33	0.2	0.5	0.32		0.55	
	Level 3	0.33		0.5	0.32		0.4	0.5
	Level 4	0.33	0.15		0.24		0.05	0.5
Jul 15 - Jun 16	Level 1		0.65		0.12	0.45		
	Level 2	0.33	0.2	0.5	0.32	0.15	0.55	
	Level 3	0.33		0.5	0.32	0.3	0.4	0.5
	Level 4	0.33	0.15		0.24	0.1	0.05	0.5

Appendix H6: Households on controlled load tariffs

Table 74 Proportion of households on controlled load vs. residential tariff

	Electric (instant or storage) to heat pump (kWh)	Electric (instant or storage) to gas instant or storage (kWh)	Electric (instant or storage) to solar electric (kWh)	Electric (instant or storage) to solar gas
Controlled load tariff	89%	72%	57%	82%
Peak tariff	11%	28%	43%	18%

Appendix H7: Cost-effectiveness results: electricity and gas pathways inclusive of contributions by households

Table 75 Cost-effectiveness results: electricity pathways – incl. household contributions

Cost level	Electric (instant or storage) to heat pump (kWh)	Electric (instant or storage) to gas instant or storage (kWh)	Electric (instant or storage) to solar electric (kWh)	Electric (instant or storage) to solar gas
Level 1	0.25	(6.49)	1.73	1.31
Level 2	0.30	(7.61)	2.03	1.54
Level 3	0.38	(9.74)	2.59	1.97
Level 4	0.45	(11.57)	3.08	2.34
Total program effectiveness	**0.45**	**(11.57)**	**3.09**	**2.34**
Proportion of participants by pathway	12%	8%	3%	3%

Table 76 Cost-effectiveness results: gas pathways – incl. household contributions

Cost level	Gas instant or storage to solar gas(MJ)	Gas storage to Instant gas(MJ)	Gas instant or storage to heat pump(MJ)	Gas instant to Gas Instant(MJ)
Level 1	0.043	0.041	0.039	0.031
Level 2	0.051	0.048	0.045	0.036
Level 3	0.065	0.062	0.058	0.046
Level 4	0.077	0.073	0.069	0.054
Total program effectiveness	**0.077**	**0.073**	**0.069**	**0.054**
%-of participants by pathway	46%	7%	6%	16%

Appendix H8: CBA results based on total program cost, including household contributions

Table 77 CBA results based on total program cost: cumulated four-level cost analysis incl. household contribution

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	$ (3,640)	0.38	$ (4,376)	0.26
2	Electric (instant or storage.) to gas instant or storage	$ (3,823)	0.35	$ (4,650)	0.21
3	Electric (instant or storage.) to solar electric	$ (5,564)	0.06	$ (5,632)	0.064
4	Electric (instant or storage) to solar gas	$ (3,747)	0.36	$ (4,563)	0.23
5	Gas instant or storage to solar gas	$ (4,964)	0.16	n/a	n/a
6	Gas instant to solar gas	$ (4,917)	0.17	n/a	n/a
7	Gas storage to instant gas	$ (4,850)	0.18	n/a	n/a
8	Gas instant or storage to heat pump	$ (4,914)	0.17	n/a	n/a

Appendix H9: CBA results – scenario 2

Table 78 CBA results based on technology only costs: BSL/CH subsidies and household contribution

		BSL/Community Housing subsidy				Co-contribution			
		Residential tariff		Controlled load tariff		Residential tariff		Controlled load tariff	
	Pathway	NPV	BCR	NPV	BCR	NPV	BCR	NPV	BCR
1	Electric (instant or storage.) to heat pump	$492	1.28	($244)	0.86	$357	1.19	($379)	0.80
2	Electric (instant or storage.) to gas instant or storage	$1,107	2.15	$377	1.39	$803	1.63	($563)	0.70
3a	Electric (instant or storage.) to solar electric 15 years	($1,798)	0.15	($1,918)	0.10	($1,711)	0.16	($1,831)	0.10
4	Electric (instant or storage) to solar gas	($425)	0.83	($1,422)	0.45	$206	1.11	($791)	0.59
5	Gas instant or storage to solar gas (MJ)	($1,977)	0.32	n/a	n/a	($963)	0.49	n/a	n/a
6	Pathway: Gas instant to solar gas	($1,810)	0.35	n/a	n/a	($1,033)	0.49	n/a	n/a
7	Gas storage to Instant gas	($43)	0.96	n/a	n/a	($672)	0.61	n/a	n/a
8	Gas instant or storage to heat pump	($1,529)	0.39	n/a	n/a	($787)	0.55	n/a	n/a

Table 79 CBA results based on technology only costs: full cost of technology

	Pathway	NPV (residential tariff)	BCR (residential tariff)	NPV (controlled load tariff)	BCR (controlled load tariff)
1	Electric (instant or storage.) to heat pump	($1,404)	0.62	($2,227)	0.39
2	Electric (instant or storage.) to gas instant or storage	($118)	0.95	($851)	0.61
3a	Electric (instant or storage.) to solar electric 15 years	($3,837)	0.08	($3,905)	0.06
4	Electric (instant or storage) to solar gas	($2,368)	0.48	($3,184)	0.29
5	Gas instant or storage to solar gas (MJ)	($3,869)	0.19	n/a	n/a
6	Pathway: Gas instant to solar gas	($3,818)	0.20	n/a	n/a
7	Gas storage to Instant gas	($1,777)	0.37	n/a	n/a
8	Gas instant or storage to heat pump	($3,295)	0.23	n/a	n/a

Table 80 Total cost of the technology (excl. VEET + STC)

Pathway	NPV (residential tariff)	NPV (controlled load tariff)	BCR (residential tariff)	BCR (controlled load tariff)
Electric (instant or storage.) to heat pump	($1,161)	($2,134)	0.68	0.42
Electric (instant or storage.) to gas instant or storage	$34	($663)	1.02	0.70
Electric (instant or storage.) to solar electric	($3,095)	($3,359)	0.26	0.19
Gas instant or storage to solar gas	($3,534)	n/a	0.27	n/a
Gas storage to instant gas	($1,873)	n/a	0.34	n/a
Gas instant or storage to heat pump	($3,099)	n/a	0.27	n/a
Gas instant to gas instant	($2,336)	n/a	0.10	n/a

Appendix I: Budget

This section provides an overview of the total program expenditure. It is broken into four sections:

- HEEUP LIEEP / Commonwealth funds expended
- Non-LIEEP funding contributions: including all contributions to program outputs including client contributions towards hot water upgrades; and in-kind expenditure
- Expenditure on hot water systems: the contributions towards the actual hot water installations and a breakdown of the expenditure between the HEEUP/LIEEP funding and the non-LIEEP funding.
- Total HEEUP expenditure.

HEEUP – LIEEP / Commonwealth funds expended

Funding	Amount $
Government grants	3,587,621
Total funding	**3,587,621**

Expenditure	Amount $
Staffing expense	1,122,197
Property cost	114,509
Travelling expense	75,073
Administration cost	26,832
Operating expense	29,778
Promotion cost	7,903
Consultant cost	144,359
Research Consultant cost	320,000
Organisational Support cost (includes HR, Admin, IT & Finance)	267,362
Management cost	232,186
Subsidy to HEEUP Client	1,244,158
Total LIEEP expenditure	**3,584,357**
Surplus/Deficit	**3,264**

Non-LIEEP funding contributions

Other cash contributions	**Funding source**	**Amount $**
Subsidies	HESS program	135,023
Client contribution	Client upfront contribution	576,095
Client contribution	Client loan (NILS)	379,887
Existing government program	STC subsidy	395,833
Existing government program	VEET subsidy	146,407
Total other contribution		***1,633,244***
In kind contributions		
Management and recruitment	BSL	213,506
Recruitment, data, management	AGL	585,594
IT for in-home visits	Office of Environment & Heritage	32,000
	Monash Sustainability Institution	76,892
Total in kind contribution		***907,992***
TOTAL OTHER CONTRIBUTION INCL. IN KIND		**2,541,237**

Total HEEUP expenditure

Total HEEUP / LIEEP expenditure	**3,584,357**
Total other contributions	**2,541,237**
TOTAL HEEUP EXPENDITURE INCL. IN KIND	**6,125,594**

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